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# Monitoring Manual for Winter Pastures in the Transcaucasus in Azerbaijan


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# 1 Preface

## 1.1 What is the purpose of this manual?

Winter pastures in Azerbaijan are an important resource for livestock keeping and have outstanding value for biodiversity. Winter pastures of Azerbaijan are mainly located in the southern part of the Greater Caucasus. Upper parts are at a height of 300-500m, where high mountain ranges are moving to a small plateau-like elevations, while lower parts go down to sea level. This area of about 120,000 hectares is traditionally used by nomadic herding.

However, the conservation of this resource is challenged since livestock numbers have increased in Azerbaijan rapidly in the last 15 years. Absence of any care, unsystematic grazing and excessive exercise, as well as deterioration (deflation) of natural conditions have led to the fact that the typical steppe pastures decreased, while the share of semi-desert has risen to 64%. Therefore, Azerbaijan has much to gain and much to loose in making management and policy decisions for pastures. This is confirmed by the State Programs “Prevention of degradation and desertification of pasture" by Decree of the President of Azerbaijan Republic Ilham Aliyev (2004). However, the basis for informed decisions is sound knowledge about the current condition of pastures and their management.

But, what is the condition of a winter pasture in Azerbaijan like? If you ask this question to different people in Azerbaijan – scientists, herders, villagers, nature conservationists – you will probably get very different answers. Some people will say pastures are heavily degraded; some people will answer they are in a quite good condition; some will have a more differentiated opinion. Which answer is right and should be the basis for pasture management? Even scientists currently do not agree on the meaning of the term degradation.

This manual is designed to give guidance for a comprehensive and objective monitoring of pasture conditions developed on the basis of scientific knowledge. Furthermore, it provides management recommendations for sustainable pasture use in order to maintain and enhance the condition of pastures in the future.

## 1.2 What is degradation on pastures?

In this chapter we clarify our understanding of the term degradation. Of course, also natural erosion occurs, mainly on very steep or dry slopes, on saline soils or on wind exposed hilltops, where vegetation cover hardly establishes. Hence, these areas are especially vulnerable to additional disturbance by animals. Within our assessment approach, we deal with this nature born exposure to degradation as well. Here, we focus on man made impact fostering degradation.

Pastures start getting degraded where overstocking occurs and where unadjusted grazing management is practiced. This degradation has two main components:

a) Degradation means on the one hand side a reduction of the fodder production potential of pastures for livestock.

b) On the other hand side the ecosystem “pasture” is degrading when a significant decline of the number of its species occurs (i.e. a decline of biodiversity).

*Explanation to a)*

Where browsing intensity and trampling is too strong, the vegetation cover becomes weakened or hurt. The consequence is open soil which is the point of attack for erosion processes. Once the topsoil has been eroded, the “resource pasture” is strongly depleted as it now provides less fodder. This form of degradation of a pasture is virtually irreversible as it takes a very long time to return the grassland system to its original, more productive state. In consequence, the more degradation occurs on the pasture the less successful will be livestock production as the animals will find less and less fodder.

Less advanced degradation processes, as the mere decline of the vegetation cover, can be stopped or are even reversible if you allow the pasture to recover. Depending on the level of degradation and the natural potential of the vegetation to recover, suitable measures are the complete exclusion of grazing or the decrease of the stocking rate for a certain time.

*Explanation to b)*

Grasslands are habitats for many organisms. The Caucasus region and especially its mountain ranges with their predominating grasslands are very rich in species. Many of them are endemic to the region, i.e., Caucasus grasslands are of special importance for the preservation of biodiversity. For example plant species: scientists found less of them on sites that were facing strong livestock pressure compared to less grazed sites. An increase of browsing, trampling and the subsequent opening of the vegetation canopy which leads to less favorable microclimatic conditions, means that the stress for plants rises. Fewer plant species are capable to withstand this stress. Some plant species developed defense mechanisms (e.g. thorns, hairs, poisons) which protect and even allow them to gain dominance. However, the greater proportion of plant species needs to withdraw as they are not able to compete under these harsher conditions. We regard the number of plant species as one indicator for the level of degradation of a pasture.

## 1.3 How to monitor pasture condition?

Degradation is a creeping process. To maintain the productivity of a pasture, the point when degradation turns to be irreversible should be prevented. An initial assessment and consecutive monitoring of the pasture condition are indispensable for detecting and observing this point of degradation. This manual is suitable for the first assessment of the condition of pastures, as well as for the continuous monitoring.

Monitoring in general means observation of an object over time. In our context these objects could be, e.g., landscapes, ecosystems, animal or plant populations, development of livestock numbers or the condition of a pasture.

The aim of monitoring is to identify trends, may they be positive (=increase of quality or quantity), negative (=decrease) or that there is no change (stable state).

The chronology of a monitoring is as follows: you first need to assess the status-quo on a certain place. For our aims we call this place in the following *plot*. For the explanatory power of your assessment it is necessary to conduct it on several plots. The plots are selected on basis of your sampling design. For this manual we chose a *preferential sampling design*, i.e., you decide subjectively according to certain criteria on the position of your plot. Other sampling methods are random designs; they are usually developed on the basis of satellite images and the selection of plots is done randomly by Geographic Information Systems (GIS).

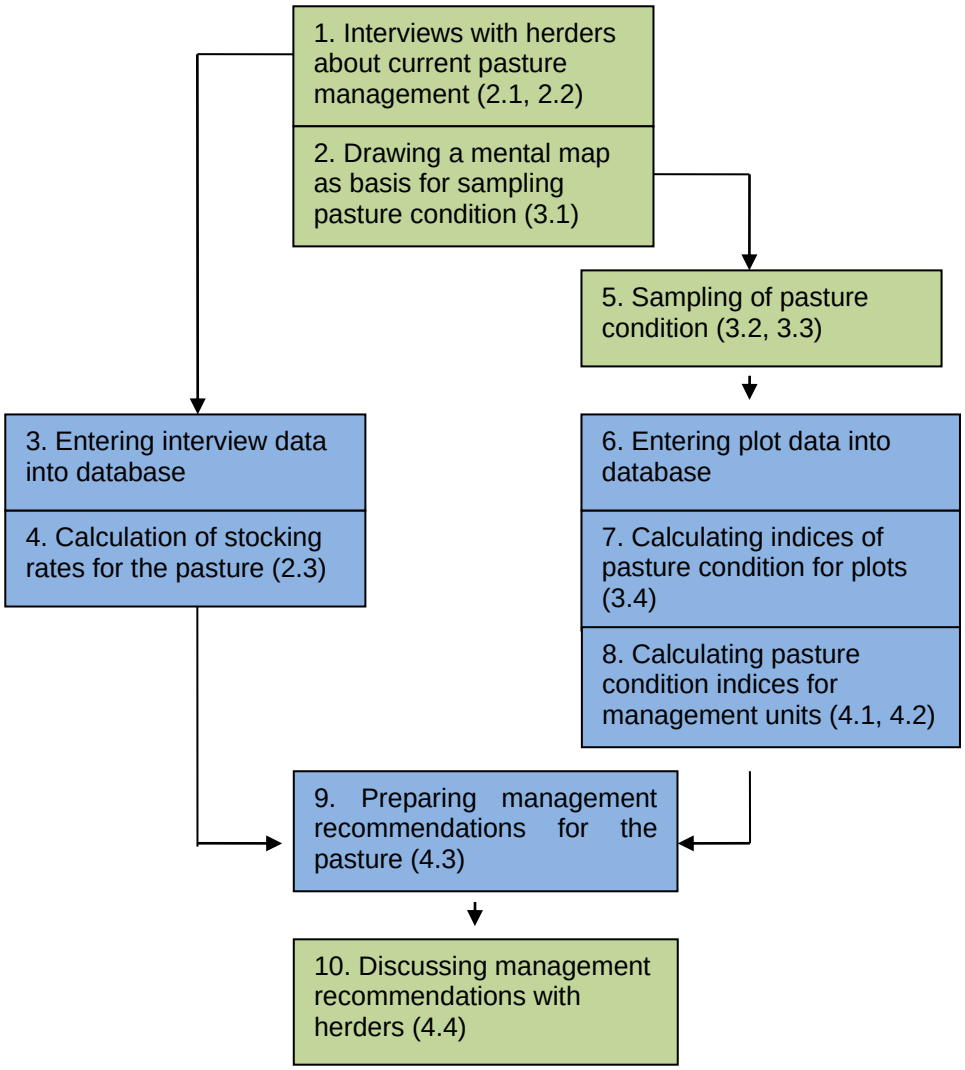
The concrete monitoring should repeat the assessment at the same plot after a certain time (e.g. every 2 years), always applying the *identical set of methods*. In the case of assessing pasture condition it is also important to conduct the repetition at approximately the same time of the year.

The longer you run a monitoring project (many repetitions) the better you understand the development of your object (i.e. here the pasture condition). When in evaluation of a monitored object changes are detected, decisions may be taken to adapt measures to fulfill a certain goal. In the case of monitoring the pasture condition you can identify those areas with the severest problems and derive or adapt recommendations for a sound management that prevents or stops degradation of a pasture.

## 1.4 Monitoring tasks described in this manual

The monitoring described in this manual reaches from the initial assessment of pasture condition over data analysis to the derivation of management recommendations which can be discussed with the herders. It consists of several distinctive tasks which can be carried out by different people, but have to be combined to arrive at management recommendations.

The figure below gives you a first overview of the separate tasks. Colours indicate field work (green) or office work (blue). The chapters in the manual explaining the specific task are given in brackets.




For the different tasks the person in charge needs appropriate skills and knowledge about other tasks in the work flow. The table below shows the required skills and possible persons in charge. It is especially important to have a person responsible for task 1 and 10 who can engage in a longer lasting dialogue with the herders to build trust and cooperation between the Advisory Unit and the herders.

| Task | Required skills | Possible person in charge |
|---|---|---|
| 1. Interviews with herders about current pasture management | Strong social skills, familiarity with rural life | Head ranger/ NGO-employee<br>*Same person as Task 10* |
| 2. Drawing a mental map as basis for sampling pasture condition | Strong social skills | Head ranger/ NGO-employee<br>*Same person as Task 1*<br>*Person responsible for Task 5 participates* |
| 3. Entering interview data into database | Computer skills | Resource management specialist of National Park/ NGO-employee/ external expert |
| 4. Calculation of stocking rates for the pasture | Computer skills | Resource management specialist of National Park/ NGO-employee/ external expert |
| 5. Sampling of pasture condition | Familiar with Data Sheet II, good physical fitness | Ranger of National Park/ NGO-employee<br>*Person participated in Task 2* |
| 6. Entering plot data into database | Computer skills | Ranger of National Park/ NGO-employee/ Secretary |
| 7. Calculating indices of pasture condition for plots | Computer skills | Resource management specialist of National Park/ NGO-employee/ external expert |
| 8. Calculating pasture condition indices for management units | Computer skills | Resource management specialist of National Park/ NGO-employee/ external expert |
| 9. Preparing management recommendations for the pasture | Computer skills | Resource management specialist of National Park/ NGO-employee/ external expert |
| 10. Discussing management recommendations with herders | Strong social skills, familiar with rural life; information about Tasks 1-9 | Head ranger/ NGO-employee<br>*Same person as Task 1* |

## 1.5 Scientific baçckground

This manual is developed by scientists from Greifswald University, Institute DUENE and the Department of Agrarian Science of Azerbaijan National Academy of Science under supervision of Academic Prof. Garib Sh. Mammadov at the example of the Gobustan steppe region. With smaller adaptations the manual is also applicable for pasture monitoring and management in other lowland and upland steppe regions of the Caucasus. The elaboration of this pasture monitoring manual is inspired by Cahyat et al. (2007)[1].

Authors from Greifswald University and from Institute DUENE studied the winter pastures in Gobustan and Cheiranchel from 2007 to 2010 in the Volkswagen Foundation project "Proper Utilisation of Grasslands in Azerbaijan's Steppe and Mountains: an Ecological and Socio-Economic Assessment to Avoid Overgrazing and to Ensure Sustainable Rural Development". Socio-economic assessment and management recommendations are based o n a thorough investigation of sheep production, farm organization and regulations for land tenure. For further information see Neudert & Allahverdiyeva (2009)[2] and Allahverdiyeva (2009)[3]. Management recommendations for the winter pastures are based on the maximal stocking rate of 8 sheep/ha, as mentioned in the corresponding law of the Cabinet of Ministers (2000)[4].

Analyses of 360 pasture plots helped to choose and weight the variables that are used for calculating the indices of the presented pasture monitoring approach. The indices were developed commonly by the authors from Greifswald and from Baku. Different approaches from other experts worldwide were taken into account in the development of this manual. Topographic Relative Moisture Index (TRMI, Parker 1982)[5] and the Relative Site Moisture Index (RSMI, Van de Grift 1996)[6], both describing plant available moisture as an important factor for the regeneration potential of the vegetation, are regarded. Additionally, we considered works on soil quality indicators like VSA[7], MSQR[8] and of Bonitirovka according to ANAS guidelines for pasture assessment (cf. Mammadov, 2002[9]). Determination of characteristic vegetation types was based on recent findings of Peper (2010)[10] for Azerbaijan and on literature on the characteristics of distributed phytocenosis and the definition of forage land (Prilipko, 1970[11]; Iglovikov et al, 1971[12],

1 Cahyat A, Gönner C, Haug M. 2007: Assessing Household Poverty and Wellbeing – A Manual with Examples from Kutai Barat, Indonesia: Center for International Forestry Research Jl. CIFOR, Situ Gede, Sindang Barang.

2 Neudert R., and N. Allahverdiyeva 2009: The economic performance of transhumant sheep farming in Azerbaijan and prospects for its future development: South Caucasian Annals of Agrarian Science, v. 7, pp. 153-157.

3 Allahverdiyeva, N. (2009): Kooperasiyanın köçəri ekoloji qoyunçuluq təsərrüfatlarının inkişafında əhəmiyyəti: Ekoloji Kənd təsərrüfatı, No 1-3: Gəncə Aqrobiznes Assosiasiyası (GABA), pp. 18-19.

4 Resolution of the Cabinet of Ministers of the Azerbaijan Republic No. 42 of March 15, 2000: Rules of Allocation and Use of Pastures, Commons and Hayfields, III.13.

5 Parker A. J. 1982: The topographic relative moisture index: an approach to soil-moisture assessment in mountain terrain: Physical Geography 3(2):9. Variables used are inclination, aspect, topographic position and slope configuration.

6 Van de Grift J. 1996: The Relative Site Moisture Index: an Expansion of the Topographic Relative Moisture Index: Senior thesis, Geography, University of Wisconsin-Madison. Variables used additionally to the TRMI are soil depth and texture.

7 Shepherd, T.G. 2010: Visual Soil Assessment (VSA) Field guide for Pasture, FAO, Rome, Italy.

8 Mueller L, Schindler U, Behrendt A, Eulenstein F, Dannowski R (2007) The Muencheberg Soil Quality Rating (SQR). Field Guide for Detecting and Assessing Properties and Limitations of Soils for Cropping and Grazing.

9 Mammadov, G. 2002: Land reforms. Baku, Publish House „Elm", pp. 186-187.

10 Peper, J. (2010). Semi-desert vegetation of the Greater Caucasus foothills in Azerbaijan: Effects of site conditions and livestock grazing. Mathematisch-Naturwissenschaftliche Fakultät. Greifswald, University of Greifswald. Doktor der Naturwissenschaften: 113 p.

11 Prilipko, L. I. (1970). Rastitel'nyj Pokrov Azerbajdžana (Vegetation cover of Azerbaijan). Baku, Elm.

12 Iglovikov V.T. (1971) Metody opytov na senokosakh i pastbishakh, chast 1, (Methods of experiments on hayfields and pastures, part 1) M, 56 p.

Tsatsenkin et al, 1974[13][13]). Experiences from trainings in Azerbaijan and Georgia on this manual from 2010 to 2013 led to minor improvements in the methodology.

# 2 Assessing pasture management

In this chapter, you find the guidelines for conducting interviews with herders to assess the current pasture management. The interviews are conducted and recorded with the help of Data Sheet I (see Chapter 5.1). As pasture management decisively influences pasture condition, the interviews provide detailed information where degradation problems on specific summer pastures may root. Furthermore, the information helps to develop recommendations for improved pasture management and to discuss them with herders.

## 2.1 Interview guidelines

*Finding camps*

- The questionnaire is designed for one winter farm (yataq) as pasture unit. With their firm stables and houses the farms can be identified easily when approaching the winter pasture regions.
- When an assessment of all winter farms in one region is required, ask your respondents or local authorities whether there are farms located in places difficult to find.

*Approaching camps*

- Be careful in approaching a winter farm. Better wait with leaving the car until a farmer or shepherd arises, because shepherd dogs can be very dangerous!
- If you see a shepherd somewhere on the pasture it is better to approach him first rather than going directly to the camp.

*Selecting respondents*

- Introduce yourself and explain what the interview will be about.
- Ask for a person who is responsible for this winter farm and feels in the position to answer the questions. The questionnaire can be answered by knowledgeable shepherds or managers. The questionnaire must not be answered by a visitor or guest.

*Before an interview*

- Ask, if the respondent has time for the interview. It will take not more than 45 min.
- If you see that the respondent is busy with other tasks, return another time or make an appointment.
- Ensure that no other persons except those belonging to the camp are present during the interview.
- Make sure that the respondent understands the purpose of the interview.

*During an interview[14]*

- Be polite, friendly and patient.
- Do not provide the respondent with answers or direct responses in any way.
- Avoid suggestive questions.
- Give the respondent time to think, listen attentively to what he or she says.
- Be attentive to any worries a respondent may have. Be sensitive.

[13] Tsatsenkin I. A. (1974): Metodycheskiye rekomendatsii po geobotanicheskomu i kulturno-tekhnicheskomu obsledovaniyu prirodnikh kormovykh ugodiy (Guidelines for geobotanical, cultural and technical inspection of natural grasslands) M. 1974, 72 p.

[14] After Cahyat et al. (2007): Assessing Household Poverty and Wellbeing – A Manual with Examples from Kutai Barat, Indonesia: Center for International Forestry Research Jl. CIFOR, Situ Gede, Sindang Barang.

- If a respondent's answer is too long-winded or unrelated to a question, interrupt at an appropriate moment, but do not be rude - be tactful and sensitive when interrupting.
- If information in one topic seems contradicting, ask if you understood the answers correctly, but never blame a respondent for giving false information!

*Closing an interview*

- End the interview by asking if there is anything the respondent would like to know about the pasture monitoring activities.
- Thank the respondent.
- Take time for discussing something informal rather than leaving immediately.

### 2.2 Guidelines for completing Data Sheet I

*1. Basic data*

- Make sure that you clearly name and number the data sheet.
- Don't forget to take a GPS-Point and fill in the data.

*2. Summer pasture*

- The majority of livestock on the winter pasture goes to summer pastures, as well. Usually, summer pastures are rented from district administrations, but in some cases plots are rented from village administrations or the livestock grazes on common village pastures.
- If the livestock is split up and goes to different locations, ask where the majority of sheep is kept.

*3. Farm organisation:*

- When this part is completed you should have gained an understanding, how the farm is organised and who makes the major decisions.
- Fill in the table according to the instructions in the questionnaire.
- The contact person to be identified in Question 3.5 should be involved in management tasks of the farm.

*4. Pasture access*

- In case you conduct the interview with a shepherd he probably cannot give information about lease contracts. Then you should ask your respondent to name another person, who can provide this information. Ask the respondent when and where the person is available for an interview or for a telephone number.
- Sublease contracts for pasture are prohibited in most regions of Azerbaijan. Nevertheless, sometimes people rely on these agreements.
- The leased pasture area is indicated in the lease contract. The area of fertile land is indicated there as well. Usually, this information should also be shown on a map attached to the lease contract. If such documents are not shown by the respondent and you have doubt on the correctness of the pasture size mentioned by your respondent for some reason, you should receive the most reliable information from the responsible regional branch of the State Committee of Land and Cartography. Possibly in the future, with technical means like tablet PCs and via satellite images and GIS functions, we should be able to calculate the pasture size ourselves by means of the pasture borders shown in the field.

*5. Livestock*

- The livestock numbers are crucial for calculating stocking rates. However, people tend to record fewer animals than they actually have. That is why you should cross-check livestock

numbers with your own counts (for advice see: 9. Cross-checking livestock numbers). Sometimes additional fodder is provided. That is why you should ask for type and amount of fodder.

*6. Use of shepherd dogs*

- Information about shepherd dogs is needed as straying dogs may disturb and predate wild animals.

*7. Spatial organisation of pasture use*

- As consequence of the sampling design (see chapter 1.3 and 3.1) the hand-drawn map is the basis for delimiting management units. As your respondent knows his pasture best, ask for his assistance. Ask your respondent for his understanding of homogenous parts of the pasture (e.g. güney, kusey, pasture quality).
- If you have access to the cadastral maps of pastures of the State Committee of Land and Cartography or if the respondent is able to show it to you during the interview, you can use it as the basis for filling in details of the mental map.
- Ask the respondent, if he can draw the map himself. Add yourself only notes needed to understand his drawings.
- If possible, leave the farmer's house and go to a hilltop with the respondent and discuss which ridge or road represents a border of the farm signed in the map.
- Most herders in the winter pasture practice the winter fodder reserve management (*xam*). When the livestock arrives in autumn on the winter pasture, it gets access only to a small proportion of winter pasture area. Every day throughout the winter the herd gets access to a small pasture part which is still ungrazed during the ongoing season. By end of March some fodder reserve should be left which can be used in case the spring rains come late. Ask the respondent about this management tool and mark especially the spring fodder reserve on the map.

*8. Pasture condition*

- The respondent should express his own opinion about the pasture condition. Please beware of expressing your opinion before.
- This part also provides information about the general perception of degradation problems and their causes by the respondent.

*9. Cross-checking livestock numbers*

- If your task is also to assess pasture condition with Data Sheet II, you have time to observe herds while you are on these plots. Alternatively a possibility might occur while you are approaching or leaving the farm. You might also count all the livestock from a certain distance when they are, usually at noon time, resting in the farmyard.
- During cross-checks keep in mind that the animals may be split up into several herds which move to different directions. To estimate the total number of livestock on the farm you have to observe all herds at nearly the same time.
- A reliable and quick method is to count in steps of 10 individuals. You may use the mechanical counter included in the equipment for filling in Data Sheet II. First count 10 animals one by one, then always add another group of approximately the same size. For each group of 10 animals you click once on your counter. The final flock number you receive by multiplying your counter result by 10.
- While cross-checking be aware of the following variation of livestock numbers: The total number of sheep, goats or cattle consists of females, males and young stock. While the

number of females and males stays normally constant during the year, the number of young stock varies: When, e.g., roughly all ewes give birth to one lamb the total number of livestock doubles after all lambs are born. For migrating stock most lambs are born in autumn and sold successively during the summer months. That means, on the winter pasture you can find 800 sheep in April and 500 in October, while the farmer tells you that hisis herd has 400 ewes – and all figures are correct, because meanwhile 300 lambs were sold, while still a hundred are kept.

- Compare your cross-check counts and the information given in the interview. If the figures deviate strongly, it is best to discuss these deviations with the decision-maker identified in Question 3.5. The responsible person from the camp has to agree with the livestock number used for the data analysis, as it is the basis for discussing management recommendations.

### 2.3 Calculating actual sheep units and actual stocking rates

Stocking rates are the indicator to measure grazing pressure on the pasture. They are an important tool for reducing degradation and improving pasture management, as well (Chapter 4.3).

You need:

- Livestock numbers recorded in Question 5.1
- Fertile land of the summer pasture (ha) recorded in Question 4.6

Calculate *actual sheep units* as indicated in the following table:

| | Number from questionaire | | Conversion factor[15] | | Sheep units |
|---|---|---|---|---|---|
| Sheep | | x | 1 | = | |
| Goats | | | 0,7 | | |
| Cattle | | | 6 | | |
| | | | | **Sum:** | |

Calculate the *actual stocking rate* as follows:

**Actual stocking rate = sum of actual sheep units / area (ha)**

[15] Conversion factors are calculated based on the weight ratios of livestock. Sheep: 50 kg, Cattle: 300 kg, Goat: 35 kg

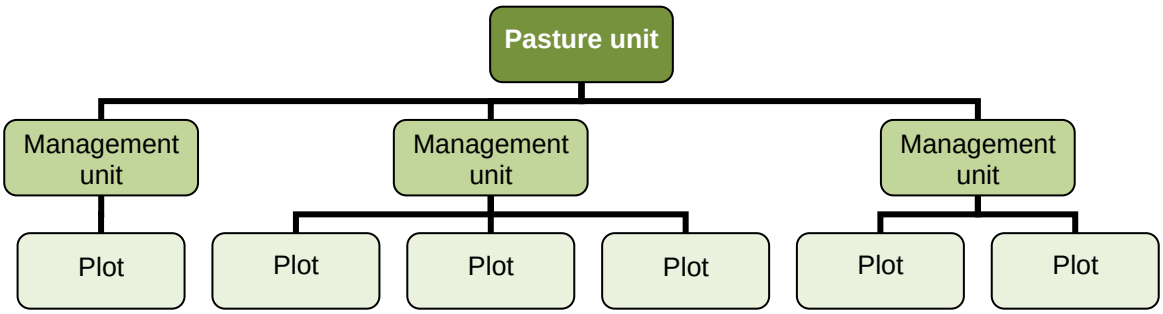
# 3 Assessing pasture condition

This chapter explains all steps needed to assess the ecological condition of pastures. The first part of Chapter 3 including 3.3 is field work, while 3.4 describes work done in the office.

With the help of Chapter 3.1 and 3.2 you can locate your plots on the pasture. Chapter 3.3 gives advice for filling out Data Sheet II (from chapter 5.2) in the field. With this information you calculate in Chapter 3.4 two indices which give you and other people a clear idea of the pasture condition.

## 3.1 The sampling design

When you are standing on the pasture you can see that the pasture condition is not the same everywhere. It is impossible to assess the pasture condition in detail on all parts of the pasture, so you need a sampling method: you look at the pasture condition in detail on some plots and extrapolate the results later. The figure below shows how the sampling design used here works.




Your largest unit is the *pasture unit* which is the pasture managed by one farm. You collected information about this pasture unit in the interviews with the herders (Chapter 2). You use this information to determine 2 to 5 relatively homogeneous *management units* on each pasture unit. For each management unit you gather data about pasture condition on 1 to 3 *plots*. The next parts explain how you apply this sampling design.

*Determining management units*

As you need assistance of the herders for this task, you should conduct it after completing the interview with the herder (Chapter 2). It is advantageous when you have a general overview about the pasture as well. If possible, visit a point where you can see as much of the pasture as possible.

- Prepare a map with the outline of the pasture by copying the outline of the mental map from Part 7 of Data Sheet I (see Chapter 2.2).
- Note the total size of the pasture and the fertile land in ha as given by the lease contract (Question 4.6 in Data Sheet I) and calculate the area of non-fertile land. For this purpose subtract the fertile land from the total area.
- Identify together with the herder, where fertile and non-fertile areas of the pasture are located.

- Estimate the share of non-fertile land on the map and judge if it is consistent with the figure given in the lease contract. If data is consistent, proceed with the next point. If the figures are inconsistent, proceed as follows:
    - Estimate the share of non-fertile land on the map in percent as precisely as possible.
    - Multiply this figure with the total area and divide by 100. Your result is the new area of non-fertile land in ha.
    - Replace the figure given in the lease contract with this one and calculate the new area of fertile land.
- Now continue only with the fertile land indicated in the map: Identify together with the herder areas which are relatively homogeneous regarding the following criteria (one after another):
    - exposition and inclination
    - soil parameters
    - vegetation productivity
- The mental map may give you a first idea, where homogenous areas might exist. As described in Chapter 2.2 (Part 7 of Data Sheet I) herders often have clear ideas about different parts of their pasture and their distinctive features. It is not unusual if they mention to you already “management units” where they conduct different grazing regimes (güney, kusey, etc.)
- By combining these criteria, you should be able to identify 2 to 5 homogeneous units which are now your management units. If you arrive at more than 5 units, try to combine two areas where the difference is not that large or discard very small areas.
- Name each management unit with a clear name or number and mark it in the map and in a table.
- Estimate the share of each management unit of the area of fertile land. Calculate the size of each management unit by multiplying the estimated share in percent divided by 100 with the area of fertile land.

### 3.2 Criteria for selecting plots

Each of your management units now has to be sampled with plots. These plots should be representative examples for their management unit. Small management units, especially if they are very homogeneous in terms of the criteria given above, need to be sampled with only one plot. Larger management units still show, despite their relative homogeneity, some variations. These can be covered more or less by choosing three different plots spread over the whole management unit. In medium sized or smaller, less homogeneous management units two plots might be sufficient. With 2 to 5 management units with each 1 to 3 plots you will have to work on maximum 15 plots per pasture unit. The minimum number of plots will be five or six. The average pasture unit will need around 10 plots for its sufficient assessment.

If you now already have a good overview of the pasture and its management units you can fix the number of plots required. Otherwise you can flexibly adapt the number of necessary plots when walking on each management unit.

The plot area should be a circle with a radius of 50 m. It should as well be a representative example of its surrounding territory and fulfill the criteria of homogeneity. This means that the plot should be homogeneous in terms of inclination, aspect and the kind of vegetation cover. Due to the

varied relief it is often difficult to find such a large homogeneous circle. If you fail to find one, then please note the shortest radius of a homogeneous circle around you. However, the favoured version is r = 50 m.

### 3.3 Filling out Data Sheet II

You have to carefully fill out Data Sheet II (see chapter 5.2) to gather all information that is needed for assessing the site conditions and the state of the pasture on a plot. This procedure will take you less than one hour, when you have gained some routine. This means you most likely will be able to examine several plots per day. In the ideal case you will be able to complete all plots belonging to one summer camp in one day.

For this field work you need to take with you:

- Clipboard for the data sheets and pen
- Rain clothes and/or an umbrella. The latter will help you keeping dry the paper you are writing on. Beware of quickly changing weather conditions in the mountains.
- GPS
- Inclinometer
- Compass
- Folding rule or a measuring tape
- Mechanical counter (“counting clock”)
- Spade, can be little folding spade
- Water, for testing soil texture
- Plastic basin (about 45 x 35 x 25 cm), a hard board (about 26 x 26 cm) to fit in the bottom of the basin and a large plastic bag (for assessing soil structure with drop-shatter-test after Shepherd (2010)[16])
- Digital camera

In the following you find instructions to every step on Data Sheet II.

*1.1 Location*

Question 1.1.1 “Description of region (valley, nearest mountain, nearest village)” is very important, as it is needed for a better orientation, either for yourself, when you need to return to the site after a certain period of time (e.g. in the next monitoring cycle), or for any other person processing the data that you have assessed.

A GPS device is needed for the sub-points 1.1.2 (GPS-Point) and 1.1.3 (Altitude). Save the coordinates of the centre of your plot circle with a clear name, e.g., the sheet number and your name. Then note the coordinates and the altitude given by the GPS in their corresponding fields.

As each plot belongs to a certain summer camp, note the GPS-name you have saved before and measure with your GPS the distance to this camp (1.1.4). This has some explanatory value for the grazing intensity on your site.

[16] Shepherd, T.G. 2010: Visual Soil Assessment (VSA) Field guide for Pasture, FAO, Rome, Italy.

*1.2 Slope*

These four sub-points are of high importance to determine the susceptibility to erosion of the site. You find more explanations on the importance of these sub-points in chapter 3.4.1.

For measuring the *steepness* (1.2.1) of a slope you need an inclinometer. You achieve best results when looking uphill and targeting a fixed point that is in the same height from the ground as your eyes, so that you look parallel to the slope. Either you focus on a body part of a helper standing uphill from you in the height of your eyes (e.g. mouth, nose, eyes) or you fix a hiking stick above you and focus on a certain point of it (for this you may need to hunker down). Try to read the scale as exact as possible and note this figure.

When measuring the *aspect* (1.2.2) with a compass, try as well to be as exact as possible and note the value. Assign also the aspect category. This can help you to better understand the slope you are standing on and its ecological features.

You can easily determine the *topographic position* (1.2.3) and *slope configuration* (1.2.4) with help of the sketch in-between both sub-points.

*1.3 Soil texture*

*Soil texture* (1.3) means the combination and proportion of different sizes of soil particles. For examining this texture, use the "Guide to Texture by Feel" (USDA 2014)[17] which explains every necessary step (see figure next page). You find it in the chapter 5.4 Fig 1. You will need to take around 25 g of soil from the surface in the palm of your hand and after adding water you can start probing the sample.

*2 Erosion and degradation*

The seven questions in this section help to determine the extent of erosion and/or degradation on your plot. First find an area of 10 x 10 m which is a representative example of your circle. You can measure this quadrate with steps and mark the corners with sticks, clothes, your backpack etc.

For six of the seven sub-points you need to estimate the percentage cover on these 100 m². The second sketch in Data Sheet II should help you. If you look at, e.g., the cover of all *bare soil* (2.1.1) – that means all ground not covered by plants and stones – imagine shifting all pieces of this bare soil in one corner of your square. Then decide whether all pieces together cover only 1 % (1 x 1 m), 2-5 % and so on. Continue with estimating the cover of *bare stones* (2.1.2) which means those not covered by vegetation**.**

It can be useful to cross-check the reasonability of the cover of these both sub-points of 2.1, as they are often estimated too high. Together they cover all ground without vegetation. Just estimate the cover of the vegetation (from 3.2.2) and compare it with the sum of 2.1.1 and 2.1.2. If necessary, correct the two sub-points of 2.1.

Proceed with the estimation of the *livestock tracks* (2.2). These are small paths, mostly running parallel to a slope (also called terracettes), caused by the trampling of livestock. They often cause open soil and are therefore often the beginning of erosion processes. On steeper slopes you often

[17] USDA (2014) Guide to Texture by Feel (modified from S.J. Thien. 1979). A flow diagram for teaching texture by feel analysis. Journal of Agronomic Education. 8:54-55.), http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054311, accessed April 15th 2014.

find more cattle tracks, also with open soil, as here the pressure of animal hooves affects the slope more severe. Thereagainst, on less inclined slopes often less cattle tracks are visible, and often they are still covered by vegetation; hence they are less dangerous for beginning erosion processes.

When estimating the *erosion tracks* (2.3), you need to combine bare soil, partly the bare stones (those that are small and moveable by water or animal hooves) and visible erosion processes. Such erosion processes can be signs of soil washed or trampled away, e.g., rills or gullies or sharp edges between intact sods (topsoil with vegetation) and bare rock or soil. Sometimes you will even see larger pieces of sods sliding downhill.

*Signs of salinisation* (2.4.1/2) can hint on degradation caused by too many animals compacting the soil. *Signs of salinisation* can be visually estimated in two ways. Either salinisation can be visible as white *salt crusts* (2.4.1) on the soil surface **or** the presence of special *salt indicating plant species* (2.4.2) shows a significant amount of salts in the soil.

If salt crusts are present, you easily see them on the surface of the soil. They look like spots or lines of snow. Dipping your finger into it, you can also taste the salt on your tongue. Estimate the salt crusts the way you did for 2.1 to 2.3

Also look out for *salt indication plant species.* Most *salt indication species* have **succulent salty** leaves. You are likely to meet either small bushes *(Salsola species, Kalidium caspicum)* or little herbs *(Climacoptera crassa, Petrosimonia brachiata, Gamanthus pilosus)* with these features. Important examples you find as pictures in the chapter 5.4 Fig. 5-10. Estimate their cover as before.

For assessing *soil structure* (2.5) conduct the so-called “drop shatter test” after Shepherd (2010).

Dig out a 20 cm cube of topsoil with the spade. Many soils will come out as a single lump, especially if slightly moist. If yours doesn't cling together at all, dig out enough to have the equivalent of a 20 cm cube.

Drop the soil from a height of one metre (about waist height) onto the wood in the bottom of the basin so it shatters into pieces. Drop large clods again once or twice. Don't drop any piece more than three times. If it breaks into small pieces with the first or second drop, move on to the next stage. If roots are holding the soil together, pull it apart along any large cracks. Avoid crushing any pieces smaller than they break into naturally.

Spread the plastic bag flat on the ground beside the basin and transfer the soil onto it. Move the coarsest fractions to one end and the finest to the other. Arrange the distribution of the aggregates so that the height of the soil is roughly the same over the whole surface area of the bag.

Compare your arrangement on the plastic bag with the three pictures in chapter 5.4 Fig. 2 and put the appropriate score. You can also decide on intermediate conditions between the three categories.

*3 Vegetation*

In this section you assess different aspects of the state of the vegetation, especially whether strong alteration caused by livestock is detectable. Continue with the following tasks on your 100 m²-plot.

The combination of *dominant plant groups* (3.1.) can be used for describing the vegetation stands of lowland steppe and semi-desert landscapes. These groups are formed of plant species closely related with each other or which share a similar life cycle (living only one year =

annuals/ephemerals, being mostly small with short roots, and those living over longer period = perennial, often growing tall, partly developed as woody semi-shrubs and showing a well developed root system). With the help of the pictures in chapter 5.4 Fig. 3-21 try to identify which of these groups are present on the plot. Mark up to three groups if they each cover more than 20 % of the plot. In combination of one to three groups at least eight main vegetation types can be described. With the eighth basic plant category “Scattered vegetation” (less than 20 % total cover) you often might find an already strongly degraded variation of one of the other seven, but as well an ownstanding type representing extreme site conditions like e.g. drought and/ or salinity.

For measuring *vegetation height* (3.2.1) it is best to have a folding rule or a measuring tape. For the maximum height you look for the highest halms or stems on your plot. For estimating average height consider the heights of the most common plants. When there are higher and lower parts of vegetation, average both heights according to their coverage. Mark the corresponding category.

In order to estimate *total vegetation cover* (3.2.2) use as before the estimation sketch. As mentioned above you can cross-check this estimation with the sum of bare soil and bare stones.

*Standing crop* (3.2.3) means the amount of phytomass (i.e. plant mass) standing at this moment on your pasture site. If you have problems answering this question in the beginning, you will quickly have an overview from different pastures, how “a lot”, “medium” and “few” look like.

In the next step the actual grazing pressure is considered. For *browsing tracks* (3.1) you need to have a close look on the plants to your feet. Decide on the proportion of plant individuals that have browsing tracks. This means that they are hurt by livestock, tips of leaves are bit-off, whole leaves or flowers on stems are browsed. *Dung cover* (3.3.2) means the cover of livestock faeces on the plot and gives hints of the density of grazing animals. Estimate the *dung cover* again with the help of the sketch.

The presence of *grazing indicator species groups* (3.4) gives hints on the intensity of grazing over a longer time period. Examples of each group you find in chapter 5.4 Fig. 22-35. These groups represent plant species that benefit from grazing, as livestock does not like to eat them. If these species increase, such species that are better palatable have less space. Look for the presence of one or more of the given grazing indicator species groups and estimate their cover on 10 x 10 m the same way as you did above.

In case you found more than one of the groups, estimate the *cover sum* (3.4.5) of all of them. Look at the cover of each grazing indicator species group and add one to another. Decide in which category the sum fits. Example: the first group you assigned with 1 % cover, the second with 2-5 % (could be 2, 3, 4 or 5 %). Now you have to decide whether the sum is in the category 2-5 % or 6-10 %. This step is very important, because it is easier for you to assign the sum category as for someone in an office dealing with your data. For him/her it would often not be clear to which category the sum of all groups would belong.

In 3.5 the cover of *valuable plants groups* for livestock needs to be assessed. This information allows for the evaluation of the quality of the winter pasture. With the help of the pictures in chapter 5.4 Fig. 3-7, 15-20 and 36-41 try to identify whether some of these valuable plants groups are present and estimate as in 3.4.5 the cover of each group. Also here carefully sum up all groups to the *Cover sum of all Valuable Plants groups* (3.5.5).

The questions on *plant diversity* (3.6) are meant to tell something about the value of your plot for nature conservation.

The number of *flowering plants* (3.6.1) is important for many other organisms like insects (e.g. honey bees) or birds. As in 3.2.3 you soon have a relation what “a lot”, “medium” and “few” on a pasture means.

The *number of plant species* (3.6.2) in the Transcaucasian steppes and semi-desertssteppe is extraordinary and of high value. The number of species on a certain territory provides important information. For counting all different plant species look for a representative example of your plot, best near the circle’s centre, where you have taken the GPS-coordinates. This small plot has the size of ca. 10 m² (ca. 3 x 3 m). A good method to count all different plant species which you can distinguish is that you slowly move from one corner of your plot to the other and collect a bunch of all these species. You do not need to know the plant names! Then you sit down, put all plant species on a white paper and count one after the other. A mechanical counter would be of good help; otherwise just use a tick list. Note your final number of plant species and mark the corresponding category.

*4 Visual appraisal of state of pasture*

You have had a close look at this plot. Please give your own impression of the state of this pasture, based on your own experience.

*5 Representative picture taken*

It is important to have a digital picture of each plot you are working on. Please take at least one picture that gives an overview of your plot or shows a representative part of your plot. As you have chosen already your 10 x 10 m square with the precondition that it is representative for your plot circle of r = 50 m, it is most likely the best target for your picture. Please note the picture number given by your camera. When you later hand over your material to the person processing the data or you continue to work with it yourself, please make sure that your pictures are safely stored on a computer. It would be best if you (or together with the computer operator), give each picture a new name that contains the GPS name given in the beginning when filling out the data sheet.

## 3.4 How to calculate the indices on plot level

On basis of the information collected with **Data Sheet II** (Chapter 5.2) two indices are created**.** They each consist of several variables. Without the aim of further implications (management recommendations) a pasture monitoring could be restricted to these two indices.

In brackets, the variables refer to the numbering of **Data Sheet II** “(from X.X.X)”**.** Under 5.3.5 you find an example calculation.

### *3.4.1 Susceptibility to Erosion-Index (SEI)*

The first index is called **Susceptibility to Erosion-Index (SEI).** It is created from “physical” site conditions that are independent from the impact of livestock. The index therefore reflects the potential erosion on a site.

All variables contained in the SEI influence also the water availability to plants. Water plays the essential role for plant growth and also for regenerating after disturbances (e.g. grazing, trampling) which means the ability to “repair” the destroyed parts. If plants cannot recover, they die and less soil surface is covered by vegetation. Open soil instead of vegetation cover is more susceptible to erosion, to both water and wind erosion. In other words, the more vegetation cover protects the soil surface, the less erosion can strike.

The creation of this index follows the Topographic Relative Moisture Index (TRMI, Parker 1982) and own scientific data.

Variables

SEI is calculated based on six variables:

Var.1 Altitude

Var.2 Inclination

Var.3 Aspect

Var.4 Topographic position

Var.5 Slope configuration

Var.6 Soil texture

*Var.1 Altitude* (from 1.1.3)

Regression analyses showed that in this lowland steppe region with increasing altitude the probability of erosion tracks decreases. This seems correlated to the increase of rainfall with increasing altitude and therefore better growth condition for plants which protect the soil surface against erosion. Altitude was weighted from 0-20, equally to the two more important variables in the TRMI. Additionally, it occurred in the 2nd or 3rd place in regression models explaining erosion tracks.

| **Ranges (in m a.s.l.)** | **Value** |
|---|---|
| Above 600 | 20 |
| 451 – 600 | 15 |
| 301 – 450 | 10 |
| 151 – 300 | 5 |
| 150 and below | 0 |

*Var.2 Inclination* (from 1.2.1)

*Inclination* means the *steepness* of a slope. It is weighted from 0-40, as it is the most important factor in all regression models explaining erosion tracks. The steeper the slope is, the stronger is the gravitation as driving power for soil dislocation (= erosion).

| **Slope steepness (degrees):** | **Value** |
|---|---|
| <3.0° | 40 |
| 3.0 – 5.9° | 36 |
| 6.0 –.9° | 32 |
| 9.0 – 11.9° | 28 |
| 12.0 – 14.9° | 24 |
| 15.0 – 17.9° | 20 |
| 18.0 – 20.9° | 16 |
| 21.0 – 23.9° | 12 |
| 24.0 – 26.9° | 8 |
| 27.0 – 29.9° | 4 |
| >30.0° | 0 |

Concordantly, also the strength and speed of movement of the water which is important for erosion processes becomes higher when inclination increases. As example, the steeper a slope is, the more power water gains to move soil material.

Additionally, water availability (water movement + insolation angle influencing evapotranspiration) is mainly determined by *Inclination.* The steeper a slope is, the faster water can flow-off and the less infiltrates into the soil, where it can get absorbed by the roots of plants. On steep slopes the insolation angle is higher as well. This means the angle in which the sun energy reaches the earth's surface. In our latitudes the sun energy "arriving" on a steeper slope is higher than on a flat slope which means that here it becomes warmer and the evapotranspiration, i.e. the loss of water from the soil (evaporation) and from the plants (transpiration) is higher. In sum this means that on steeper slopes less water is available to plants than on flatter slopes and hence, their ability to regenerate after a disturbance is lower. Ranges are based on those of Parker (1982), the higher weighting multiplied the original values.

*Var.3 Aspect* (from 1.2.2)

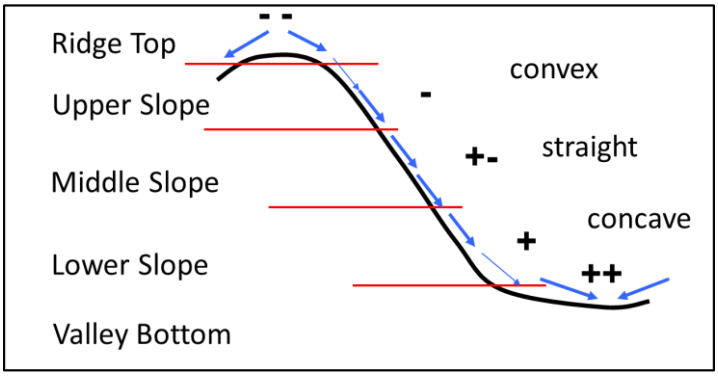
The ranges and weighting of the aspect from 0-20 follow Parker (1982) who regarded this variable as one of the most important parameters influencing water availability. The amount of sun energy reaching a slope is strongly dependent on the aspect. A southern slope receives more sun energy than a northern slope; western and eastern slopes receive almost the same amount of sun energy. Hence, evapotranspiration, in turn water availability to the plants, is different on slopes of different aspect.

| **Slope aspects [°]** | **Value** | **Slope aspects [°]** | **Value** | **Slope aspects [°]** | **Value** |
|---|---|---|---|---|---|
| 19-26 | 20 | 81-89; 316-324 | 13 | 144-152; 253-261 | 6 |
| 27-35; 10-18 | 19 | 90-98; 307-315 | 12 | 153-161; 244-252 | 5 |
| 36-44; 1-9 | 18 | 99-107; 298-306 | 11 | 162-170; 235-243 | 4 |
| 45-53; 352-360 | 17 | 108-116; 289-297 | 10 | 171-179; 226-234 | 3 |
| 54-62; 343-351 | 16 | 117-125; 280-288 | 9 | 180-188; 217-225 | 2 |
| 63-71; 334-342 | 15 | 126-134; 271-279 | 8 | 189-197; 208-216 | 1 |
| 72-80; 325-333 | 14 | 135-143; 262-270 | 7 | 198-207 | 0 |

*Var.4 Topographic position* (from 1.2.3)

As well this variable following Parker (1982) is weighted from 0-20 as it is one of the most important parameters influencing water availability. The blue arrows in the figure to the right indicate water running downhill. From a ridge top water only flows away. There, least water is available ("- -"). On an upper slope more water is flowing away than can arrive from above which means also a deficit of water ("-"). On a middle slope as much water is arriving than leaving; the water regime is balanced ("+-"). On lower slopes and valley bottoms more water arrives than leaves; the water balance is positive ("+" and "++").

| Topographic position | Value |
|---|---|
| Ridge top | 0 |
| Upper slope | 5 |
| Middle slope | 10 |
| Lower slope | 15 |
| Valley bottom | 20 |




*Var. 5 Slope configuration* (from 1.2.4)

The way a slope is formed influences the water availability significantly, though after Parker (1982) less than the position on the slope (maximum score for the highest water availability 10). With the upper sketch you can understand, why on convex (curved outwards) slopes less water ("-") is available than on concave (curved inwards like a bowl) slopes ("+").

| Slope configuration | Value |
|---|---|
| Concave | 10 |
| Concave/straight | 8 |
| Straight | 5 |
| Convex/straight | 2 |
| Convex | 0 |

*Var.6 Soil texture* (from 1.3)

Determination of the soil texture follows the USDA "Guide to texture by feel" (see chapter 3.3). To consider soil texture is important for several reasons, as the proportion and combination of different sizes of soil particles and their particular properties influence:

- the ability of soils for storing water and providing this water to plants. As example small particles like clay minerals can keep water very well in the soil, while bigger particles like sand are less able to do so. However, a high proportion of the smallest particles could mean that they hold water so well that is difficult for plant roots to use this water, especially when they need it the most in dry times. In turn, water in more sandy soils cannot be stored long in dry times but is quickly available for plants when enough rain is falling.

- the development of soil pores which are important for allowing air and water to enter the soil, both necessary for good growth of plants. For example, soils with a high proportion of fine particles tend to develop firm surface crusts which hinder this

exchange with the athmosphere. Thereagainst for example sandy soils allow for good water infiltration and aeration.

- The stability of the soil surface to resist erosion processes by water and wind.

Following own regression models explaining erosion tracks soil texture occurred to be as altitude second most important. Hence it was also weighted from 0-20.

The ranking was adopted to the semi-arid regional conditions with aid of Mammadov (2002)[18], from v.d. Grift (1994) under consideration of VSA and MSQR (see chapter 1.5).

| **Texture class** | **Value** |
|---|---|
| clay loam | 20 |
| sandy or silty clay loam | 18 |
| loam | 16 |
| silt loam | 14 |
| silty clay | 12 |
| clay, silt | 10 |
| sandy loam | 8 |
| sandy clay | 6 |
| loamy sand | 4 |
| sand | 2 |
| coarse sand | 0 |

*Wind is another important agent for soil dislocation. As well, different wind speeds effect the water availability to plants due to different rates of the so called evapotranspiration (explanation see above at Var.2). For example, on a wind-exposed ridge top plants have more water stress, as they are forced to transpirate more water and as well the soil, which provides their roots with water, evaporates more.*

*For many reasons, we are not able to assess the wind strength on our plots, as it is dependent from factors like main wind direction and relief. However, the topographic position and slope configuration already indirectly consider wind exposure: a ridge top is more prone to wind attack (i.e. possible soil location and higher evapotranspiration rate) than the bottom of a valley; any convex slope is more exposed to wind than a concave one.*

[18] Mammadov, Q. (2002): Azərbaycanda Torpaq İslahatı. Bakı. 'Elm' Nəşriyyat evi. pp. 186-187

***Calculation***

The Susceptibility to Erosion-Index (SEI) is calculated the following way:

| Code | Variable | Values | Min | Max |
|---|---|---|---|---|
| Var.1 | Altitude | 0, 5, 10, 15, 20 | 0 | 20 |
| Var.2 | Inclination | 0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 | 0 | 40 |
| Var.3 | Aspect | 0-20 | 0 | 20 |
| Var.4 | Topographic position | 0, 5, 10, 15, 20 | 0 | 20 |
| Var.5 | Slope configuration | 0, 2, 5, 8, 10 | 0 | 10 |
| Var.6 | Soil texture | 0, 2, 4, 6, 8, 10, 12, 14, 16, 20 | 0 | 20 |
| **Total sum** | | | **0** | **130** |

You need to sum up the scores obtained for the six variables**.**

The index is **normalized** using the formula:

$$\textbf{SEI} = \frac{\textbf{Sum of scores obtained}}{\textbf{Sum of maximum scores}} \times \textbf{100}$$

According to this formula SEI ranges between 0 and 100.

SEI is more vividly expressed in the colors of a **traffic light**. The alignment to such a traffic light works as follows:

| Index range | Risk to erosion level | Traffic light | Traffic light as numerical figure |
|---|---|---|---|
| 68-100 | Low risk | Green | 5 |
| 34-67 | Medium risk | Yellow | 2.5 |
| 0-33 | High risk | Red | 0 |

### *3.4.2 Pasture Degradation-Index*

Traces of erosion and the state of the pasture vegetation contribute to the *Pasture Degradation-Index (PDI).* The presence of livestock directly impacts all 13 variables recorded. The index therefore reflects the *current state of a pasture site.*

Some variables are regarded less important than others. They were assigned only 5 as maximum score values. The other variables are weighted with 0-10. They are regarded more important due to their more complex character. The categories were formed on the basis of field data from 360 winter pasture plots in the Gobustan and Cheiranchöl region.

***Part 1 of the PDI: Erosion/degradation* of soil surface** (from 2)

The six variables in this part of the PDI represent different aspects of erosion and degradation of the soil surface.

*Var. 7 Bare soil* (from 2.1.1)

The proportion of bare soil is relevant for ongoing erosion processes. Here, no vegetation protects the soil surface and erosion can attack.

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| 0-5 % | 5 |
| 6-10 % | 4.5 |
| 11-20 % | 4 |
| 21-30 % | 3 |
| 31-40 % | 2 |
| 41-50 % | 1 |
| 51-75 % | 0.5 |
| more than 75 % | 0 |

*Var. 8 Bare stones* (from 2.1.2)

Together with *bare soil*, *bare stones* sum up to all ground that is not covered by vegetation, hence to the unproductive area, which does not provide fodder. Smaller stones are relevant for ongoing erosion processes, as they can be moved by running water or trampling animals. Thereagainst, bigger stones and rocks are too big to be moved by water or trampling animals. In opposite, they might even have a stabilizing effect, preventing soil to be washed away. However, they may indicate former loss of topsoil.

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| Non visible | 5 |
| 1 % | 4.5 |
| 2-4 % | 4 |
| 5-7 % | 3 |
| 8-10 % | 2 |
| 11-20 % | 1 |
| more than 20 % | 0 |

*Var. 9 Livestock tracks* (terracettes) (from 2.2)

Cattle tracks are the most important indicator for livestock caused alteration of the pasture surface. They are mostly highly correlated with erosion tracks, but not necessarily equivalent with them as cattle tracks often can be covered by vegetation. In this state they are less susceptible to erosion**.**

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| Non visible | 5 |
| 1-5 % | 4.5 |
| 6-10 % | 4 |
| 11-20 % | 3 |
| 21-30 % | 2 |
| 31-40 % | 1 |
| 41-50 % | 0.5 |
| more than 50 % | 0 |

*Var. 10 Erosion tracks* (from 2.3)

Erosion tracks are defined as estimated cover [%] on 10 x 10 m of in combination bare soil, bare stones ***and*** visible erosion processes. They are not necessarily the sum of the variables 7 and 8, as e.g., on flat slopes with a certain cover of bare soil erosion processes do not need to be strong. Another extreme example would be that on steeper slopes with high vegetation cover (i.e low cover of bare soil and stones) erosion processes might be the sliding of larger intact pieces of sods (topsoil with vegetation). A distinction of different types of erosion (sheet, rill, gully etc.) does not need to be considered here.

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| Non visible | 10 |
| 1% | 9 |
| 2-4 % | 8 |
| 5-7 % | 6 |
| 8-10 % | 4 |
| 11-25 % | 2 |
| 26-50 % | 1 |
| more than 50 % | 0 |

*Var. 11 Salt indicators*

Salinisation meaning the increase of salts in the soil usually leads to a decrease of productivity of the pasture, as only few plant species are adapted to scope with salty soils and many nutritious plants are not able to grow on salinised sites.

With the Var. 11.1 and 11.2 *signs of salinisation* are visually estimated in two ways. Either salinisation can be visible as white salt crusts on the soil surface (Var. 11.1) **or** the presence of special plant species shows a significant amount of salts in the soil.

*Var. 11.1 Salt crusts (from 2.4.1)*

| Cover percentage on 10x10m | Value |
|---|---|
| non visible | 10 |
| 1 % | 9 |
| 2 % | 8 |
| 3-4 % | 6 |
| 5-7 % | 4 |
| 8-10 % | 2 |
| more than 10 % | 0 |

*Var. 11.2 Salt indication species (from 2.4.2)*

| Cover percentage on 10x10m | Value |
|---|---|
| non visible | 10 |
| 1 % | 9 |
| 2-5 % | 8 |
| 6-10 % | 6 |
| 11-25 % | 4 |
| 26-50 % | 2 |
| more than 50 % | 0 |

Low presence of *salt indication species* hints on a low content of salt in the soil. Under this condition, non-salt tolerant species, that are often more valuable as animal feed, grow better. Where many *salt indication species* grow in high density, salt content in the soil is high and no other plants are able to grow. This often means that the fodder basis for livestock is not very good.

**If you could observe both signs/expressions of salinisation (of both sub-variables), then use the lower score of both for further calculations.**

*Var. 12 Soil Structure*

The structure of a soil is important as it "regulates soil aeration and gaseous exchange rates, soil infiltration and erosion, the movement and storage of water, soil temperature, root penetration and development, nutrient supply, and the resistance to structural degradation by compaction and deformation under wheel traffic and stock treading" (Shepherd 2010/ VSA). Especially the latter point, the intensity of treading (trampling) of livestock hooves can lead in the winter pastures in Azerbaijan to degradation. Where a high density of livestock is grazing, the soil might become strongly compacted and above mentioned functions decrease. As result, the botanical composition of the pasture can change, less palatable plant species might increase.

Following the guidelines and pictures in chapter 3.3 you can assess the condition of the soil structure. According to Shepherd (2010) "soils with good structure have friable, fine, porous, sub-angular and sub-rounded (nutty) aggregates" which is good for plant growth. "Those with poor structure have large, dense, very firm, angular or sub-angular blocky clods that fit and pack closely together and have a high tensile strength". Growing conditions for plants are worse here.

| Visual scoring of soil structure | Value |
|---|---|
| Good condition | 10 |
| Good to moderate condition | 7.5 |
| Moderate condition | 5 |
| Moderate to poor condition | 2.5 |
| Poor condition | 0 |

***Part 2 of the PDI: Vegetation*** (from 3)

In this chapter different features of the plants growing on the pasture and the direct influence of grazing are assessed.

*Var. 13 Feed value by vegetation* (from 3.1)

The task in the field was to assess whether the listed plant groups occur with a cover of more than 20 % of the total plot's area. Various combinations of these dominant plants groups are possible, resulting in different vegetation types shown in the table below. By using extensive data from literature and own knowledge (Peper (2010), Hasanova (2012)[19] each known vegetation type was attributed a value on productivity (based on yield of phytomass per ha) and palatibility (feed quality). Both values sum up to the Feed value by vegetation. Productivity is regarded more important (weighted with 0-6) than palatability (weighted with 2-4), as principally the amount of fodder is more decisive than its quality, because during the run of one year almost all plants growing on a pasture are somehow edible.

| **Productivity dt/ha** | **Value** |
|---|---|
| > 9 | 6 |
| 5.5 to 9 | 4 |
| < 5.5 | 2 |
| Scattered vegetation | 0 |

| **№** | **Dom. plant groups** | **Vegetation type** | **Productivity** (0,2,4,6) | **Palatability** (2,3,4) | **Sum** (2, 4, 5, 6, 7, 8, 9, 10) ***= Feed value by vegetation*** |
|---|---|---|---|---|---|
| 1 | 1+6 | Artemisia-semi-shrubs - taller grass – steppe | 6 (12,5 dt/ha) | 4 | 10 |
| 2 | 1+4+5 | Artemisia-semi-shrubs - ephemeral herbs and grass - dry steppe | 6 (9,4 dt/ha) | 4 | 10 |
| 3 | 1+2+3 | Artemisia and Salsola-semi-shrubs - ephemeral salt herbs - dry steppe | 6 (13,4 dt/ha) | 3 | 9 |
| 4 | 1+2 | Artemisia and Salsola-semi-shrubs - dry steppe | 6 (9,4 dt/ha) | 3 | 9 |
| 5 | 1+2+5 | Artemisia and Salsola-semi-shrubs + ephemeral grass - semi-desert | 4 (7,00 dt/ha) | 4 | 8 |
| 6 | 1+3 | Artemisia-semi-shrubs - ephemeral salt herbs - semi-desert | 4 (5,9 dt/ha)/ (6,31 dt/ha) | 2 | 6 |
| 7 | 1+3+5 | Artemisia-semi-shrubs - ephemeral salt herbs and grasses - semi-desert | 2 (4,8 dt/ha) | 3 | 5 |
| 8 | 3+5 | Ephemeral salt herbs and grasses - semi-desert | 2 (5,5 dt/ha) | 2 | 4 |
| 9 | 7 | Scattered vegetation | 0 | 2 | 2 |

With this approach more vegetation types might become obvious. Specialists then have to find fitting values.

[19] Hasanova, A. (2012): Ecological evaluation of rangeland quality in dry subtropics of Azerbaijan. Eurasian Soil Science Vol. 47, No 12, pp. 1283–1292

*Var. 14 Roughness against wind erosion* (from 3.2)

Besides water as driving force (see chapter 3.4.1) also wind can be an important cause for erosion on the winter pastures. A plain bare soil surface is more susceptible to wind erosion than one covered with “rough” structures like stones or mainly vegetation, which “disturbs” the wind to blow away the topsoil. The higher the vegetation stands are and the more vegetation permanently covers the soil, the less wind erosion is able to attack.

This so called *roughness* is mainly determined by two important figures (sub-variables), the height of the vegetation cover (Var. 14.1) and its density (Var. 14.2 *Total vegetation cover*). Although annual plants do not cover and protect the soil surface during the whole run of the year, their coverage is taken into account, as the highest threat from wind erosion is expected for the dry summer period. In this time, the dry vegetation stands of annual plants together with perennial plants - dwarf shrubs and perennial herbs and grasses - build a shield against wind erosion.

Both sub-variables are weighted with 0-5, summing up together to the variable *roughness* with, as in other as important variables, the possible scores 0-10.

*Var. 14.1 Height of vegetation*
According to findings of Funk et al. (2014)[20] vegetation height shows a threshold at 9 cm. Below this average height of vegetation stands, impact of wind at the soil surface fosters erosion processes remarkably. Higher vegetation causes a lower threat by wind erosion.

| **Average height of vegetation cover** | **Value** |
|---|---|
| more than 21 cm | 5 |
| 19-21 cm | 4.5 |
| 16-18 cm | 4 |
| 13-15 cm | 3 |
| 10-12 cm | 2 |
| 7-9 cm | 1 |
| 0-6 cm | 0 |

*Var. 14.2 Total vegetation cover*
The higher the vegetation cover is, the lower is the threat by wind erosion.

| **Cover percentage of vegetation on 10x10m** | **Value** |
|---|---|
| more than 90 % | 5 |
| 81-90 % | 4.5 |
| 71-80 % | 4 |
| 61-70 % | 3 |
| 41-60 % | 2 |
| 21-40 % | 1 |
| 0-20 | 0 |

Both values of Var. 14.1 and Var. 14.2 are used for further calculation.

[20] Funk, R., C. Hoffmann, et al. (2014). Methods for Quantifying Wind Erosion in Steppe Regions. In: Novel Measurement and Assessment Tools for Monitoring and Management of Land and Water Resources in Agricultural Landscapes of Central Asia. Eds. L. Mueller, A. Saparov and G. Lischeid, Springer International Publishing: pp. 315-327.

After having this close look, the following visual appraisal of pasture productivity (from 3.2.3) can help cross-checking the plausibility of the results of the Variable 13, and also 14. However, it is not used for further calculation.

*Var.15. Grazing pressure*

Two sub-variables are assessed to reflect best the season's grazing intensity, *browsing tracks* on pasture plants and the *dung cover*. Both sub-variables are each weighted with 0-5, summing up together to the variable *grazing pressure* with, as in other as important variables, the possible scores 0-10.

*Var.15.1 Grazing pressure I: Browsing tracks* (from 3.3.1)

*Browsing tracks* indicate which proportion of the pasture plants was hurt, i.e. eaten by grazing livestock. Based on the ranges of browsing tracks after Klötzli (1965)[21], additionally the range of the most intensive browsing was split up into two categories.

| **Percentage of plants browsed on 10x10m** | **Value** |
|---|---|
| 1-5 % of plants browsed | 5 |
| 6-20 % of plants browsed | 4 |
| 21-50 % of plants browsed | 2.5 |
| 51-80 % of plants browsed | 1 |
| more than 80 % of plants browsed | 0 |

*Var.15.2 Grazing Pressure II: Dung Cover (from 3.3.2)*

Another indicator often used as proxy for grazing intensity is the *dung cover* (cover percentage of livestock faeces). The more cover of faeces you register, the higher is the impact by livestock. This variable proved to be a suitable indicator on the winter pastures.

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| non visible | 5 |
| 1 % | 4.5 |
| 2 % | 4 |
| 3-4 % | 3 |
| 5-7 % | 2 |
| 8-10 % | 1 |
| more than 10 % | 0 |

Both values of Var. 15.1 and Var. 15.2 are used for further calculation.

[21] Klötzli F. 1965: Qualität und Quantität der Rehäsung in Wald- und Grünland-Gesellschaften des nördlichen Schweizer Mittellandes. Bern: Huber

*Var.16 Cover sum of all recorded grazing indicator species groups* (from 3.4.5)

The presence of grazing indicator species reflects in a certain way the grazing intensity over a longer period (for details see Chapter 3.3, part *3 Vegetation*).

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| non visible | 10 |
| 1 % | 9 |
| 2-5 % | 8 |
| 6-10 % | 6 |
| 11-25 % | 4 |
| 26-50 % | 2 |
| more than 50 % | 0 |

*Var.17 Cover sum of all valuable plants groups (from 3.5.5)*

The more of a pasture is covered with valuable plants groups, the more valuable it is for livestock grazing (for details see Chapter 3.3, part *3 Vegetation*).

| **Cover percentage on 10x10m** | **Value** |
|---|---|
| more than 50 % | 10 |
| 26-50 % | 9 |
| 11-25 % | 8 |
| 6-10 % | 6 |
| 2-5 % | 4 |
| 1 % | 2 |
| non visible | 0 |

*Plant diversity* (from 3.6)

was included in the PDI, as one aim of an improved pasture management should also help to halt the loss of biodiversity.

*Var.18 Flowering plants* (from 3.6.1)

The number of *flowering plants* is meant to roughly indicate the habitat function of a grassland for other organisms like insects (also honey bees!) or birds. The number of *flowering plants* is negatively correlated with the grazing intensity, that means less plants have flowers (often the most tasty parts of the plants) where many animals are grazing, and vice versa. However, in case of strong browsing a reasonable number of not or less palatable plant species and hence their flowers might remain on a pasture. Therefore, weighting of this factor is only 0-5.

| **Flowering plants** | **Value** |
|---|---|
| a lot | 5 |
| medium | 2.5 |
| few | 0 |

*Var.19 Number of plant species* (from 3.6.2)

With the number of plant species (count on 3 x 3 m) a comparison of species richness at the same site between two monitoring dates, maybe under a changed pasture management, is possible. By this one could find out that after a changed pasture management (e.g. less sheep allowed on one ha) more plant species are recorded at the second monitoring date. The categories were formed on the basis of species numbers on 10 m² from 360 winter pasture plots in the Gobustan and Cheiranchöl region, where between 0 and 29 species were found. According to regression models, the species numbers on strongly degraded/eroded pasture sites are significantly lower than on less disturbed pastures. Therefore, the number of plant species is a suitable indicator for the state of a pasture, too.

| **Number of plant species** | **Value** |
|---|---|
| 1-10 | 0 |
| 11-13 | 2 |
| 14-16 | 5 |
| 17-19 | 8 |
| 20 and more | 10 |

***Calculation of PDI***

The Pasture Degradation Index (PDI) is calculated the following way:

| Code | Variable | Values | Min | Max |
|---|---|---|---|---|
| **Var. 7** | Bare soil | 0, 0.5, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 8** | Bare stones | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 9** | Livestock tracks | 0, 0.5, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 10** | Erosion tracks | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 |
| **Var. 11** | Salt indicators I OR II (take lower value) | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 |
| **Var. 12** | Soil structure | 0, 2.5, 5, 7.5, 10 | 0 | 10 |
| **Var. 13** | Feed value by vegetation | 2, 3, 4, 5, 6, 7, 8, 9, 10 | 2 | 10 |
| **Var. 14.1** | Roughness I: Vegetation height | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 14.2** | Roughness II: Vegetation density | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 15.1** | Grazing pressure I: Browsing tracks | 0, 1, 2.5, 4, 5 | 0 | 5 |
| **Var. 15.2** | Grazing pressure II: Dung Cover | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 |
| **Var. 16** | Cover grazing indicator species groups | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 |
| **Var. 17** | Cover valuable plant species groups | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 |
| **Var. 18** | Flowering plants | 0, 2.5, 5 | 0 | 5 |
| **Var. 19** | Number of plant species | 0, 2, 5, 8, 10 | 0 | 10 |
| **Total sum** | | | **2** | **110** |

You need to sum up the scores obtained of the 13 variables**.**

The index is **normalized** using the formula:

$$\textbf{PDI} = \frac{\textbf{Sum of scores obtained}}{\textbf{Sum of maximum scores}} \textbf{ x 100}$$

According to this formula PDI ranges between 0 and 100.

As for SEI the PDI is expressed in the colors of a **traffic light:**

| Index range | Degradation of Pasture | Traffic light | Traffic light as numeric figure |
|---|---|---|---|
| 68-100 | Low | Green | 5 |
| 34-67 | Medium | Yellow | 2.5 |
| 0-33 | Strong | Red | 0 |

# 4 Giving management recommendations

This part helps to develop and implement recommendations for improved pasture management. Chapters 4.1 to 4.3 explain the steps from the monitoring results to management recommendations which are mainly office work. In Chapter 4.4 and 4.5 you find advice, how to discuss management recommendations with the herders on their pastures.

## 4.1 Extrapolating results from plots to management units (MU)

Chapter 3 closed with the calculation of SEI and PDI indices and their translation into traffic lights for easy visual accessibility. However, both indices are only valid for the plot level, i.e., a circle of r = 50 m (ca. 0.8 ha).

Implications derived from the two indices should be feasible management recommendations. But management recommendations are reasonable only for pasture management units in a grazing regime or for whole pasture areas used by one farm. In order to extrapolate the results from plots to management units you use the sampling design developed in Chapter 3.1. In this part you selected manually relatively homogenous management units (MU) of which several plots are representative examples.

For extrapolation you need:

- Map and table with information about management units (Chapter 3.1)
- Results of SEI and PDI on plots (Chapter 3.4)

Both indices, SEI and PDI, first need to be extrapolated to MU-level.

Add the SEI of all plots within one MU and divide them by the number of plots. The result is the index on management-unit level, SEI-MU.

For example, if you have three plots in one management unit:

**(SEI 1 + SEI 2 + SEI 3)/ n = SEI-MU**

As the simple SEI also SEI-MU gets aligned to the colors of a **traffic light**.

| **Index range SEI -MU** | **Degradation of Pasture on MU** | **SEI-MU in Traffic light** | **Traffic light as numeric figure** |
|---|---|---|---|
| 68-100 | Low | Green | 5 |
| 34-67 | Medium | Yellow | 2.5 |
| 0-33 | Strong | Red | 0 |

The same you do for the PDI of all plots within one MU (here again the example with three plots):

**(PDI 1 + PDI 2 + PDI 3)/ 3 = PDI-MU**

| **Index range PDI -MU** | **Degradation of Pasture MU** | **PDI-MU in Traffic light** | **Traffic light as numeric figure** |
|---|---|---|---|
| 68-100 | Low | Green | 5 |
| 34-67 | Medium | Yellow | 2.5 |
| 0-33 | Strong | Red | 0 |

The last columns (SEI-MU and PDI-MU in traffic light as figures) are needed for further operations.

## 4.2 Calculating the State of Pasture-Index of one MU (SPI-MU)

For giving management recommendations you combine both indices to calculate the *State of Pasture-Index of one management unit (SPI-MU).* This index is calculated as the sum of SEI-MU and PDI-MU which in their traffic lights had been assigned the following values: green -> 5, yellow -> 2.5, red -> 0.

**SEI-MU + PDI-MU = SPI-MU**

Depending on the five possible SPI-MU values the following stocking rates (sheep units per ha (SU/ha)) are recommended:

| SEI –MU | PDI –MU | SPI-MU | Recommended stocking rate |
|---|---|---|---|
| **5 (green)** | 5 (green) | 10 | 4 SU/ha |
| **5 (green)** | 2.5 (yellow) | 7.5 | 3 SU/ha |
| **5 (green)** | 0 (red) | 5 | 2 SU/ha |
| **2.5 (yellow)** | 5 (green) | 7.5 | 3 SU/ha |
| **2.5 (yellow)** | 2.5 (yellow) | 5 | 2 SU/ha |
| **2.5 (yellow)** | 0 (red) | 2.5 | 1 SU/ha |
| **0 (red)** | 5 (green) | 5 | 2 SU/ha |
| **0 (red)** | 2.5 (yellow) | 2.5 | 1 SU/ha |
| **0 (red)** | 0 (red) | 0 | No grazing |

In the following table the four management options are given in a condensed way.

| SPI-MU | Recommended stocking rate |
|---|---|
| 10 | 4 SU/ha |
| 7.5 | 3 SU/ha |
| 5 | 2 SU/ha |
| 2.5 | 1 SU/ha |
| 0 | No grazing |

## 4.3 Preparing management recommendations

*Calculating the recommended livestock number for a pasture*

During the previous chapter you identified the *recommended stocking rate* for each management unit. It says, how many animals are allowed to be kept on one hectare of pasture land of a certain condition. It can be transformed into *recommended sheep units (MU).* They indicate how many sheep units are allowed on the specific management unit.

Calculate the recommended sheep units for each management units according to the instructions in the table.

However, the only reasonable unit for recommending livestock numbers is a pasture. Sum up the numbers of all management units to obtain the *recommended sheep units for the pasture.*

| **Name of MU** | **Size (ha)** | | **Stocking rate (SU/ha)** | | **Recommended sheep units** |
|---|---|---|---|---|---|
| MU 1 | | | | | |
| MU 2 | | **x** | | **=** | |
| MU 3 | | | | | |
| MU 4 | | | | | |
| **Sum (Recommended sheep units for the pasture)** | | | | | |

*Calculating required change in livestock numbers*

You calculated the actual sheep units currently stocking on the pasture in Chapter 2.3.

Now you can calculate the required *change in sheep units.* It says how many sheep units you can keep more or have to keep less to arrive at the recommended sheep units on a certain pasture.

**Change in sheep units = Recommended sheep units for the pasture – actual sheep units**

Three cases are possible:

*Case 1:* Change in sheep units is positive: The pasture condition allows you to keep more livestock on the pasture than the farm actually has.

*Case 2:* Change in sheep units is zero: The pasture condition allows you to keep just as much livestock as the farm currently has.

*Case 3:* Change in sheep units is negative: The pasture condition allows you only to keep fewer animals on the pasture than the farm actually has.

Note these results on the recommendations data sheet (see below).

*Preparing grazing regime recommendations*

Different management units of one pasture may have different recommended stocking rates, but they are grazed by one herd consisting of all animals together. Therefore, the different units have to be grazed in different shares of the grazing time to ensure appropriate use.

**Share of grazing time** (MU) says which percentage of the grazing time in one summer the whole herd should use this management unit. Calculate it for each management unit as follows:

$$\textbf{Share of grazing time (MU) (\%)} = \frac{\textbf{Recommended sheep units for a management unit x 100}}{\textbf{Recommended sheep units for the pasture}}$$

The figure is always below 100 and the sum of all shares is 100. How these figures are translated into grazing regimes depends on the decision of the herder. You should discuss this together with the herders on the pasture.

### *Preparing a recommendations data sheet*

A pasture management *recommendations data sheet* has to be prepared which can be used during the discussion of management recommendations with herders. It should contain the following information:

- Map with pasture and management units
- Current pasture management
    a) Actual sheep units
    b) Size of the pasture in ha
- Pasture condition
    a) SEI-index traffic light
    b) PDI-index traffic light
- Pasture management
    a) SPI: Resulting recommended stocking rate
    b) Recommended sheep units for each management unit
    c) Total recommended sheep units
    d) Change in sheep units
- Grazing regime
    a) Share of grazing time for each management unit
- Conversion key for transforming sheep units into livestock heads (see Chapter 2.3)

The recommendations data sheet needs to be as comprehensible as possible. It is also meant to be stored by the herders for their own documentation, so they should be able to read and understand it without your help.

## 4.4 Implementing improved pasture management

After completing the calculations you can start to discuss the management recommendations with the herders. Recall the results given in the pasture management recommendations sheet and the notes from the initial interview (Data Sheet I).

Do not try to achieve complete agreement with the herders at once and set the aims low at the beginning of discussion. Rather see the implementation of improved pasture management as a process of working with the herders over several years and set achievable goals from year to year together with the herder. At best, the same person (you) should work with the herders over several years and also return after a certain time to evaluate the results of the changed practices.

*General rules for discussions of pasture management*

- Discuss the management recommendations with the responsible persons. You identified the person in Question 3.5 in Data Sheet I.
- Make sure that the person has sufficient time and is not in a hurry during your discussion.
- Stay objective and patient throughout the conversation.
- Listen carefully and try to understand the situation from the herder's point of view.
- Try to convince the person with objective arguments.
- Let the person understand, how these management recommendations were derived.
- Assure the herder that you and your organisation will assist and accompany the implementation of improved pasture management in the future.

***Arguments for improved pasture management***

Herders may ask, why all this is necessary and why they have to change their behaviour. The only way to achieve lasting changes in behaviour is when you can convince herders that sustainable pasture management is for their best. Here are some arguments you can use:

1. Pasture land is a valuable but fragile resource. Herders have the power to destroy this resource, but the responsibility to preserve it. You can irreversibly destroy the pasture when you keep too much livestock on it. If the soil is washed away once, it may take thousands of years until a new productive lawn can grow there. Your children and grandchildren will not be able to use this resource in the future if it is damaged.
2. Some areas are by nature more fragile than others. The SEI-Index of a particular area indicates this natural susceptibility to erosion (chapter 3.4). If the index is "red" or "yellow", it says, e.g., that the slopes are very steep or that the bedrock is unstable. Here, decreased stocking rates are necessary just because of the natural conditions.
3. Some areas show already signs of degradation. You can observe this, e.g., by cattle tracks and bare soil on the pastures which is indicated in the PDI-index (Chapter 3.4). If this index is "red" or "yellow", try to let the herders see these signs of degradation. Every square inch of bare soil means that there is no grass for the livestock to graze. Therefore, the productivity of a pasture is highest, where the area covered with grass is highest. Of course, you cannot avoid bare soil completely, as some erosion occurs naturally in the mountains. Your aim is to keep the erosion at a minimum level.

4. If the PDI-index is “red” or “yellow”, it is necessary to improve the condition of the pasture which is only possible with an improved grazing regime or less animals. The reduction of livestock may be only temporarily, when the pasture condition improves in the future. The herder will benefit himself, if the pasture recovers and is more productive in the future. Sustainable pasture management should lead to a “green” result.
5. Ask old people how the condition of pastures was 50 years ago. Probably they will tell you that you could find more plant and animal species on the pastures at this time. This is a result of the high livestock numbers today which make those plants and animals species disappear that are sensitive to disturbance. Some of these species are valuable medicine for livestock. They are valuable for the herders and their families, as well.
6. If you compare the situation of livestock on one heavily grazed and one lightly grazed pasture, you will probably recognize that the livestock is better able to keep its weight over winter on the lightly grazed pasture. The fatter the animals are, the better they can survive the winter. Fatter animals make the work of the shepherds easier in winter and need less barley and hay which cost a lot of money. Isn’t it then in the interest of every herder that their animals are as fat as possible? Three fat animals can yield more money than four thin ones.
7. Every herder will agree that sheep farming is risky, because of the variable weather conditions. With fewer animals on the pasture you are better secured against environmental risks because you are able to keep grazing reserves for bad times. If there is e.g. a cold spell in winter, fat animals can deal better with this situation. If you have a fodder reserve with high-standing dwarf shrubs, animals can still eat this when there is some snow. If the rain does not come in time in spring, it is good to have a fodder reserve which the livestock can use then, while on pasture without a fodder reserve the animals would stay hungry.

***Discussing recommended livestock numbers and destocking***

Give all herders the following explanation how sheep units can be transformed into livestock heads:

- Imagine the recommended sheep units as an amount of tokens the herder can allocate to different livestock according to the conversion key (Chapter 2.3). The herder is free to choose, how many individuals from each livestock he wants to keep.

| **Livestock** | **Sheep units** |
|---|---|
| 1 sheep | 1 sheep unit |
| 1 goat | 0.7 sheep units |
| 1 cow | 6 sheep units |

Explain to the herders, what the “change in sheep units”-figure means:

- *Case 1:* Change in sheep units is positive. This means, the pasture condition allows keeping more livestock on the pasture than the farm actually has. – The herder will be glad to hear this. Nevertheless, tell him, how much more livestock he is allowed to keep.
- *Case 2:* Change in sheep units is zero: The pasture condition allows keeping just as much livestock as the farm currently has. – The herder should not keep more livestock on the pasture in the future.
- *Case 3:* Change in sheep units negative. The pasture condition allows only keeping fewer animals on the pasture than the herder actually has. – The herder has to bring less livestock to the pasture in the future. You will probably have to convince the herder, why less livestock is necessary for sustainable pasture management and discuss strategies, how this reduction in livestock numbers can be achieved. Refer to the proposals given below for this discussion.

*Ways of mitigating economic hardships of decreased livestock numbers*

Herders may argue that they have to earn money and that they cannot earn sufficient income with reduced livestock numbers. Indeed, fewer ewes mean fewer lambs and decreased overall income for one herder. But this is not inevitable. What about the following proposals?

- Sometimes livestock numbers are very high in one year because one shepherd or a friend of the owner brought many animals. You can discuss with the herder if somebody can send animals to another winter pasture where livestock numbers are not that high. Many herders have friends and relatives working on other pastures or some herders even lease two or more or more winter pastures and can shift animals easily. In some cases a shepherd with many animals may shift to another pasture, while a shepherd with few animals comes to this pasture.
- On some farms economic problems root in insufficient knowledge about sheep production or insufficient veterinary care which lead to low rearing rates of livestock. If herders mention such problems, try to assist with organising information material or the contact to an agricultural extension service to improve the situation.

- If winter pastures are too small, herders may try to reduce the time that they are with their herds on the winter pasture. Sometimes it is possible to have some intermediate autumn/spring pasture in the upper parts of the winter pasture area. While it is not optimal to stay there in deep winter because of snow, the fodder is generally abundant in spring and autumn. Using an autumn/spring pasture besides winter and summer pasture is in fact the traditional pattern of mobile livestock keeping in Azerbaijan.

### *Discussing grazing regimes*

The *share of grazing time* is the most important figure to design grazing regimes. It says which share of the grazing time in one summer the whole herd should use this management unit. Different opportunities exist to design grazing regimes according to these shares.

For example, if the share of grazing time is 80 % for MU 1 and 20 % for MU 2, these opportunities are possible:

- The herd can graze four days on MU 1 and go one day to MU 2, when one rotation is five days.
- The herd can graze two days on MU 1 and a half day on MU 2, when one rotation is two and a half days
- The herd can graze 8 hours on MU 1 and two hours on MU 2, when one rotation is one day with 10 grazing hours.

The herder can decide himself which grazing regime he chooses. It is only important that the shares of total grazing time are ensured. Using the example above, explain the herder to graze 4/5 of the time on MU 1 and 1/5 on MU 2.

If you have problems to understand the share of grazing time in percent you can translate this figure into *grazing days (MU).* You only need the length of the *summer pasture period* in days, i.e., the number of days the herd stays on the summer pasture altogether. Calculate:

**Grazing days (MU) = (Share of grazing time (%) /100) x summer pasture period (days)**

Especially when you have very low percentage values, grazing days (MU) may lead to a better understanding.

### 4.5 Improving the framework for pastoral farms

Herders may have other problems with their farm which prevent the implementation of improved pasture management.

*Insecurity of lease contracts:*

If the rights for pasture access are insecure, herders have no incentive to think of their children and grandchildren regarding their own pasture. Rather, they think from day to day or from season to season. Information about the lease contract of the herder is provided in Part 4 of Data Sheet I.

Lease contracts are insecure if:

- The duration of the lease contract is less than 5 years (Question 4.5)
- The contract is oral or a sublease agreement (Question 4.2)
- The herders estimate the security of the lease contract as insufficient (Question 4.7, try to identify the cause in an informal discussion.)

If you want to implement sustainable pasture management in the long run, secure rights for the herders are indispensable. It is also to your advantage, because you work with only one or few herders, rather than convincing every year somebody else. If you have the opportunity, try to convince the responsible administration that long-term lease contracts are to the benefit of all sides.

*Problems with awareness of degradation:*

Herders may not see changes to the worse on the pastures or may not link them to overstocking with livestock. They may blame climate changes or bad fate.

If the decision maker with whom you are discussing is not the person interviewed for Data Sheet I, try to assess his opinion of pasture condition and degradation problems. Use questions from Part 8 in Data Sheet I in an informal conversation.

If on one winter pasture the decision-maker on livestock numbers rarely visits the pasture, he is probably not familiar with the pasture condition. Explain the results of your assessment of pasture condition. If degradation problems are already apparent, show them on the pasture.

Indicators of awareness problems:

- The herder does not understand the question related to “degradation”. Or he does not see problems at all, while for other persons the problems are obvious (Question 8.5).
- The herder does not see that keeping too much livestock on the pasture leads to negative effects for livestock and the pasture (Question 8.6).

If awareness-problems exist, try to use Arguments 3 and 7 in Chapter 4.4. Be aware that ways of thinking change slowly. In this case, it is better to provide food for thought in one conversation and to return another time for continuing the discussion.

# 5 Annex

## 5.1 Data Sheet I: Management questionnaire for winter pastures

*Interviewer:* Date: *Sheet No.*

---

**1. Basic data of winter pasture**

1.1 GPS-Point (Name):

N (Latitude): E (Longitude): Altitude [m above sea level, from GPS]:

1.2 Name of winter pasture:

1.3 Name of interview partner:

For how many years do you personally come to this winter pasture?

years

When do you usually arrive on this winter pasture and when do you leave?

Arrival date: Departure date:

1.4 Related sheet numbers of data sheets for pasture condition (Data Sheet II):

---

**2. Summer pasture**

2.1 Where does the livestock kept on this pasture stay in summer?

☐ Summer pasture: Name of rayon:

Near which village/town/mountain:

☐ Village Name of rayon:

Name of village:

---

## 3. Farm organisation

3.1 Who is responsible for herding on this winter pasture?

*Fill in the names in the table and mark "herding tasks" and "presence on the winter pasture"*

| No. | Name | Herding tasks | Management tasks | Livestock ownership | Presence on winter pasture |
|---|---|---|---|---|---|
| 1. | | ☐ | ☐ | | ☐ |
| 2. | | ☐ | ☐ | | ☐ |
| 3. | | ☐ | ☐ | | ☐ |
| 4. | | ☐ | ☐ | | ☐ |
| 5. | | ☐ | ☐ | | ☐ |
| 6. | | ☐ | ☐ | | ☐ |
| 7. | | ☐ | ☐ | | ☐ |
| 8. | | ☐ | ☐ | | ☐ |

3.2 Who is responsible for the management of this winter pasture?

*Mark "management tasks" in the table.*

*In case the persons were not mentioned yet, fill in additional names and their tasks in the table. To fill in the last column ask:*

Do these additional persons stay on the winter pasture at least one month each winter?

*Mark "presence on the winter pasture in case the answer is "yes".*

3.3 Who are the three most important livestock owners on this winter pasture?

*Mark the most important livestock owner with "1", the second most important with "2" and the third most important with "3".*

*In case the persons were not mentioned yet, fill in additional names and other information in the table as described in Question 3.2.*

3.4 Who decides about the following issues?

*Write down the No. of the persons as indicated in the table.*

*In case other persons are responsible, add them to the table.*

a.) Daily organisation of herding

b.) Fodder purchase and veterinary care for livestock

c.) Time and organisation of seasonal migration

d.) Number of livestock on the winter pasture

3.5 With whom can we discuss management recommendations for your pasture?

*Write down the No. of the person as indicated in the table*

---

**4. Pasture access**

4.1 Can you give information about the lease contract for this winter pasture?

☐ Yes, *Proceed with Question 4.2.*

☐ No, Who can give information? When and/or where is the person available for an interview?

*Proceed the interview with Question 5.1*

4.2 Which form of lease agreement secures the access of your farm to this summer pasture?

☐ Written contract with administration

☐ Oral agreement with administration

☐ Written sublease contract with original leaseholder

☐ Oral sublease agreement with original leaseholder

4.3 Who holds this lease contract/agreement?

Name: If applicable: No. from table in Topic 3:

Else: Relationship to persons involved in the farm:

4.4 Which administration issued the original lease contract/agreement?

☐ Rayon administration ☐ Belediye

☐ other

Name of administration:

4.5 For how many years is the contract/agreement valid?

☐ years ☐ only for this year

4.6 According to the lease contract how many hectares do you use?

Total: Fertile land:

4.7 How do you estimate the security of your rights to this winter pasture?

☐ secure ☐ medium ☐ insecure

---

**5. Livestock**

5.1 How much livestock is kept on the winter pasture?

*Fill in total number.*

Sheep:

Goats:

Cattle (older than 6 months):

5.2 How did the number of livestock develop in the last years?

☐ Became more ☐ Stayed the same ☐ Became less

5.3 Do you provide additional fodder to your livestock?

☐ No ☐ Yes: (please specify)

## 6. Use of shepherd dogs

6.1 How many adult dogs do you keep on your winter pasture?

Number:

6.2 Do you take dogs with you during herding?

☐ Always ☐ Sometimes ☐ Never

6.3 Where do your dogs go during the day?

☐ Stay in camp

☐ Go max. 200 m radius from camp ☐ Go further than 200 m from camp

6.4 What do you feed regularly to your dogs?

☐ barley ☐ barley and meat ☐ other:

---

## 7. Spatial organisation of pasture use

*Space for drawing a **mental map** is provided on the last page of the data sheet.*

*If your interview partner can show you the map belonging to his lease contract, you can use it as the basis for filling in details of the mental map.*

7.1 Can you draw a simple map of your winter pasture?

Show the location of streams/valleys and ridges.

Show the location of the camp and access roads.Where can you find much fodder?

Where is the fodder scarce?

Which places does the livestock like/dislike?

7.2 Do you use a spatial and/or temporal pattern of herding, e.g. grazing reserve management (xam or xesil)?

Please explain it by using your map.

Are there places, where the livestock does not go/goes only infrequently?

*Please make sure that all aspects of the discussion are recorded on the map.*

## 8. Pasture condition

8.1 How do you appraise the condition of this pasture compared to neighbouring pastures?

☐ Better ☐ same ☐ worse

If the pasture condition is better or worse, please explain why.

8.2 Did the condition of this pasture change during the last 10 years?

☐ Better ☐ same ☐ worse

8.3 Is the pasture area enough for the livestock kept here?

☐ More than enough ☐ just enough ☐ not enough

8.4 What measures do you use to improve the condition of this pasture?

8.5 In general: Are there degradation problems on winter pastures in this region?

☐ Not at all ☐ few problems ☐ severe problems

8.6 When you keep too much livestock on a pasture…

a.) …what happens to the livestock?

b.) …what happens to the pasture?

---

## 9. Cross-checking of livestock numbers

*(do not integrate in interview, but conduct cross-check later on pasture)*

9.1 Sheep and goats

9.2 Cattle

Please draw map here:

## 5.2 Data Sheet II: Site conditions and state of winter pastures

*Interviewer:* _____ *Date:* _____ *Sheet No.*: _____

### 1 Site conditions (within radius = 50 m)

*Find a slope that is ± homogeneous within a circle of 50 m radius. If you do not find such a large circle, then please note the shortest radius of a homogeneous circle around you:* m

### 1.1 Location

1.1.1 Description of region (valley, nearest mountain, nearest village):

1.1.2 GPS-Point (Name): _____ N (latitude): _____ E (longitude): _____

1.1.3 Altitude [m above sea level, from GPS]: _____

1.1.4 Distance to next winter camp [m]: _____ GPS-Name of winter camp: _____

### 1.2 Slope

1.2.1 Slope Inclination/ Steepness [°]: _____

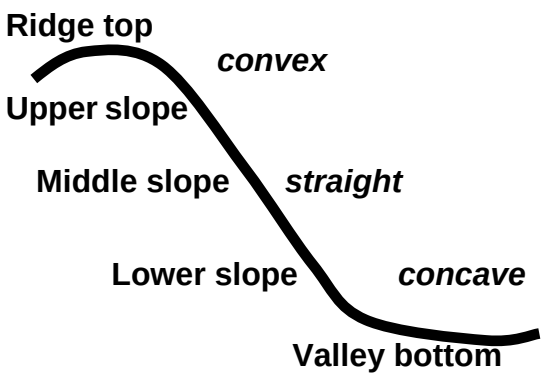
1.2.2 Aspect [°] _____ (fill in exact figure from compass)

Aspect category:

☐ N (345-75°) ☐ E (75-165°) ☐ S (165-255°) ☐ W (255-345°)

1.2.3 Topographic position:

| | |
|---|---|
| ☐ | Ridge top |
| ☐ | Upper slope |
| ☐ | Middle slope |
| ☐ | Lower slope |
| ☐ | Valley bottom |



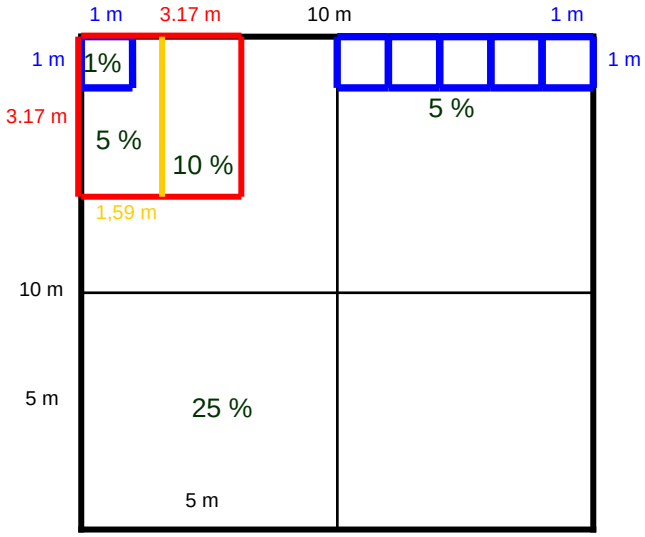

1.2.4 Slope configuration:

| | |
|---|---|
| ☐ | Convex |
| ☐ | Convex /straight |
| ☐ | Straight |
| ☐ | Concave /straight |
| ☐ | Concave |

**1.3 Soil texture** following USDA “Guide to texture by feel" (see chapter 5.4 Fig. 1)

| | | |
|---|---|---|
| ☐ Clay – Silty Clay | ☐ Sandy Clay | ☐ Sandy Clay Loam |
| ☐ Clay Loam | ☐ Silty Clay Loam | ☐ Silt Loam |
| ☐ Loam | ☐ Silt | ☐ Sandy Loam |
| ☐ Loamy Sand | ☐ Sand | ☐ Coarse Sand |

**Choose a representative plot of 10 x 10 m and mark the corners with sticks, clothes, rucksack etc**.




Sketch to help with estimating cover percentage on 10 x 10 m

**2 Erosion/degradation**

**2.1 Ground not covered by vegetation,** estimated cover [%] on 10 x 10 m (cross-check with 3.2.2)**:**

**2.1.1 Bare soil:** ☐ 0-5 % ☐ 6-10 % ☐ 11-20 % ☐ 21-30 ☐ 31-40 % ☐ 41-50 % ☐ 51-75 % ☐ more than 75 %

**2.1.2 Bare stones:** ☐ non visible ☐ 1 % ☐ 2-4 % ☐ 5-7 % ☐ 8-10 % ☐ 11-20 % ☐ more than 20 %

**2.2 Livestock tracks** (Terracettes), estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1-5 % ☐ 6-10 % ☐ 11-20 % ☐ 21-30 % ☐ 31-40 % ☐ 41-50 % ☐ more than 50 %

**2.3 Erosion tracks**, estimated cover [%] on 10 x 10 m in combination of bare soil, little moveable bare stones ***AND*** visible erosion processes: ☐ non visible ☐ 1 % ☐ 2-4 % ☐ 5-7 % ☐ 8-10 % ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**2.4.1 Salt crusts,** estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1 % ☐ 2 % ☐ 3-4 % ☐ 5-7 % ☐ 8-10 % ☐ more than 10 %

***AND/ OR***

**2.4.2 Salt indication species** (succulent salty leaves, pict. examples s. chapter 5.4 Fig. 5-10), estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 % ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**2.5 Soil structure (**see chapter 5.4 Fig. 2) is in**:** ☐ good ☐ good to moderate ☐ moderate ☐ moderate to poor ☐ poor condition.

**3. Vegetation**

**3.1 Dominant plant groups,** > 20 % cover estimated on 10 x 10 m (several answers possible, picture examples see chapter 5.4 Fig. 3-21)**:**

☐ 1. Semi-shrubs up to 40 cm height, strong smell, grey-bluish colour (=*Artemisia* spp.)
☐ 2. Semi-shrubs up to 70 cm height, succulent salty leaves (=*Salsola* spp. etc.)
☐ 3. Small annual/ephemeral (short roots) herbs, succulent, salty leaves
☐ 4. Other small herbs (=annuals/ephemerals)
☐ 5. Small grasses (=annuals/ ephemerals)
☐ 6. Taller grasses (=perennials)
☐ 7. Scattered vegetation (cover < 20 %)

**3.2.1 Vegetation height** maximal [cm]: (fill in exact estimate);
Average height [cm]: ☐ 0-6 ☐ 7-9 ☐ 10-12 ☐ 13-15
☐ 16-18 ☐ 19-21 ☐ more than 21

**3.2.2 Total vegetation cover,** estimated [%] on 10 x 10 m:
☐ 0-20 % ☐ 21-40 % ☐ 41-60 % ☐ 61-70 %
☐ 71-80 % ☐ 81-90 % ☐ more than 90 %

**3.2.3 Standing crop**: ☐ a lot ☐ medium ☐ few

**3.3.1 Browsing tracks,** [%] of plants browsed**:** ☐ 1-5 % ☐ 6-20 %
☐ 21-50 % ☐ 51-80 % ☐ more than 80 %

**3.3.2 Dung cover,** estimated cover [%] of faeces on 10 x 10 m:
: ☐ non visible ☐ 1 % ☐ 2 % ☐ 3-4 %
☐ 5-7 % ☐ 8-10 % ☐ more than 10 %

**3.4 Grazing indicator species groups** (unpalatable plants) and their cover [%] on 10 x 10 m (picture examples for categories see chapter 5.4):

**3.4.1 Thistles:** ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 22-23 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.2 Other thorny plants:** ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 24-27 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.3 Hairy plants:** ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 28-31 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.4 Poisonous and other unpalatable plants** (as stated by herders or own knowledge)**:**
chapter 5.4 Fig. 32-35 ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.5 ! Cover sum of all recorded grazing indicator species groups !**
☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5 Valuable plants** and their cover [%] on 10 x 10 m (picture examples see chapter 5.4):

**3.5.1 Legumes** (soft herbs with trifoliate leaves (like clover) or pinnate leaves (like Vicia/vetch)**:**
chapter 5.4 Fig. 36-41 ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.2 *Artemisia* spp.** (semi-shrub up to 40 cm height with strong smell, grey-bluish colour)**:**
chapter 5.4 Fig. 3-4 ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.3 *Salsola* spp.** (semi-shrub up to 70 cm height with succulent salty leaves):
chapter 5.4 Fig. 5-7 ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.4 Grasses (Graminoids):** ☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 15-20 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.5 ! Cover sum of all valuable plants groups !**
☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.6 Plant diversity**

**3.6.1 Flowering plants** ☐ a lot ☐ medium ☐ few

**3.6.2 Number of plant species** (count on 3 x 3 m): _____ (give exact number)
In categories: ☐ 1-10 ☐ 11-13 ☐ 14-16
☐ 17-19 ☐ more than 20

**4. Visual appraisal of state of pasture**

☐ Good ☐ Medium ☐ Bad

**5. Representative picture taken (***file name should later have the site's GPS name*)

**Picture Nr.:**

## 5.3 Example calculation

*5.3.1 Filled-in Data sheet I*
*(see chapters 2.1, 2.2, 5.1)*

**Data Sheet I: Management questionnaire for winter pastures**

*Interviewer:* Elgün Date: 12.05.2014 *Sheet No.* P 1

---

**1. Basic data of winter pasture**

1.1 GPS-Point (Name): P 1

N (Latitude): 40.435135° E (Longitude): 49.152377°
Altitude [m above sea level, from GPS]: 328

1.2 Name of winter pasture: Durbala

1.3 Name of interview partner: Haci Memmed

For how many years do you personally come to this winter pasture?

10 years

When do you usually arrive on this winter pasture and when do you leave?

Arrival date: Oct. 20 Departure date: May 20

1.4 Related sheet numbers of data sheets for pasture condition (Data Sheet II): P 1-1 to 3

---

**2. Summer pasture**

2.1 Where does the livestock kept on this pasture stay in summer?

☒ Summer pasture: Name of rayon: Quba
Near which village/town/mountain: Xinaliq

☐ Village Name of rayon:
Name of village:

---

## 3. Farm organisation

3.1 Who is responsible for herding on this winter pasture?

*Fill in the names in the table and mark "herding tasks" and "presence on the winter pasture"*

| No. | Name | Herding tasks | Management tasks | Livestock ownership | Presence on winter pasture |
|---|---|---|---|---|---|
| 1. | Haci Memmed | ☐ | ☒ | 1 | ☒ |
| 2. | Abdullah | ☒ | ☐ | | ☒ |
| 3. | Füzuli | ☒ | ☒ | 2 | ☒ |
| 4. | Rza | ☒ | ☐ | 3 | ☒ |
| 5. | Elnur | ☒ | ☐ | | ☒ |
| 6. | Tahira | ☐ | ☐ | | ☒ |
| 7. | | ☐ | ☐ | | ☐ |
| 8. | | ☐ | ☐ | | ☐ |

3.2 Who is responsible for the management of this winter pasture?

*Mark "management tasks" in the table.*

*In case the persons were not mentioned yet, fill in additional names and their tasks in the table. To fill in the last column ask:*

Do these additional persons stay on the winter pasture at least one month each winter?

*Mark "presence on the winter pasture in case the answer is "yes".*

3.3 Who are the three most important livestock owners on this winter pasture?

*Mark the most important livestock owner with "1", the second most important with "2" and the third most important with "3".*

*In case the persons were not mentioned yet, fill in additional names and other information in the table as described in Question 3.2.*

3.4 Who decides about the following issues?

*Write down the No. of the persons as indicated in the table.*

*In case other persons are responsible, add them to the table.*

| | |
|---|---|
| a.) Daily organisation of herding | 1,2,3,4,5 |
| b.) Fodder purchase and veterinary care for livestock | 1 |
| c.) Time and organisation of seasonal migration | 1,3,6 |
| d.) Number of livestock on the winter pasture | 1 |

3.5 With whom can we discuss management recommendations for your pasture?

*Write down the No. of the person as indicated in the table* 1

---

**4. Pasture access**

4.1 Can you give information about the lease contract for this winter pasture?

☒ Yes, *Proceed with Question 4.2.*

☐ No, Who can give information? When and/or where is the person available for an interview?

*Proceed the interview with Question 5.1*

4.2 Which form of lease agreement secures the access of your farm to this summer pasture?

☒ Written contract with administration

☐ Oral agreement with administration

☐ Written sublease contract with original leaseholder

☐ Oral sublease agreement with original leaseholder

4.3 Who holds this lease contract/agreement?

Name: Füzuli  If applicable: No. from table in Topic 3: 3

Else: Relationship to persons involved in the farm:

4.4 Which administration issued the original lease contract/agreement?

☒ Rayon administration ☐ Belediye

☐ other

Name of administration: Gobustan Rayon

4.5 For how many years is the contract/agreement valid?

☐ 15 years ☐ only for this year

4.6 According to the lease contract how many hectares do you use?

Total: 250 Fertile land: 200

4.7 How do you estimate the security of your rights to this winter pasture?

☐ secure ☒ medium ☐ insecure

---

**5. Livestock**

5.1 How much livestock is kept on the winter pasture?

*Fill in total number.*

Sheep: 500

Goats: 50

Cattle (older than 6 months): 25

5.2 How did the number of livestock develop in the last years?

☒ Became more ☐ Stayed the same ☐ Became less

5.3 Do you provide additional fodder to your livestock?

☒ No ☒ Yes: Hay (please specify)

## 6. Use of shepherd dogs

6.1 How many adult dogs do you keep on your winter pasture?

Number: 6

6.2 Do you take dogs with you during herding?

☐ Always ☒ Sometimes ☐ Never

6.3 Where do your dogs go during the day?

☐ Stay in camp

☐ Go max. 200 m radius from camp ☒ Go further than 200 m from camp

6.4 What do you feed regularly to your dogs?

☒ barley ☐ barley and meat ☐ other:

---

## 7. Spatial organisation of pasture use

*Space for drawing a **mental map** is provided on the last page of the data sheet.*

*If your interview partner can show you the map belonging to his lease contract, you can use it as the basis for filling in details of the mental map.*

7.1 Can you draw a simple map of your winter pasture?

Show the location of streams/valleys and ridges.

Show the location of the camp and access roads.

Where can you find much fodder?

Where is the fodder scarce?

Which places does the livestock like/dislike?

7.2 Do you use a spatial and/or temporal pattern of herding, e.g. grazing reserve management (xam or xesil)?

Please explain it by using your map.

Are there places, where the livestock does not go/goes only infrequently?

*Please make sure that all aspects of the discussion are recorded on the map.*

## 8. Pasture condition

8.1 How do you appraise the condition of this pasture compared to neighbouring pastures?

☐ Better ☒ same ☐ worse

If the pasture condition is better or worse, please explain why.

8.2 Did the condition of this pasture change during the last 10 years?

☐ Better ☐ same ☒ worse

8.3 Is the pasture area enough for the livestock kept here?

☐ More than enough ☒ just enough ☐ not enough

8.4 What measures do you use to improve the condition of this pasture?

none

8.5 In general: Are there degradation problems on winter pastures in this region?

☐ Not at all ☒ few problems ☐ severe problems

8.6 When you keep too much livestock on a pasture…

a.) …what happens to the livestock? does not gain so much weight

b.) …what happens to the pasture? nothing, grass grows again next autumn

---

## 9. Cross-checking of livestock numbers

*(do not integrate in interview, but conduct cross-check later on pasture)*

9.1 Sheep and goats 650

9.2 Cattle 35

*5.3.2 Calculation of actual sheep units and actual stocking rates*

You need:

- Livestock numbers recorded in Question 5.1
- Fertile land of the winter pasture (ha) recorded in Question 4.6

Calculate *actual sheep units* as indicated in the following table:

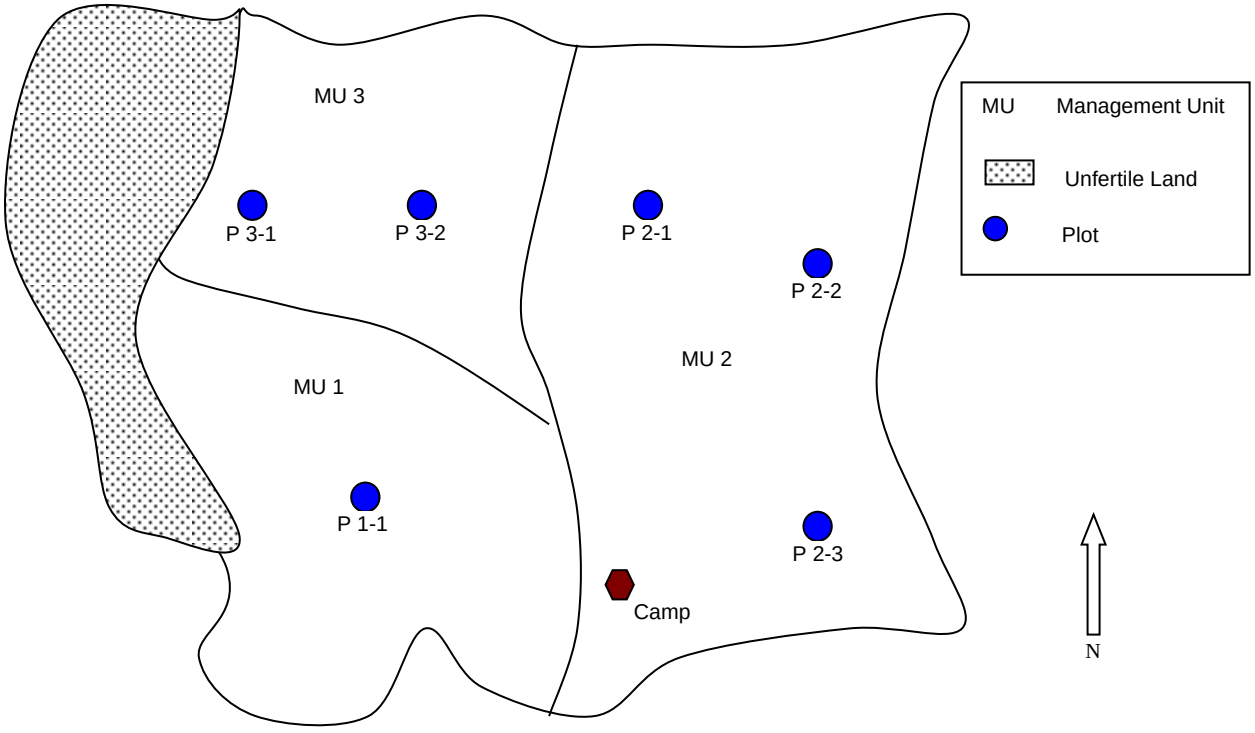
| | Number from questionaire | | Conversion factor[22] | | Sheep units |
|---|---|---|---|---|---|
| Sheep | 500 | x | 1 | = | 500 |
| Goats | 50 | | 0,7 | | 35 |
| Cattle | 25 | | 6 | | 150 |
| | | | | **Sum:** | **685** |

Calculate the *actual stocking rate* as follows:

**Stocking rate** = sum of sheep units / area (ha) = 685 / 200 = **3.4 SU/ha**

*5.3.3 Mental map*
*(see chapters 3.1, 3.2)*

Together with the herder the persons in charge derived three management units. In the management units one, two and three plots were selected. In this example MU 1 and MU 3 represent each 25 % and MU 2 represents 50 % of the total fertile land (200 ha).




[22] Conversion factors are calculated based on the weight ratios of livestock. Sheep: 50 kg, Cattle: 300 kg, Goat: 35 kg

*5.3.4 Filled-in Data Sheet II*
*(see chapters 3.3, 5.2)*

**Data Sheet II: Site conditions and state of winter pastures**

*Interviewer:* Elgün *Date:* 12.05.2014 *Sheet No.*: P 1-1

**1 Site conditions (within radius = 50 m)**

*Find a slope that is ± homogeneous within a circle of 50 m radius. If you do not find such a large circle, then please note the shortest radius of a homogeneous circle around you:* 35 m

**1.1 Location**

1.1.1 Description of region (valley, nearest mountain, nearest village): Gobustan, near river Jeyrankechmaz

1.1.2 GPS-Point (Name): P 1-1 N (latitude): 40.437082° E (longitude): 49.157849°

1.1.3 Altitude [m above sea level, from GPS]: 428

1.1.4 Distance to next winter camp [m]: 650 GPS-Name of winter camp: P 1 (Durbala)

**1.2 Slope**

1.2.1 Slope Inclination/ Steepness [°]: 31

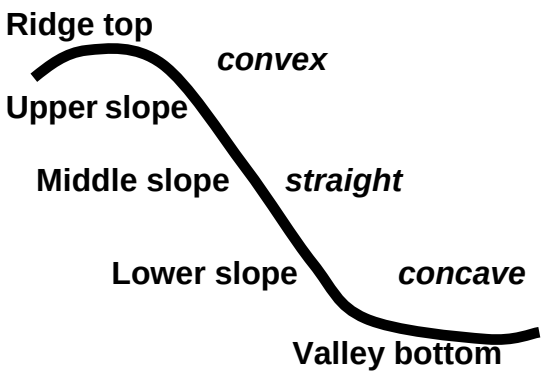
1.2.2 Aspect [°] 221 (fill in exact figure from compass)

Aspect category:

☐ N (345-75°) ☐ E (75-165°) ☒ S (165-255°) ☐ W (255-345°)

1.2.3 Topographic position:

| | |
|---|---|
| ☐ | Ridge top |
| ☒ | Upper slope |
| ☐ | Middle slope |
| ☐ | Lower slope |
| ☐ | Valley bottom |



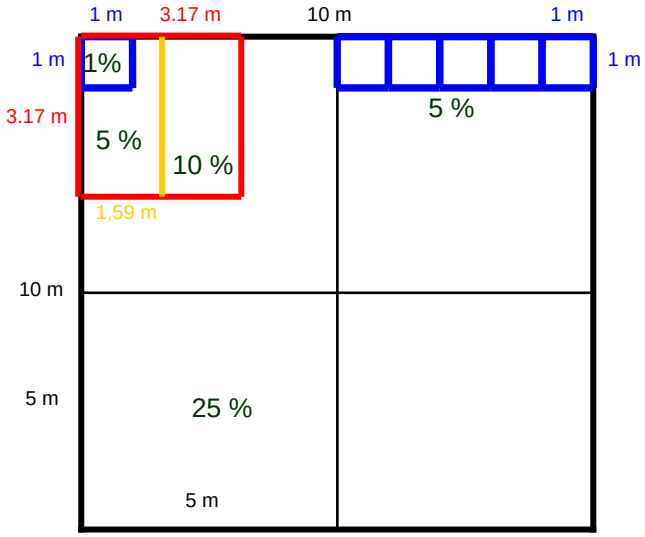

1.2.4 Slope configuration:

| | |
|---|---|
| ☒ | Convex |
| ☐ | Convex /straight |
| ☐ | Straight |
| ☐ | Concave /straight |
| ☐ | Concave |

**1.3 Soil texture** following USDA “Guide to texture by feel" (see chapter 5.4 Fig. 1)

| | | |
|---|---|---|
| ☐ Clay – Silty Clay | ☐ Sandy Clay | ☐ Sandy Clay Loam |
| ☐ Clay Loam | ☐ Silty Clay Loam | ☐ Silt Loam |
| ☐ Loam | ☐ Silt | ☒ Sandy Loam |
| ☐ Loamy Sand | ☐ Sand | ☐ Coarse Sand |

**Choose a representative plot of 10 x 10 m and mark the corners with sticks, clothes, rucksack etc**.




Sketch to help with estimating cover percentage on 10 x 10 m

**2 Erosion/degradation**

**2.1 Ground not covered by vegetation,** estimated cover [%] on 10 x 10 m (cross-check with 3.2.2)**:**

**2.1.1 Bare soil:** ☐ 0-5 % ☐ 6-10 % ☐ 11-20 % ☐ 21-30 ☐ 31-40 % ☐ 41-50 % ☒ 51-75 % ☐ more than 75 %

**2.1.2 Bare stones:** ☐ non visible ☐ 1 % ☐ 2-4 % ☐ 5-7 % ☒ 8-10 % ☐ 11-20 % ☐ more than 20 %

**2.2 Livestock tracks** (Terracettes), estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1-5 % ☐ 6-10 % ☐ 11-20 % ☐ 21-30 % ☐ 31-40 % ☒ 41-50 % ☐ more than 50 %

**2.3 Erosion tracks**, estimated cover [%] on 10 x 10 m in combination of bare soil, little moveable bare stones ***AND*** visible erosion processes: ☐ non visible ☐ 1 % ☐ 2-4 % ☐ 5-7 % ☐ 8-10 % ☐ 11-25 % ☐ 26-50 % ☒ more than 50 %

**2.4.1 Salt crusts,** estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1 % ☐ 2 % ☒ 3-4 % ☐ 5-7 % ☐ 8-10 % ☐ more than 10 %

***AND/ OR***

**2.4.2 Salt indication species (succulent salty leaves,** pict. examples see chapter 5.4 Fig. 5-10**),** estimated cover [%] on 10 x 10 m: ☐ non visible ☐ 1 % ☒ 2-5 % ☐ 6-10 % ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**2.5 Soil structure (**see chapter 5.4 Fig. 2) is in**:** ☐ good ☐ good to moderate ☒ moderate ☐ moderate to poor ☐ poor condition.

**3. Vegetation**

**3.1 Dominant plant groups,** > 20 % cover estimated on 10 x 10 m (several answers possible, picture examples see chapter 5.4 Fig. 3-21)**:**

☐ 1. Semi-shrubs up to 40 cm height, strong smell, grey-bluish colour (=*Artemisia* spp.)
☐ 2. Semi-shrubs up to 70 cm height, succulent salty leaves (=*Salsola* spp. etc.)
☐ 3. Small annual/ephemeral (short roots) herbs, succulent, salty leaves
☐ 4. Other small herbs (=annuals/ephemerals)
☐ 5. Small grasses (=annuals/ ephemerals)
☐ 6. Taller grasses (=perennials)
☒ 7. Scattered vegetation (cover < 20 %)

**3.2.1 Vegetation height** maximal [cm]: 25 (fill in exact estimate);

Average height [cm]: ☐ 0-6 ☐ 7-9 ☒ 10-12 ☐ 13-15
☐ 16-18 ☐ 19-21 ☐ more than 21

**3.2.2 Total vegetation cover,** estimated [%] on 10 x 10 m:

☒ 0-20 % ☐ 21-40 % ☐ 41-60 % ☐ 61-70 %
☐ 71-80 % ☐ 81-90 % ☐ more than 90 %

**3.2.3 Standing crop**: ☐ a lot ☐ medium ☒ few

**3.3.1 Browsing tracks,** [%] of plants browsed**:** ☐ 1-5 % ☐ 6-20 %
☐ 21-50 % ☒ 51-80 % ☐ more than 80 %

**3.3.2 Dung cover,** estimated cover [%] of faeces on 10 x 10 m:

: ☐ non visible ☒ 1 % ☐ 2 % ☐ 3-4 %
☐ 5-7 % ☐ 8-10 % ☐ more than 10 %

**3.4 Grazing indicator species groups** (unpalatable plants) and their cover [%] on 10 x 10 m (picture examples for categories see chapter 5.4):

**3.4.1 Thistles:** ☐ non visible ☐ 1 % ☒ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 22-23 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.2 Other thorny plants:** ☐ non visible ☒ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 24-27 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.3 Hairy plants:** ☐ non visible ☐ 1 % ☐ 2-5 % ☒ 6-10 %
chapter 5.4 Fig. 28-31 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.4 Poisonous and other unpalatable plants** (as stated by herders or own knowledge)**:**
chapter 5.4 Fig. 32-35 ☐ non visible ☒ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.4.5 ! Cover sum of all recorded grazing indicator species groups !**

☐ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☒ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5 Valuable plants** and their cover [%] on 10 x 10 m (picture examples see chapter 5.4):

**3.5.1 Legumes** (soft herbs with trifoliate leaves (like clover) or pinnate leaves (like Vicia/vetch)**:**
chapter 5.4 Fig. 36-41 ☐ non visible ☒ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.2 *Artemisia* spp.** (semi-shrub up to 40 cm height with strong smell, grey-bluish colour)**:**
chapter 5.4 Fig. 3-4 ☒ non visible ☐ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.3 *Salsola* spp.** (semi-shrub up to 70 cm height with succulent salty leaves):
chapter 5.4 Fig. 5-7 ☐ non visible ☒ 1 % ☐ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.4 Grasses (Graminoids):** ☐ non visible ☒ 1 % ☐ 2-5 % ☐ 6-10 %
chapter 5.4 Fig. 15-20 ☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.5.5 ! Cover sum of all valuable plants groups !**
☐ non visible ☐ 1 % ☒ 2-5 % ☐ 6-10 %
☐ 11-25 % ☐ 26-50 % ☐ more than 50 %

**3.6 Plant diversity**

**3.6.1 Flowering plants** ☐ a lot ☐ medium ☒ few

**3.6.2 Number of plant species** (count on 3 x 3 m): 12 (give exact number)
In categories: ☐ 1-10 ☒ 11-13 ☐ 14-16
☐ 17-19 ☐ more than 20

**4. Visual appraisal of state of pasture**

☐ Good ☐ Medium ☒ Bad

**5. Representative picture taken (***file name should later have the site's GPS name*)

**Picture Nr.:** IMG_100_0539

*5.3.5 Calculation of SEI and PDI*
*(see chapter 3.4)*

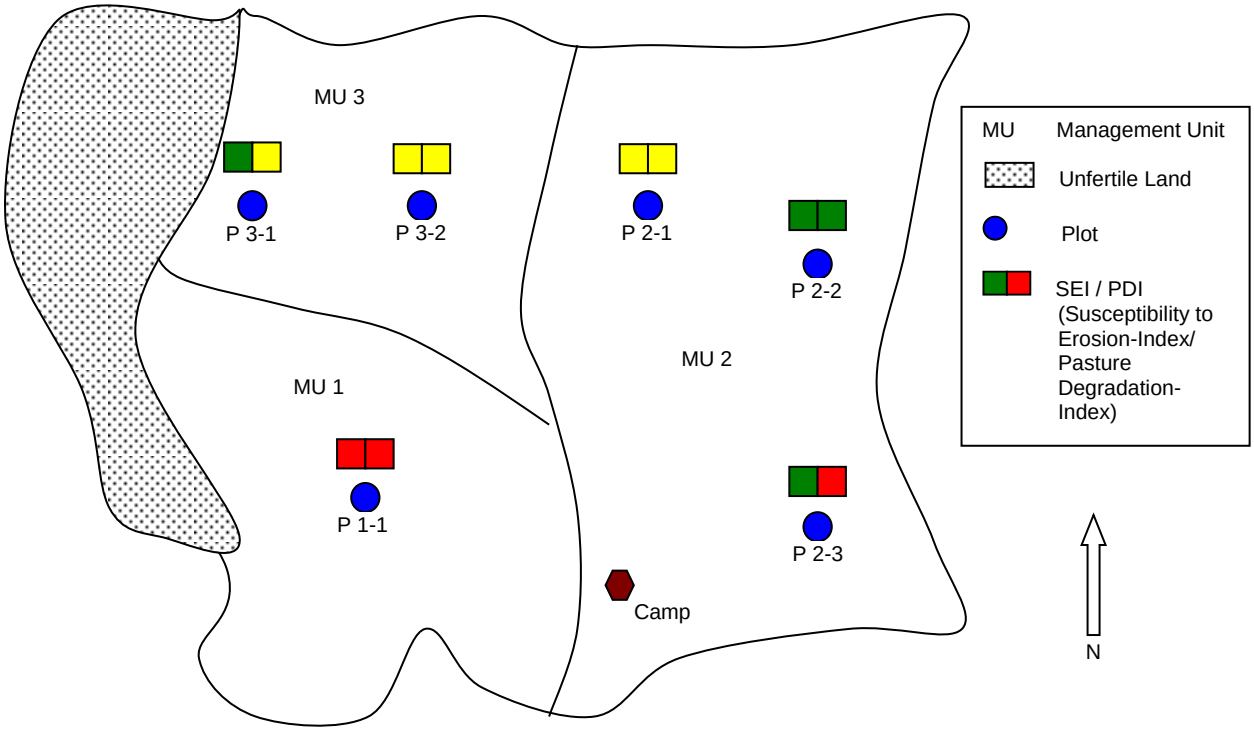
*Example calculation of **Susceptibility to Erosion-Index (SEI)** (see Chapter 3.4.1)*

| | | | | | Example Data sheet II | Further example figures | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code of variable** | **Variable** | **Values** | **Min** | **Max** | **Scores obtained P 1-1** | **Scores obtained P 2-1** | **Scores obtained P 2-2** | **Scores obtained P 2-3** | **Scores obtained P 3-1** | **Scores obtained P 3-2** |
| **Var. 1** | **Altitude** | 0, 5, 10, 15, 20 | 0 | 20 | 10 | 10 | 10 | 10 | 15 | 10 |
| **Var. 2** | **Inclination** | 0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 | 0 | 40 | 0 | 24 | 36 | 40 | 28 | 16 |
| **Var. 3** | **Aspect** | 0-20 | 0 | 20 | 2 | 13 | 11 | 10 | 20 | 15 |
| **Var. 4** | **Topographic position** | 0, 5, 10, 15, 20 | 0 | 20 | 5 | 10 | 15 | 20 | 10 | 10 |
| **Var. 5** | **Slope configuration** | 0, 2, 5, 8, 10 | 0 | 10 | 0 | 2 | 8 | 10 | 5 | 2 |
| **Var. 6** | **Soil texture** | 0, 2, 4, 6, 8, 10, 12, 14, 16, 20 | 0 | 20 | 8 | 14 | 18 | 10 | 14 | 12 |
| **Sum of maximum scores** | | | | **130** | | | | | | |
| **Sum of scores obtained** | | | | | **25** | **73** | **98** | **100** | **92** | **65** |
| **SEI (normalized) = (Sum of scores obtained / Sum of maximum scores) x 100** | | | | | **19.2** | **56.2** | **75.4** | **76.9** | **70.8** | **50.0** |
| **Risk to erosion level** | | | | | **High risk** | **Medium risk** | **Low risk** | **Low risk** | **Low risk** | **Medium risk** |
| **Expressed as traffic light** | | | | | **Red** | **Yellow** | **Green** | **Green** | **Green** | **Yellow** |

*Calculation of Pasture Degradation-Index (PDI)*
*(see chapter 3.4.2)*

| | | | | | Example Data sheet II | Further example figures | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code of variable** | **Variable** | **Values** | **Min** | **Max** | **Scores obtained P 1-1** | **Scores obtained P 2-1** | **Scores obtained P 2-2** | **Scores obtained P 2-3** | **Scores obtained P 3-1** | **Scores obtained P 3-2** |
| **Var. 7** | **Bare soil** | 0, 0.5, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 0.5 | 3 | 4 | 2 | 4 | 2 |
| **Var. 8** | **Bare stones** | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 2 | 4 | 5 | 4.5 | 4.5 | 4 |
| **Var. 9** | **Livestock tracks** | 0, 0.5, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 1 | 4 | 4.5 | 3 | 2 | 3 |
| **Var. 10** | **Erosion tracks** | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 | 0 | 6 | 9 | 4 | 6 | 2 |
| **Var. 11** | **Salt indicators I OR II (take lower value)** | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 | 6 | 8 | 10 | 2 | 8 | 6 |
| **Var. 12** | **Soil structure** | 0, 2.5, 5, 7.5, 10 | 0 | 10 | 5 | 5 | 7.5 | 0 | 5 | 2.5 |
| **Var. 13** | **Feed value by vegetation** | 2, 3, 4, 5, 6, 7, 8, 9, 10 | 2 | 10 | 2 | 6 | 10 | 4 | 10 | 9 |
| **Var. 14.1** | **Roughness I: Vegetation height** | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 2 | 3 | 4 | 1 | 2 | 3 |
| **Var. 14.2** | **Roughness II: Vegetation density** | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 0 | 4 | 4.5 | 3 | 4 | 3 |
| **Var. 15.1** | **Grazing pressure I: Browsing tracks** | 0, 1, 2.5, 4, 5 | 0 | 5 | 2.5 | 0 | 1 | 0 | 1 | 1 |
| **Var. 15.2** | **Grazing pressure II: Dung Cover** | 0, 1, 2, 3, 4, 4.5, 5 | 0 | 5 | 4.5 | 4 | 4.5 | 3 | 4.5 | 4.5 |
| **Var. 16** | **Cover grazing indicator species groups** | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 | 4 | 6 | 8 | 4 | 4 | 6 |
| **Var. 17** | **Cover valuable plant species groups** | 0, 2, 4, 6, 8, 9, 10 | 0 | 10 | 4 | 8 | 9 | 4 | 6 | 8 |
| **Var. 18** | **Flowering plants** | 0, 2.5, 5 | 0 | 5 | 0 | 2.5 | 5 | 0 | 2.5 | 2.5 |
| **Var. 19** | **Number of plant species** | 0, 2, 5, 8, 10 | 0 | 10 | 2 | 5 | 10 | 0 | 8 | 5 |
| **Sum of maximum scores** | | | | **110** | | | | | | |
| **Sum of scores obtained** | | | | | **35.5** | **68.5** | **96** | **34.5** | **71.5** | **61.5** |
| **PDI (normalized) = (Sum of scores obtained / Sum of maximum scores) x 100** | | | | | **32.3** | **62.3** | **87.3** | **31.4** | **65.0** | **55.9** |
| **Degradation of Pasture** | | | | | **High** | **Medium** | **Low** | **High** | **Medium** | **Medium** |
| **Expressed as traffic light** | | | | | **Red** | **Yellow** | **Green** | **Red** | **Yellow** | **Yellow** |

*Calculated SEI and PDI depicted in the example mental map*
*(see chapter 5.3.3)*




*5.3.6 Extrapolation of results from plots to management units (MU)*
*(SEI-MU and PDI-MU, see chapter 4.1)*

*Calculation of SEI-MU according to chapter 4.1 and example mental map*
*(see chapter 5.3.3)*

**SEI-MU 1 = 19.2**

$$\textbf{SEI-MU 2} = \frac{SEI\ P\ 2\text{-}1 + SEI\ P\ 2\text{-}2 + SEI\ P\ 3\text{-}2}{3} = \frac{56.2 + 75.4 + 76.9}{3} = \textbf{69.5}$$

$$\textbf{SEI-MU 3} = \frac{SEI\ P\ 3\text{-}1 + SEI\ P\ 3\text{-}2}{2} = \frac{70.8 + 50.8}{2} = \textbf{60.4}$$

Alignment to the colors of a **traffic light and the corresponding figures**

| | **SEI-MU** | **Index range SEI-MU** | **Risk to erosion level** | **SEI-MU in Traffic light** | **Traffic light as figure** |
|---|---|---|---|---|---|
| **SEI-MU 1** | 19.2 | 0-33 | High risk | Red | 0 |
| **SEI-MU 2** | 69.5 | 68-100 | Low risk | Green | 5 |
| **SEI-MU 3** | 60.4 | 34-67 | Medium risk | Yellow | 2.5 |

*Calculation of PDI-MU according to chapter 4.1 and example mental map (see chapter 5.3.3)*

**PDI-MU 1 = 32.3**

**PDI-MU 2** = $\frac{\text{PDI P 2-1} + \text{PDI P 2-2} + \text{PDI P 3-2}}{3}$ = $\frac{62.3 + 87.3 + 31.4}{3}$ = **60.3**

**PDI-MU 3** = $\frac{\text{PDI P 3-1} + \text{PDI P 3-2}}{2}$ = $\frac{65.0 + 55.9}{2}$ = **60.5**

Alignment to the colors of a **traffic light and the corresponding figures**

| | **PDI-MU** | **Index range PDI-MU** | **Degradation of Pasture MU** | **PDI-MU in Traffic light** | **Traffic light as figure** |
|---|---|---|---|---|---|
| **PDI-MU 1** | 32.3 | 0-33 | Strong | Red | 0 |
| **PDI-MU 2** | 60.3 | 34-67 | Medium | Yellow | 2.5 |
| **PDI-MU 3** | 60.5 | 34-67 | Medium | Yellow | 2.5 |

*5.3.7 Calculation of the State of Pasture-Index (SPI) of one MU (SPI-MU, see chapter 4.2)*

**SPI-MU 1** = SEI-MU 1 + PDI-MU 1 = 0 + 0 = **0**

**SPI-MU 2** = SEI-MU 2 + PDI-MU 2 = 5 + 2.5 = **7.5**

**SPI-MU 3** = SEI-MU 3 + PDI-MU 3 = 2.5 + 2.5 = **5**

The corresponding stocking rates (sheep units per ha (SU/ha)) are recommended.

| | **SPI-MU** | **Management recommendation** |
|---|---|---|
| **SPI-MU 1** | 0 | No grazing |
| **SPI-MU 2** | 7.5 | 3 SU/ha |
| **SPI-MU 3** | 5 | 2 SU/ha |

*5.3.8 Example of preparing management recommendations (see 4.3)*

*Calculation of the recommended livestock number for a pasture (see…)*

| Name of MU | Size (ha) | | Stocking rate (SU/ha) | | Recommended sheep units |
|---|---|---|---|---|---|
| MU 1 | 50 | x | 0 | = | 0 |
| MU 2 | 100 | | 3 | | 300 |
| MU 3 | 50 | | 2 | | 100 |
| **Sum (Recommended sheep units for the pasture)** | | | | | 400 |

**400 sheep units** are recommended to be kept on this pasture.

*Calculating the required change in livestock numbers*

Change in sheep units = Recommended sheep units for the pasture – actual sheep units

Change in sheep units = 400 – 685 = – 285

Case 3 has occurred: The pasture condition allows you only to keep less animals on the pasture than the farm actually has. The herder has to destock 285 sheep units to improve the pasture condition. For more than the half he could destock his 25 cattle (150 sheep units) completely.

*Calculation of Share of grazing time (MU)*

$$\text{Share of grazing time (MU) (\%)} = \frac{\text{Recommended sheep units for a management unit x } 100}{\text{Recommended sheep units for the pasture}}$$

$$\text{Share of grazing time (MU 1) (\%)} = \frac{0 \text{ x } 100}{400} = 0\ \%$$

$$\text{Share of grazing time (MU 2) (\%)} = \frac{300 \text{ x } 100}{400} = 75\ \%$$

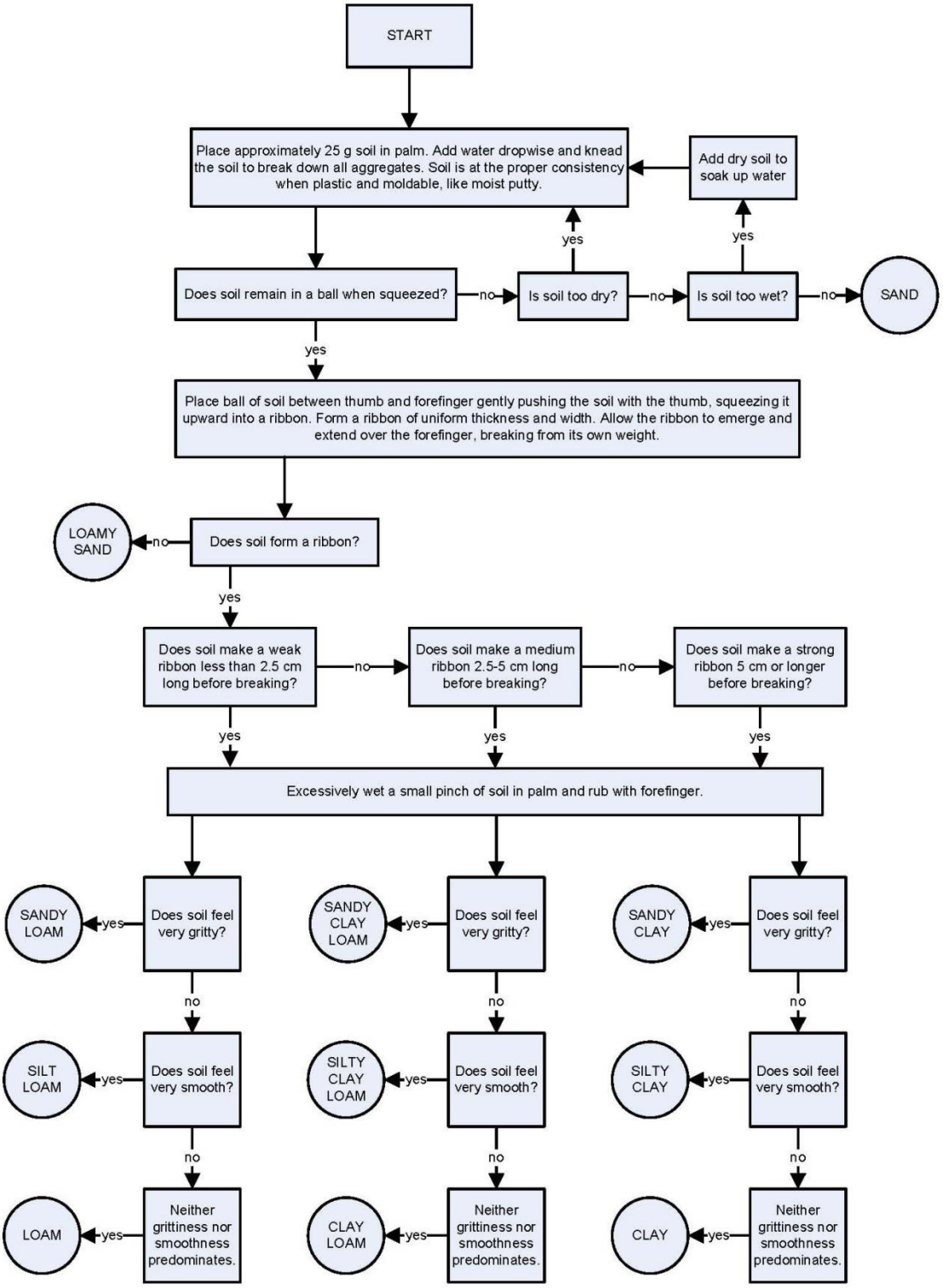
$$\text{Share of grazing time (MU 3) (\%)} = \frac{100 \text{ x } 100}{400} = 25\ \%$$

One quarter of the grazing time the herd should spend on MU 2, while three quarters are allowed on MU 2. There against, MU 1 has to be abandoned for a while to facilitate its regeneration.

We could express the allowed grazing time per MU also in grazing days. With a grazing period of 210 days, as in our example (Oct. 20$^{th}$ to May 20$^{th}$), the livestock could graze approx. 157 days on MU 2 and 52 days on MU 3.

## 5.4 Picture catalogue aiding to fill out Data Sheet II

### To 1.3 Soil texture by "Guide to Texture by Feel" (USDA 2014)23




**5.4 Fig. 1: Flow chart to assess soil texture "by feel"**

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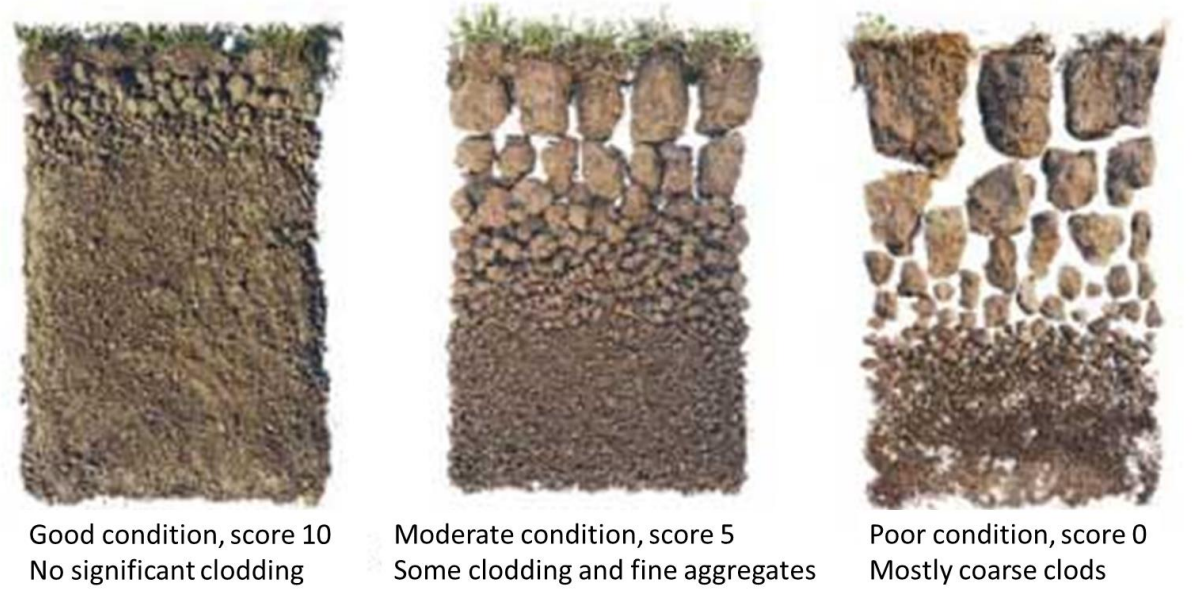
[23] USDA (2014) Guide to Texture by Feel (modified from S.J. Thien. 1979). A flow diagram for teaching texture by feel analysis. Journal of Agronomic Education. 8:54-55.), http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054311, accessed April 15th 2014.

## To 2.5 Soil structure by “drop shatter test” after Shepherd (2010)




**5.4 Fig. 2: Condition ranking after “drop shatter test” acc. to Shepherd (2010) (scoring modified)**
Compare your arrangement on the plastic bag with the three pictures and put the appropriate score. You can also decide on intermediate conditions between the three categories (2.5; 7.5).
**Source of figure: http://www.consumer.org.nz/reports/soil-quality/check-your-soil-condition**

## To 3.1 Dominant plant groups

### To 3.1.1 Semi-shrubs up to 40 cm height, strong smell, grey-bluish colour (=Artemisia spp.)

**5.4 Fig. 3 *Artemisia lerchiana* (Lerx yovşanı)**

**5.4 Fig. 4 Typical stand with *Artemisia lerchiana* dominance**

**To 3.1.2 Semi-shrubs up to 70 cm height, succulent salty leaves (=*Salsola* spp. etc.)**

**Fig. 5 *Salsola dendroides***
**(Ağacvari Şorangə),**

**source: L. Nepomenko, http://www.plantarium.ru/page/image/id/259904.html**

**Fig. 6 *Salsola ericoides***
**(Kövrək Şorangə çərən),**

**source: S. Banketov, http://www.plantarium.ru/page/image/id/157597.html**

**5.4 Fig. 7 *Salsola nodulosa* (Gəngiz Şorangəsi)**

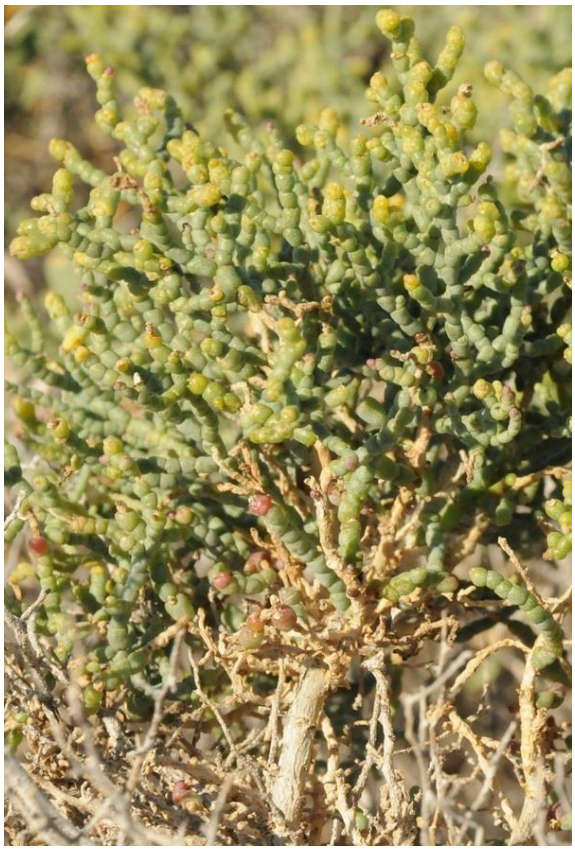


**Fig. 8 *Kalidium caspicum***
**(Kaspi sarıbaşı),**

**source: V. Epiktetov, http://www.plantarium.ru/page/image/id/216651.html**

## To 3.1.3 Small annual/ephemeral (short roots) herbs, succulent, salty leaves

**5.4 Fig. 9 *Climacoptera crassa* (Ətli şorangə),**
**source: M. Kucherov, http://www.plantarium.ru/page/image/id/40529.html**

**Fig. 10 *Petrosimonia brachiata* (Budaqlı qışotu),**

**source: S. Svirin, http://www.plantarium.ru/page/image/id/67364.html**

## To 3.1.4 Other small herbs (=annuals/ephemerals)

**5.4 Fig. 11 *Lagoseris orientalis* (Şərq Laqozerisi)**

**5.4 Fig. 12 *Neotorularia contortuplicata* and *Arnebia decumbens* (Sürtük)**

**5.4 Fig. 13 *Erodium-cicutarium* (Leylək durnaotu)**

**5.4 Fig. 14 *Veronica polita* (Bulagotu dəstərək) and *Filago vulgaris* (Adi küllücə)**

**To 3.1.5 Small grasses (=annuals/ ephemerals)**

**5.4 Fig. 15 *Poa bulbosa* (Soğanaqlı dişə)**

**5.4 Fig. 16 *Eremopyrum orientale* (Şərg bozağı)**

**5.4 Fig. 17 *Hordeum leporinum* (Dovşan arpası)**

**5.4 Fig. 18 *Aegilops cylindrica* (İstivanəvi buğdayıot)**

### To 3.1.6 Taller grasses (=perennials)

**5.4 Fig. 19 *Festuca ovina* agg. (Qoyun topal)**

**5.4 Fig. 20 *Stipa caspica* (Xəzər şiyavı)**

### 3.1.7 Scattered vegetation (cover < 20 %)

**5.4 Fig. 21 Strongly eroded slope with less than 20 % vegetation cover, i.e. scattered vegetation**

## To 3.4 Grazing indicator species groups (unpalatable plants)

### To 3.4.1 Thistles

**5.4 Fig. 22 *Carduus cinereus* (Bozak Şeytan qanqalı)**

**5.4 Fig. 23 *Carduus sp.* (Şeytan qanqalı)**

### To 3.4.2 Other thorny plants

**5.4 Fig. 24 *Stachys fruticulosa* (Polug kolcugvari)**

**Fig. 25 Astracantha microcephala (Astrakant xırdagantəpər),**

**source: http://commons.hortipedia.com/wiki/File:Astragalus_microcephalus_PDB.jpg**

**5.4 Fig. 26 *Alhagi pseudalhagi* (Adi yağtikan),**
**source: A. Gaziev, http://www.plantarium.ru/page/image/id/1669.html**

***Fig. 27 Centaurea solstitialis (Günəbaxanvari güləvər)***

**source: L. Bartolini, http://www.lucianabartolini.net/Immagini/fiori1/Centaurea-solstitialis.jpg**

**To 3.4.3 Hairy plants**

**5.4 Fig. 28 *Nonea rosea* (Çəhrayı nonneya)**

**5.4 Fig. 29 *Onosma* sp. (Tüklü onosma)**

**5.4 Fig. 30 *Meniocus linifolius* (Kətani yastımeyvə)**

**5.4 Fig. 31 *Teucrium polium* (Ağ məryəmnoxudu)**

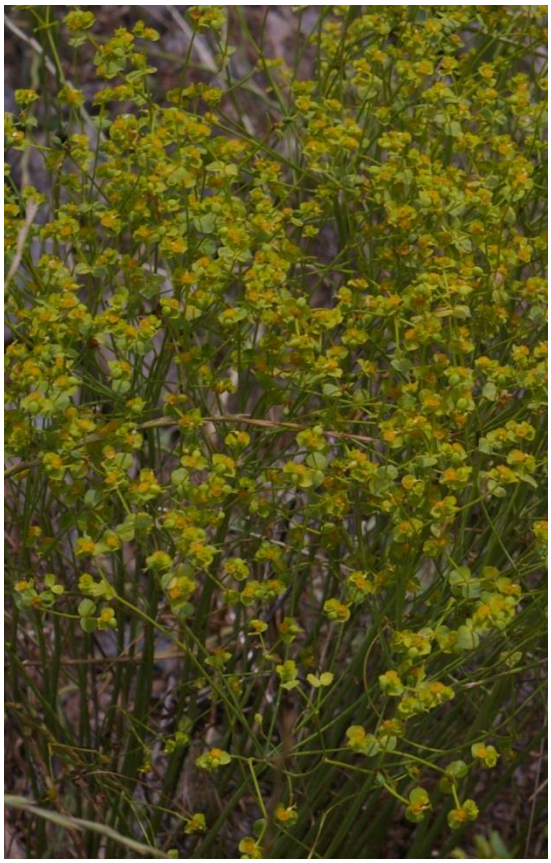
**To 3.4.4 Poisonous and other unpalatable plants (as stated by herders or own knowledge)**

**5.4 Fig. 32 *Adonis binertii* (Binert xoruzgülü)**


***Fig. 33 Peganum harmala* (Üzərrik),**

**source: http://ukhtoma.ru/geobotany/asia03_persia.htm**

**5.4 Fig. 34 *Papaver ocellatum* (Xaşxaş lalə)**



**5.4 Fig. 35 *Euphorbia* sp. (Süddüyan)**

## To 3.5 Valuable plants

### To 3.5.1 Legumes (soft herbs with trifoliate leaves (like clover) or pinnate leaves (like Vicia/vetch)

**5.4 Fig. 36 Onobrychis vaginalis (Esparset)**

**5.4 Fig. 37 Vicia peregrina (Gəlmə lərgə)**

**5.4 Fig. 38 Astragalus cf. psiloglottis (Gəvən)**

**5.4 Fig. 39 Medicago minima (Balaca qarayonca)**

**5.4 Fig. 40 Medicago orbicularis (Girdəpaxlalı qarayonca)**

**5.4 Fig. 41 Trigonella monspeliaca (Güldəfnə)**

**To 3.5.2 Artemisia spp. (semi-shrub up to 40 cm height with strong smell, grey-bluish colour)**

See 5.4 Fig. 3 and 4.

**To 3.5.4 Salsola spp. (semi-shrub up to 70 cm height with succulent salty leaves)**

See 5.4 Fig. 5, 6, 7.

**To 3.5.4 Grasses (Graminoids)**

See 5.4 Fig. 15–20.

**Sources of figures**

If not stated differently in the figure captions, all photographs were taken by Jan Peper. Only the photographs 5.4 Fig. 4, 21, 24, 31 and 35 were taken by Jonathan Etzold.

# 6 Glossary[24] and abbreviations

***Ecosystem**:* An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.

***Evaporation**:* A meteorological term that shows the evaporation of water from free or vacant land or from water areas.

Transpiration: The evaporation of water into the atmosphere from the leaves and stems of plants.

***Evapotranspiration**:* In meteorology called the sum of transpiration and evaporation, so the evaporation of water from plant and animal world and from soil surface. The Evapotranspirations value plays an important role in the hydrological and agricultural and horticultural sector.

***GIS**:* A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. In the simplest terms, GIS is the merging of cartography, statistical analysis, and computer science technology.

***GPS**:* The Global Positioning System (GPS) is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

***Gravitation**:* A natural phenomenon by which all physical bodies attract each other.

***Landscape**:* Comprises the visible features of an area of land, including the physical elements of landforms such as (ice-capped) mountains, hills, water bodies such as rivers, lakes, ponds and the sea, living elements of land cover including indigenous vegetation, human elements including different forms of land use, buildings and structures, and transitory elements such as lighting and weather conditions.

***Phytomass**:* plant biomass, any quantitative estimate of the total mass of plants in a stand, population, or within a given area, at a given time.

***Regeneration**:* In biology, regeneration is the process of renewal, restoration, and growth.

***Tablet** PC:* A tablet computer or simply tablet, is a mobile computer with touch screen.

**Abbreviations:**

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| MU | Management Unit |
| P- | Plots |
| PDI | Pasture Degradation-Index |
| SEI | Susceptibility to Erosion-Index |
| SPI | State of Pasture-Index |
| SU | Sheep Unit |
| TRMI | Topographic Relative Moisture Index |

[24] Definitions after http://www.wikipedia.org/