

RANGELAND MANAGEMENT



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1. Rangelands and the Importance of Preventing Degradation

Introduction:

Since ancient times, humans have relied on natural resources to escape the scarcity of food in the face of increasing populations, seeking solutions to these challenges. This solution involved the proper and increased use of natural resources and their conservation. Initially, humans used wild forage, and over time, they gradually began domesticating wild plants for food. Later, they learned how to domesticate animals and use their products. As a result of their evolving knowledge, they began domesticating animals, leading to the need for pastures. Given the importance of pastures in providing food for animals and soil conservation, it is crucial to give more attention to them than has been done so far.

Today, the pastures and rangelands of the country are facing degradation due to overgrazing, excessive grazing, failure to respect grazing capacity, and the imbalance between the number of animals and the amount of forage produced. Without proper management, these areas do not allow for natural regeneration and growth of pasture plants. As a result, valuable forage plants diminish while the number of undesirable and non-palatable plants increases. In many cases, pastures may become dominated by plants that are either non-palatable or even toxic, causing damage and losses to livestock.

Thus, pastures play an important role in preventing soil degradation. The only way to control soil erosion in pastures is through proper management. Areas that have been eroded by rain or floods over several years can be restored through planting trees or shrubs, preventing further degradation. Therefore, farmers and livestock owners should ensure that pastures, as a national resource, are not used continuously for grazing, as this leads to the destruction of forage vegetation. Additionally, farmers should avoid cultivating pastureland, as this contributes significantly to the degradation of pastures.

Definition of Pasture:

Pasture is a natural resource essential to life and social and economic development of villages & households:

Pastures provide:

- Food for livestock
- Water
- Fuel source for heating and cooking
- Medical Plants
- Natural protection against flood

A pasture is land that, for at least part of the year, has a cover of wild plants. Therefore, in our country, any land or territory that has even a minimal amount of vegetation that animals can graze on during part of the year is considered a pasture.

2. Impact of Natural Cycles on Rangeland Quality

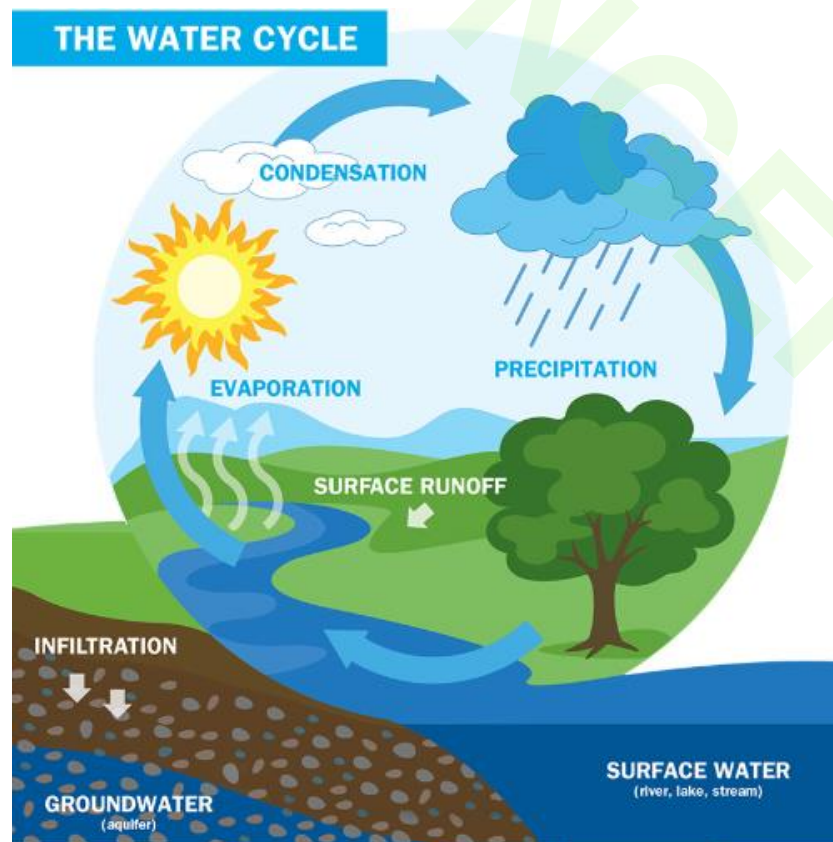
In the past pastures were abundant and provided enough for humans and livestock needs.

The productivity of pastures depends on how humans use them.

If we clear all the plants for fodder and fuel, the plants cannot spread seed to grow again. The bare soil will become hard and dry and the springs will dry up because the rain and snow cannot soak in.

The quality of rangelands is a direct result of how well the water cycle, mineral cycle, and solar energy flows are functioning. These constant processes drive all of life processes and can flow in a direction that supports more life and increasingly productive ecosystems, OR by human actions can be degraded and flow in a direction that leads to decreasing productivity and death.

The Water Cycle:



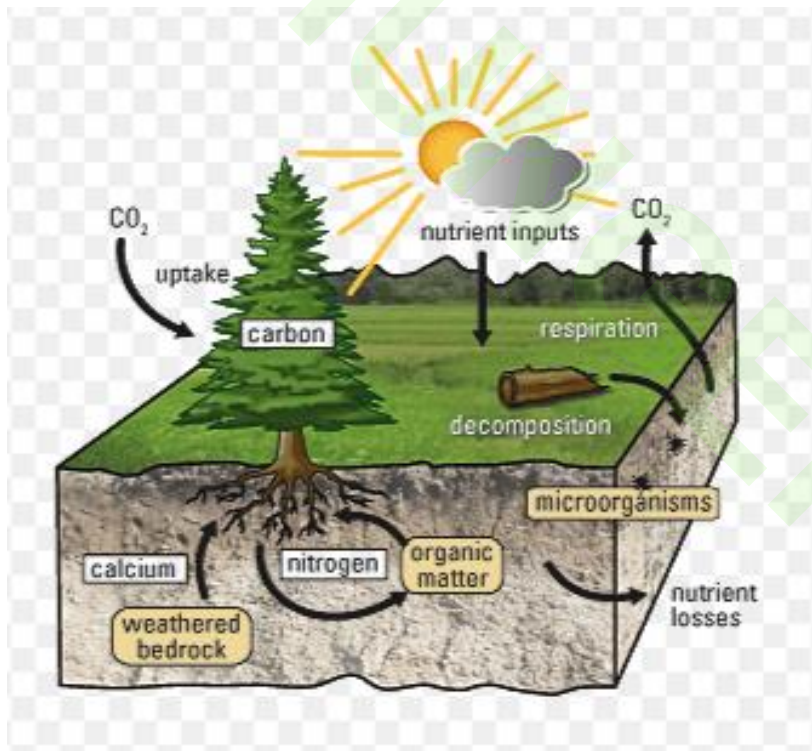
Examples of negative cycle: The water cycle is broken when the rangelands are overgrazed and the soil is left bare and becomes dry. Dry soil creates a barrier, not allowing the rainfall and snow melt to soak into the soil or re-charge the springs and groundwater. This reduces the amount of vegetation that can grow.

Clearing trees and shrubs reduces the amount of moisture transpired, which reduces the amount of moisture in the atmosphere for rainfall. As rainfall reduces, the amount of water in rivers and lakes

become less, reducing the amount of evaporation, which further reduces the amount of moisture in the atmosphere for rainfall, resulting in cycles of drought.

Actions to create a positive cycle: The water cycle can be improved by creating contour swales and allowing more vegetation to grow so that water can soak into the soil. This will recharge the ground water and keep springs flowing, which will allow more plants to grow. As more plants grow, there will be more transpiration, increasing the amount of moisture in the atmosphere for rainfall, resulting in more rainfall.

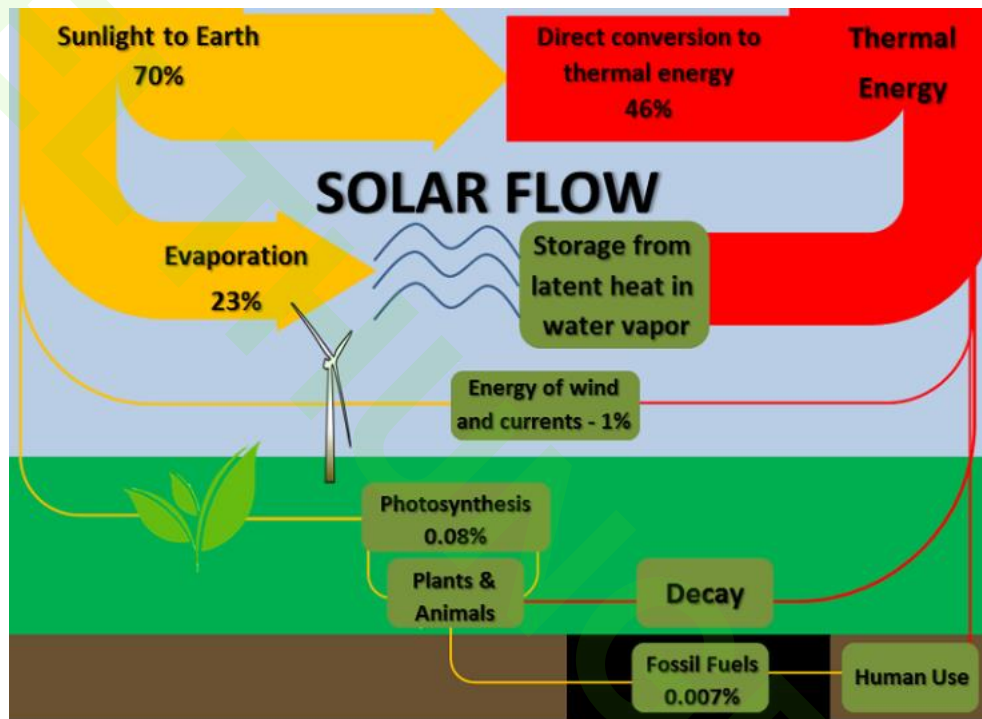
The Nutrient Cycle:



Examples of negative cycle: The nutrient cycle is broken when the animal manure is used for burning instead of for fertilizing the soil. Collecting all the fire wood, clearing all the shrubs from the roots and over grazing also reduces the flow of nutrients in the soil resulting in low soil fertility. As soil fertility decreases, less variety of plants are able to grow, and they grow to a smaller size, meaning there is less for animals to eat and humans to collect.

Actions to create a positive cycle: The flow of nutrients and fertility of the rangelands can be increased by leaving animal manure in the field, not clearing vegetation, adding organic matter to the soil and allowing a wide diversity of plants to grow in the rangelands.

Solar Energy Flow



The amount of sunlight reaching the earth and amount of evaporation is not within human control. However, these processes can be experienced as positive or devastating depending on the quality of the rangeland.

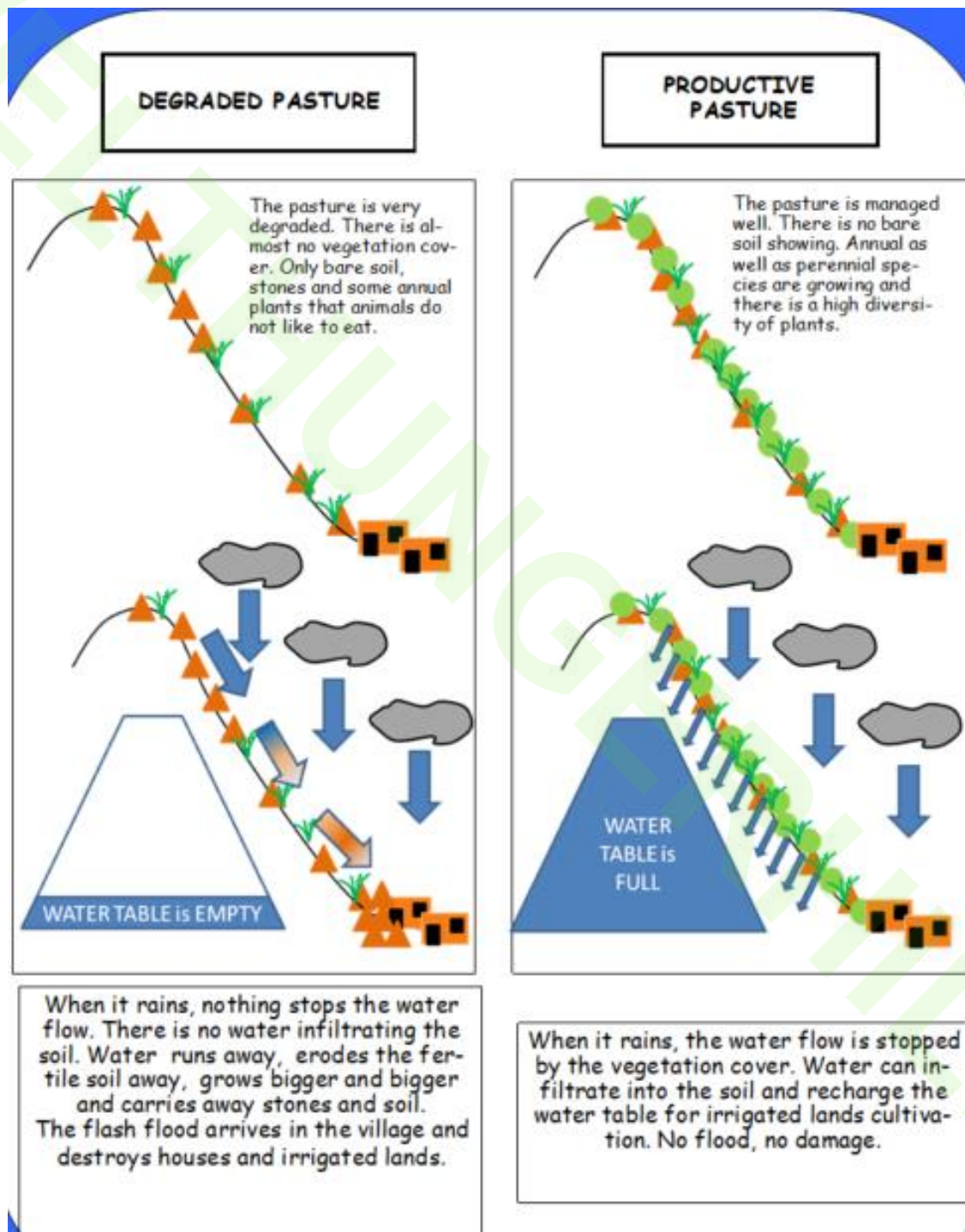
Examples of negative cycle: if there are few trees or plants to cover the soil, then the sun can make the soil very hot, the wind created by temperature differences can become very strong, increasing the evaporation and making the environment even more challenging for plants to grow.

The flow of solar energy is the primary driver of photosynthesis in plants, which directly impacts pasture growth. Plants capture sunlight through their leaves, converting it into energy that supports growth. If

Actions to create a positive cycle: Allowing more plants to grow and planting diverse crops, uses the solar energy for positive outcome and reduces the temperature of the soil, and the creates protection from wind. Implementing rotational grazing ensures plants can fully utilize solar energy for photosynthesis, allowing for optimal pasture growth without degradation.

3. Pasture Degradation

Based on an understanding of the natural cycles that drive all life processes, it is clear how a healthy pasture can quickly become degraded. However, with change in how humans use the rangelands, and good management practices, degraded pastures can also become productive again.



The main factors of soil degradation in rangelands can be classified into two categories:

A. Natural Factors: Heavy rainfall and strong winds can be major natural causes of soil degradation in rangelands. Very steep slopes and low fertility soil where only a few species of plants are able to grow also make it easier for a natural environment to become degraded.

B. Non-Natural Factors: Human interference in disrupting the ecosystem has left unforgettable consequences, such as overgrazing over clearing and lalmi practices. These have resulted in low plant density in rangelands (bare soil), low plant diversity and an increase in toxic plants, soil erosion, drying springs, drying rivers and floods.

Rangeland's vegetative cover plays a critical role in soil conservation and water retention. Wherever there is dense vegetation or rich pastures, soil erosion caused by water or wind is less likely to occur or does not happen at all. During heavy rains, floods are less frequent. Vegetative cover helps more water penetrate the ground, reducing surface runoff and wastage and recharging spring flow and groundwater. In summary, it controls surface water, allowing it to infiltrate the soil and increase groundwater levels.

4. Causes of Rangeland Degradation

Agricultural causes

- *Crop residue is not used efficiently.*
Removing crop residue for animal feed or for sale removes it from the nutrient cycle, reducing soil fertility.
- *Forage production is not well integrated into crop rotation on irrigated land.*
People rely on the 'mountains' and are not planting the borders of their irrigated land with forage crops to increase the amount of fodder available and maximize the use of their irrigation water.
- *Rainfed forage production is not practiced.*
People rely on the 'mountains' and keep taking, without putting anything back.
- *Not using enough manure.*
Chemical fertilizers feed the plant, but kills the soil in the long term. Chemical fertilizers are a short term solution. Animal manure feeds the soil so it can feed the plants and increases soil productivity long term.
- *Conversion of rangelands into rainfed crop production areas (lalmi).*
This reduces the area of land for grazing, it takes a very long time for the pasture plants to grow again, and ploughing on slopes usually causes erosion.
- *Soil fertility.*
Crop residue is removed, animal manure is removed, shrubs and their roots are removed – resulting on low soil fertility and a change in the types of plants that grow from ones that are nutritious for animals, to ones that can grow in low soil fertility conditions and have low nutrition or are toxic to animals.

Environmental causes

These are all signs that the water cycle is going in a negative way:

- *Reduction of rainfall.*
Rainfall is reduced as the amount of vegetation is reduced.
- *Low level of water table.*

Water table is not being recharged because the pastures are degraded and there is bare soil forming a barrier to water soaking into the soil.

- *Impact of severe drought.*
Drought cannot be controlled by the farmer, but the drought situation makes everything that is already happening, worse.
- *High runoff.*
Bare soil is not protected by plants, so the raindrops break it up and wash it away. The situation is worse on sloped land.
- *Wind and water erosion.*
Bare soil is not protected by plants, so the wind can blow it away and water flow can wash it away.
- *No anti erosion measures.*
No swales, stones or plough lines on contour, and not enough plants to slow the speed of water flow down the slope.

Livestock causes

- *Overgrazing around the villages.*
Rotational grazing is not practiced, so pastures close to the villages are completely degraded.
- *Not enough forage production.*
Farmers rely on the 'mountains' to feed their animals instead of growing fodder crops to supplement their feed.
- *Collection of winter fodder.*
Whatever plants the animals did not eat in summer, the farmers collect for winter – leaving the soil completely bare in winter.
- *Too high number of animals.*
Every farmer tries to have as many animals as he can, meaning the number of animals is higher than the amount of pasture feed available.
- *Lack of knowledge in livestock management*
Unhealthy animals are a waste of resources as they do not produce a high quantity of good product. Livestock that is well managed, and improved breeds of animals would have higher productivity on the same amount of feed.
- *Livestock is only available savings mechanism.*
This means that farmers try and keep as many animals as they can, even if it means they are destroying the rangeland in the long term.

Household practices

- *Inefficient technology for cooking and heating.*
Inefficient use of fuel means that people have to collect more than is actually needed.
- *Over exploitation and uprooting of plants for fuel (heating and cooking).*
Peoples need for fuel is higher than what the rangelands can produce.
- *Use of dung for cooking and heating.*
This is dung that could be providing soil fertility for better pasture growth.

- *Over harvesting of food and medicinal plants.*

Over harvesting means that not enough plants are left to spread their seed so that the plant can grow again next year.

- *No re-seedling process.*

Communities think that because they have always collected from the mountains without giving anything in return, that they can continue to do this. The truth is that humans have collected so much from the rangelands for so many years, that they must start giving something back to the rangelands. This includes raising and planting out seedlings.

Social causes

- *No knowledge of and no awareness for resource protection and management.*

Cultural beliefs that 'the mountains will provide' leads to poor management and overuse. This belief needs to be challenged to show that humans need to work together, set limits to what they take and work to replace what they take.

- *Food insecurity.*

Degraded soil and rangelands result in less availability of wild foods and lower productivity of livestock, contributing to food insecurity.

- *Lack of community coherence and action*

Every livestock owner and user of the rangelands must agree to the proposed changes in how rangelands are managed, otherwise, any improvements in productivity will be taken by the next person.

- *No communal land titles or usage rights.*

Lack of clear land ownership rules makes communal management very difficult.

Signs of overgrazing

Overgrazing happens when animals eat vegetation more quickly than it can regrow. Recognizing when overgrazing is happening, and moving animals on to new grazing areas is crucial to prevent damage to pastureland. Here are some key indicators that a plant or pasture might have been overgrazed:

1. Reduced Plant Growth

- **Short and sparse vegetation:** One of the most obvious signs of overgrazing is the presence of very short, sparse grass or other pasture plants. If animals are consuming plants faster than they can grow back, there will be bare patches in the field, and the vegetation will appear stunted.
- **Weak root systems:** Overgrazing can weaken the root system of plants, as the plants are not allowed to grow and strengthen. This makes the plants more vulnerable to drought and other stresses.

2. Bare Soil or Erosion

- **Exposed soil:** When grazing pressure is too high, plants are unable to regrow, leading to bare ground. Without vegetation to protect it, the soil erodes more easily, especially in windy or rainy conditions.

- Soil compaction: Overgrazing can lead to compaction of the soil, especially if livestock are frequently concentrated in certain areas. Compacted soil restricts water infiltration and root growth, further damaging the pasture.

3. Weed and Invasive Plant Growth

- Weed encroachment: Overgrazing opens up space for weeds and invasive species to take root. These plants typically have lower nutritional value and can further reduce the quality of the pasture for livestock.
- Changes in plant composition: If you notice that the pasture is dominated by less nutritious plants, such as woody shrubs, toxic plants or weeds, it may be a sign that the forage plants (grasses and legumes) that animals prefer are being overgrazed.

4. Poor Animal Health

- Reduced weight gain or poor milk production: Livestock are often affected by overgrazing. If you notice a decline in weight gain, milk production, or overall health in your animals, it could be due to a lack of nutritious pasture.
- Animals searching for more: When pasture quality declines due to overgrazing, animals may begin searching for additional food sources (like browsing on shrubs or moving into nearby fields), which indicates that the pasture is no longer able to meet their needs.

5. Visible Signs of Stress on Plants

- Decreased leaf size: Overgrazed plants often show reduced leaf size, which limits their ability to photosynthesize. Over time, this stress can weaken plants and reduce pasture productivity.
- Regrowth issues: If plants are not producing new shoots or leaves after grazing, it's a sign they are being grazed too frequently or too intensely, not allowing the plants to recover.

6. Loss of Desired Species

- Decline in pasture species: Overgrazing can result in a shift away from desirable pasture species (such as grasses or legumes) to less nutritious or more hardy species that tolerate heavy grazing. If you notice a decline in the types of plants you originally planted, it may be a result of overgrazing.

5. Summary of Solutions for Productive Rangelands

The rangelands have become degraded from many decades of overgrazing and overuse, so it will take many approaches and several years to change the rangeland function from a negative cycle to a positive one.

Changes in practice need to be made in a range of areas:

Change and improve crop cultivation and breeding habits

- *Limit lalmi cultivation by intensifying irrigated land and developing livestock as income generating activities.*
- *Introduce new exotic/indigenous and perennial species to improve soil structure and fertility, to cover the soil and supply fuel wood.*
- *Improve soil organic matter by leaving manure and crop aftermaths on the ground.*
- *Plan grazing as a community. Agree not to graze very steep slopes. Agree to only graze certain areas after seed production. Extend the grazing area. Not only graze around the villages, but*

also graze in further areas to limit overgrazing.

- *Develop winter forage crops in irrigated land in order to reduce pasture fodder harvesting.*

Find and use alternative heating and cooking sources

- *Establish Passive Solar Houses to heat houses, to reduce fuel consumption, to reduce children winter diseases and to develop other income generating activities inside.*
- *Solar Ovens can be used during the spring and summer to heat water and cook. Low fuel stoves can be used.*
- *Plant Non fruit trees and fodder shrubs along the water channels, near springs and around the reservoirs to harvest as fodder and fuel wood.*

Limit and change the bad pasture practices

- *Stop pulling out plants from the roots, instead cut shrubs and grasses at the base*
- *If the roots are still present, the plant can grow again. It is important not to uproot or to graze the roots*

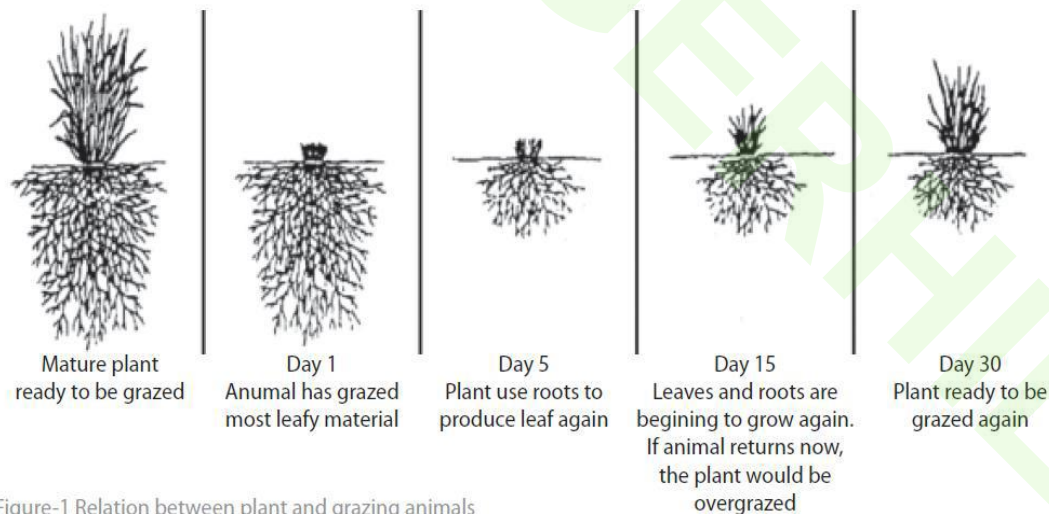


Figure-1 Relation between plant and grazing animals

The picture shows how a grass plant uses its energy to re-grow when the top is cut or grazed.

It is important to wait 30 days in between allowing plants to be grazed so they have time to recover. To achieve this:

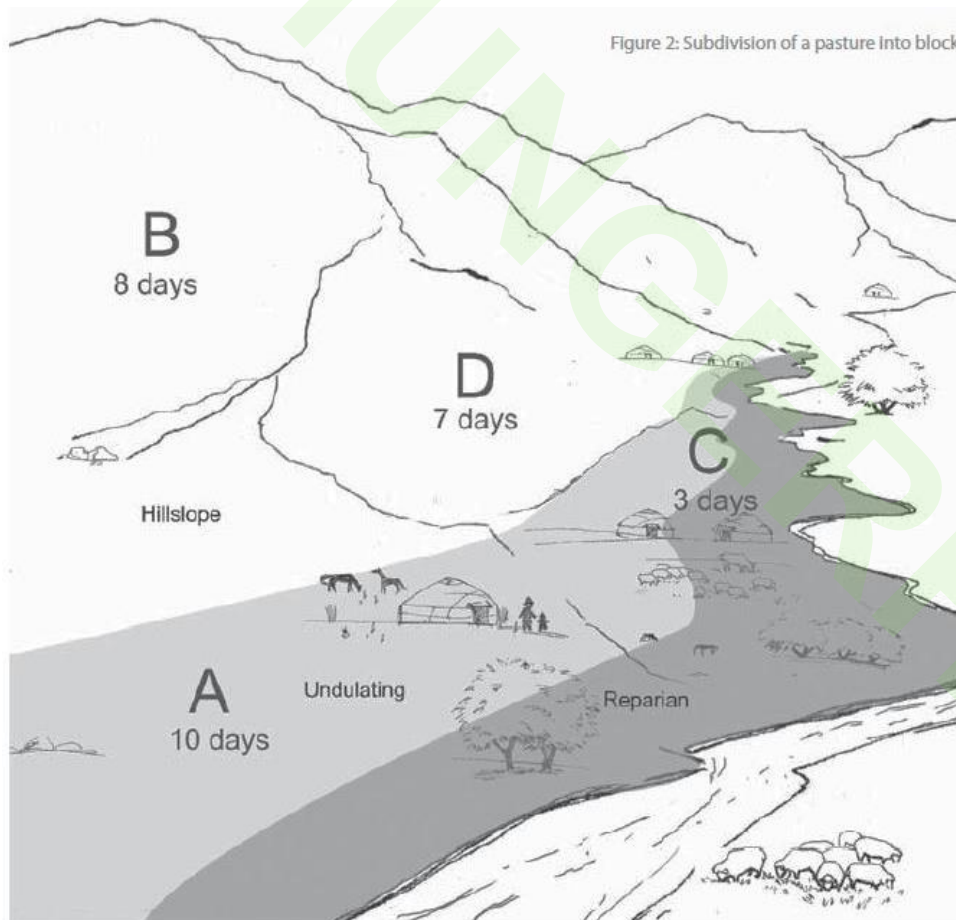
- *Focus grazing in one area for several days before moving on. Wait enough time before grazing again so the grasses have time to regenerate.*

Other ways to prevent overgrazing (Outlined in detail in Section 7) include:

- **Rotational grazing:** Divide the available rangeland into grazing 'areas'. Rotate animals between different pasture areas to allow plants time to recover.

- Set grazing limits: If possible, limit the number of animals per unit of pasture (stocking rate) to prevent excessive grazing pressure.
- Monitor pasture health: Regularly assess your pasture's condition, noting any signs of overgrazing or areas where plants are struggling to regenerate.

In the picture below, the available rangeland has been divided into 4 areas with a different number (A 10 days, B 8 days, C 3 days and D 7 days). If livestock graze in these areas for the selected number of days, it will be almost 30 days before they come back to graze the same place, allowing the plants time to recover and regrow.



- *Collect seeds and re-seed the most degraded pastures with convenient species*

Collect seeds of the best plants in the pasture:

- *Best seeds quality*
Look for plants that have large, even colored seeds with no disease or damage.
- *Healthiest plant condition (disease, size)*

Only collect seeds from the plants that have positive characteristics. Eg. animals like to eat them, fast growing, large, no diseases, are not attacked by insects.

- *Density*

Collect seeds from areas where there is a high density of the plant growing and plant them where there is low density.

Spread the seeds in degraded pasture areas at the right time (before winter).

Let it grow again! Avoid grazing the area from the moment the seeds are spread until the plants have grown up to the right size. This will take approximately 30 days.

Agree with all livestock owners to protect some areas from grazing until after the seeds have matured.

Advised species for reseeding:

- *Ghigo*
- *Legumes such as: Zard Gul Chadak, Zard Gul Pashmak, Zard Gul Turbak, Local Alfalfa and French Alfalfa*
- *Chadak, Pali*

6. The Impact of Forage Crops and Shrubs in Preventing Soil Degradation

Forage crops such as Ghigo, legumes such as: Zard Gul Chadak, Zard Gul Pashmak, Zard Gul Turbak, Local Alfalfa and French Alfalfa, Chadak, Pali, and shrubs and trees suitable for animals to eat such as mulberry and atriplex play an essential role in maintaining rangeland conditions. Their effectiveness depends on the climate, environmental conditions, and the density and nature of the forage cover, which can have positive or negative effects.

Alfalfa

Alfalfa – both rainfed and irrigated varieties are widely used and unmatched by other forages. It is a nutritious staple for livestock and, in addition, can benefit poultry, especially by laying hens.

Rangelands dominated by alfalfa often suffer from trampling and grazing damage, particularly when the plants are overgrown. To prevent damage, rangelands should be managed by keeping the plants short. Overgrazing should be strictly avoided.

Soil studies have emphasized the use of vegetative cover to protect soil in rangelands. y

Key considerations for grazing alfalfa fields

1. **Avoid grazing when animals are very hungry:** Animals should not graze on fresh alfalfa fields when extremely hungry.
2. **Feed dry forage before grazing:** Animals should be fed with dry forage before entering the grazing area.

3. **Provide water and salt nearby:** Water and salt should always be available near or within the grazing area.

7. Sustainable Management and Proper Use of Rangelands and Pastures

Rotational Use of Different Sections of Pastures and Grasslands

Rotational grazing is a method where a livestock owner divides the available rangeland into sections and moves the herd from one section to another every few days. The main advantage of this approach is that it allows the livestock owner to provide their animals with healthy, nutritious forage and ensure an adequate supply for feeding. This method is commonly practiced in advanced livestock farming countries, where they also use proper fencing to divide the pastures into sections.

By rotating grazing areas, the pasture has time to recover and regenerate, which helps maintain the health of the land and the animals.

Other benefits of rotational grazing for achieving sustainable management and proper use of rangelands and pastures include:

1. Financial Benefits:

One of the most significant advantages of using rangelands efficiently is the reduction in the costs associated with feeding livestock such as cattle, sheep, and goats. When these rangelands are used optimally, the management of feeding costs becomes more effective. By planning and managing the rangelands properly, this goal can be better achieved. Additionally, dividing the rangelands into sections allows plants to have sufficient time to regrow, especially in the spring season, after each grazing cycle.

2. Environmental Effects:

Unfortunately, newly sprouted plants like grasses and clovers can sometimes cause digestive issues for livestock. This problem may arise occasionally. Moreover, when animals are allowed to graze without control, they tend to consume the most desirable and palatable forages first (depending on the type of livestock, these forages may vary). As a result, the animals will overgraze certain sections of the pasture while leaving other sections untouched.

Generally, sheep, goats, and cattle tend to move towards areas with more palatable forage. This excessive consumption prevents plants from having the opportunity to regrow. If this cycle continues unchecked, it can lead to the degradation of the plant cover, particularly the more palatable species. If you are unaware of this issue, you might try to boost the pasture with fertilizers and other

chemicals, but this approach is typically ineffective, as the vegetation has already suffered significant damage.

3. Help Maintain Herd Health:

Proper rotational grazing generally does not result in harm and can be beneficial, especially during certain seasons. When livestock such as sheep, cattle, and goats are kept in one location permanently, the likelihood of disease and parasitic infestations increases. These problems are particularly common in the spring and summer months, when humidity and temperatures rise significantly.

It is important to note that livestock, especially when grazing excessively on fresh plants, may develop various diseases, including parasitic infections. While these issues are somewhat natural due to the anatomy of these animals, it is rare to find an animal that will not develop some parasitic load even under ideal conditions.

By creating time intervals for rest between grazing cycles, the pastures have time to recover. This rest period helps reduce the growth of parasites in the animals' bodies and slows down the rate at which these parasites are transmitted to the herd.

Planning for Sustainable Management and Proper Use of Rangelands and Pastures through Rotational Grazing:

Proper planning is essential for the sustainable management of rangelands. Using a rotational grazing system requires careful organization of grazing periods to ensure that each section of the pasture has time to recover and regenerate. This system helps balance the pasture's health and the nutritional needs of livestock.

To achieve effective management, consider the following steps:

- a. **Divide the Rangeland into Sections:** Divide the land into different sections to allow proper rotation. Ensure that each section has enough forage to meet the livestock's needs while also giving plants enough time to recover.
- b. **Set Grazing and Rest Periods:** Establish a clear schedule for grazing and resting each section. The length of time livestock spends grazing and the length of rest for each section should depend on seasonal conditions, plant growth rates, and livestock needs.
- c. **Monitor Pasture Health:** Regularly check the condition of the pastures to ensure that the rotation system is working. Watch for overgrazing signs and adjust the grazing schedule if needed.

This approach helps maintain pasture health, reduces environmental degradation, and improves the overall welfare of the livestock.

Identify the Type of Livestock You Plan to Graze:

The first step in this planning process is to determine the nutritional needs of each type of livestock you intend to raise. Creating a rotational grazing plan that works for different livestock types can be challenging and generally requires the expertise of a nutritionist to develop such a program.

You need to consider factors like the breed of the animal, the size of the herd, and the type of land. Other factors to consider include the type of forage and the climate of your geographical area. If you have several types of livestock in your herd, you can assign a coefficient to each based on its specific characteristics, and then partition your grazing land according to the total of these coefficients.

For example, you can use the following coefficients:

- One 450 kg adult dairy cow: 1 animal unit
- One 900 kg adult dairy cow: 1.7 animal units
- One 60 kg ewe: 0.17 animal units
- One 136 kg ram: 0.42 animal units

Decide How Much Grazing Land You Will Need:

Once you know the type and number of animal units you plan to raise in the pasture, you can calculate their forage needs based on the number of hectares of pastureland available. It's better to make these calculations before starting any work.

The key point here is that during the spring season, when grazing typically begins in many regions, the amount of vegetation available in the pastures will depend on several factors, including:

- Soil characteristics
- Amount of rainfall
- Geographic climate
- Fertilization
- Plant species
- And more...

You should decide on the breeds of livestock you plan to graze and the types of plants you wish to grow for their nutrition. Keep in mind that certain plants are suitable for specific animals, and what may be suitable for feeding cattle may not be appropriate for goats.

Take some time to research the nutritional needs of each livestock species you have.

Divide the Grazing Area:

After gathering the information mentioned above, it's time to divide the pasture and grazing area into smaller sections. In countries with advanced livestock farming industries, this is typically done with great precision, and sometimes, even fencing is used for the division of pastures.



Fencing

The number of panels or fences required depends on the number of animals and how many days you want to keep them in a specific section. The duration for which the animals should stay in a section can vary based on the time of year and the climate of your area. For example, a flock of sheep may stay in one section twice as long as a flock of goats under the same grazing conditions. As mentioned earlier, the main goal of rotational grazing is to preserve the vegetation cover of the pastures.

It's important to note that the growth of your pastures is primarily affected by soil fertility and seasonal rainfall. However, considering rest periods for each section of the pasture will help maintain the vegetation cover.

Choose the Appropriate Fences:

Selecting the right fence to prevent animals from escaping the designated area is crucial. Since grazing areas are often large, the importance of using appropriate fencing becomes even greater. Today, there are electric fences and other types of fencing designed for sustainable pasture management, which you can consider using if possible.

Another important factor is the availability of adequate water in the subdivided grazing areas. Having sufficient clean water for livestock is very important. Additionally, you may need to adjust the pre-prepared grazing plan. This is because sometimes, due to calculation errors, you may not reach the desired results. Therefore, it's recommended to revise the area measurements and overall grazing management plan.

Special Considerations for Each Type of Livestock

Sheep: Sheep should typically be moved between sections of the pasture according to a regular schedule. The frequency of movement depends on the breed of the sheep, the vegetation cover of the pasture, and the sheep's feed conversion rate.

Goats: Goats can consume a variety of plants, including weeds, leaves, shrubs, and more, which they can digest more easily than other animals. You may be able to keep goats in each section of the pasture for a longer period than sheep. However, like with sheep, it's important to consider parasite load and other factors.

Cattle: Although cows are not the only milk-producing animals, special attention is needed when grazing dairy cows. Farmers aiming to increase the milk production of their herd must pay close attention to the quality of the forage that these animals consume. Therefore, it may be necessary to keep them in each section of the pasture for shorter periods. Another aspect of cattle grazing is the use of supplemental feeds. These supplements help better meet the nutritional needs of dairy cows.



8. Care and Preservation of Pastures:

Most of the pastures that have turned into unusable land and deserts today were once covered with various plants. However, over time, their vegetation cover has been lost. Overgrazing (especially at the wrong times) and ignoring the grazing capacity, particularly in recent years, have been the primary causes of the destruction of vegetation and the transformation of pastures into barren land.

In addition to overgrazing, other factors such as the implementation of improper farming methods, the unbalanced use of land in watershed areas, the collection of plants from natural pastures for fuel in certain regions, and the washing away of land due to severe floods have contributed to the destruction of vegetation. As a result of this vegetation loss, the topsoil becomes vulnerable to erosion by wind and water, and once the topsoil is lost—which is one of the most important natural resources—it becomes difficult for plants to grow in eroded lands.

It is estimated that in optimal environmental conditions, it takes about 100 years to form 2.5 cm of topsoil. In dry, low-water regions like southern Iran, where strong winds and moving sand dunes are common, this process may take more than a century.

Although the regeneration of vegetation and the restoration of degraded pastures is essential and unavoidable, it is more logical to first prevent and stop the factors causing the destruction of vegetation and the resulting soil erosion in the pastures. Unfortunately, the damage done to pasture vegetation in Iran is often blamed on the nomadic tribes of the country, who are wrongly seen as the direct cause of pasture degradation. Contrary to this belief, it must be acknowledged that the nomads and tribes of Iran have thousands of years of experience and are well aware of how to protect pastures and make the best use of the existing vegetation.

They plan their movements and migrations based on very precise principles. In practice, they allocate certain pastures for unsuitable seasons and leave others before overgrazing occurs. Additionally, the movement of nomads is either fast or slow depending on the quality or scarcity of vegetation, and

before making any decisions, a member of the tribe is sent to assess the quality of pastures, even in distant areas, to predict the condition for grazing.

In fact, the grazing and sheep farming activities among the nomads and tribes are carried out systematically, with sheep being distributed and gathered according to the availability of forage resources. In other words, all these activities serve as a form of natural pasture management and protection. Perhaps the nomadic method is the only correct approach that aligns with the diverse climatic conditions and the use of forage resources in the difficult terrains of the country. Rather than imposing forced and unscientific changes to their sheep farming practices, it is better to learn from their extended experiences in pasture management, while addressing the causes of their challenges and finding solutions.

How Many Sheep Per Hectare Should Be Raised?

One of the most common questions asked by farmers due to overgrazing and the weakening of vegetation cover is how many sheep can be raised per hectare of pasture. The answer depends on various factors, which we will examine below.

One of the most important determining factors is the climate of the geographical region where your pasture is located. In areas with adequate rainfall and fertile soils, pastures have more vegetation and grasses, which can meet the nutritional needs of a larger number of sheep. The speed and timing of plant growth also directly affect this.

However, in regions with a moderate climate, you can generally consider about 20 ewes and 25 lambs per hectare of pasture, provided that rotational grazing is properly implemented by the farmer. Rotational grazing allows sheep to graze well in each designated area of the pasture, and then they are moved to a new section before they can damage the roots of the grasses.



Some experts argue that if traditional methods are used for sheep farming and the forage reserves of the pasture are properly managed, you can roughly plan for 100 ewes and 150 lambs per 12 hectares throughout the year. In this system, it is better to divide the entire pasture into three 4-hectare sections, if possible.

Other Influencing Factors Include:

Size or body mass of the sheep: Smaller sheep usually consume less forage, so you might be able to graze a larger number of sheep per hectare of pasture.

Daily grazing duration: Sheep in colder climates may graze for longer periods compared to sheep in tropical regions because they need more energy to cope with the cold.

Topography of the grazing land: If the pastures are flat and accessible to fresh water, your sheep may perform more efficiently than those grazing in uneven, hilly areas with limited access to water.

Assessing the Forage of Pastures and Grazing Areas:

Sheep are grazing and ruminating animals, and they will eat nearly any grass or plant present in the pasture. It is advisable to assess the quality and type of forage in the pastures before bringing your flock to graze. This will help you better understand the vegetation cover, which may vary in quality each year due to different rainfall conditions, and identify any toxic plants or other hazards, so you can prevent potential harm.

Final Note on Sustainable Management and Proper Use of Pastures:

Regardless, if you are using natural pastures for feeding the livestock you are raising, if you cannot make the best use of the most nutritious plants, you will not achieve good results in increasing livestock product output. Overuse of these natural resources could lead to the destruction of vegetation in those areas.

If you are unable to follow all the guidelines, at the very least, ensure that your livestock does not consume all the plants in one section of the pasture. Allow access only until the vegetation cover is halved. Failure to do so may result in the complete loss of the pasture vegetation, leading to various challenges in livestock farming soon.

10. Range Management and Livestock Grazing During Drought

Drought is a normal and constant part of the rangeland environment. It is not a matter of whether a drought will occur, but when and how severe it will be. Farmers who are aware of the need to prepare for enduring and quickly recovering from drought will ensure the success of passing through this phase. However, the drought cycle is unpredictable.

There is no specific formula for drought management. Good rangeland management is drought management. There is no quick fix for overgrazing.

A fundamental understanding of the potential capabilities and limitations of all livestock production resources is key to proper management. High plant vitality and sensitive rangeland conditions are critical for rapid drought tolerance and recovery. Recognizing this is equally important for optimizing livestock performance and minimizing the risk of potential hazards. Drought considerations must align with plant management every year.

Guidelines for Drought Management in Rangelands and Grazing Areas:

Drought is generally defined as a prolonged period in which annual precipitation is less than 75% of the average. According to this definition, a drought occurred with only 21% of the average annual rainfall in the vast northern plains in 1940 (Holechek et al., 1989). Poorly distributed rainfall in a single year or consecutive years of below-average rainfall can also lead to drought.

Drought is a key factor in rangeland management. Each year, rangeland vegetation may either be in a recovery phase or affected by drought. While drought has long-term impacts, recovery and improvement is a slow process. Management strategies should aim to either maintain or improve the vigor and energy of plants.

The rate of forage recovery is a crucial tool for grazing management, especially under drought conditions. There is no method for compensating overgrazing, and the recovery rates of unique pastures must be based on target levels for the removal of leaves from key plant species so that the condition of the range can increase the relative drought impact. The most effective drought management strategy is preparation in the years before a drought. The best time to prepare is now.

Drought is always a loss for the livestock industry, especially for ranchers who do not make predictions during wet years. It is essential for farmers to invest in the higher-than-average forage produced in good years, but timely adjustments must align the needs of livestock with the available forage and food resources when a drought occurs. Flexibility in management is necessary for survival. The fundamental goals of drought management include: 1) reducing damage to rangeland resources during and after drought, and 2) minimizing financial losses. Ranchers who meet these goals can invest in extra forage during good years. When farmers make decisions in time, damage to forage and land resources is minimized, and potential profits (income) increase. Farmers can gain valuable insights from past droughts and use them to inform their decisions. Numerous methods for extending drought management are discussed in this article. Timely decisions can prevent damage by reviewing and implementing proper drought management plans. Success lies in viewing drought as a natural event in the livestock production environment, not as a catastrophic event.

Herd Management during Drought

Rotational grazing management is the best way to provide forage during drought. The divisions and transformations of forage stock during a drought:

- a. Optimizing animal performance
- b. Completely reducing the cost of winter feed
- c. Minimizing forage losses
- d. Increasing the regeneration of rangelands and pastures during drought

As soon as there is a shortage or shift in the availability of forage, it becomes predictable because markets begin storing forage from the start of the drought. If there is a forage shortage, additional costs such as feed, labor, and transportation of cows to regions with more feed and forage are added. If calculations show that these expenses are unreasonably high, the producer will stop milking the

calves or, as a precaution, sell part or all the herd. The following strategies can help minimize losses in herd management:

1. **Early Weaning:** Early weaning can increase the basic forage supply. Often, cows are busy nursing their calves, but once this period ends, their condition improves over the long term, and energy efficiency increases. With better cow condition, winter feed requirements decrease, and their potential for rebreeding improves. Typically, weaning calves earlier in mid-September is more beneficial than in mid-October, as it significantly improves the condition of cows. In some cases, weaning calves at 40 to 80 days with proper nutrition is economical. However, feeding weaned calves can be expensive due to their need for higher-quality feed. In Nebraska, a cooperative office has successfully implemented early weaning management for calves.
2. Implementing heavy operations, such as separating animals and separating them from older cows.
3. **Rotational Grazing:** Grazing livestock on pastures with forage shortages on a rotational basis. Proper predictions should prevent keeping animals too long in areas with excess feed unless there is a clear economic justification. It is essential to always have stored feed available to minimize pasture damage.
4. **Replacement Calves:** Attention should be paid to the nutritional needs of replacement heifers during the winter period, unless the average age of cows is high. In such cases, reducing the number of replacement heifers for one to two years is necessary to maintain commercial performance.
5. **Price Forecasting:** The possibility of rising prices for different types of cattle during the breeding season is significant. Accurately forecasting price increases during the breeding season is critical for management decisions.
6. **Keeping 1% of Marketable Cattle:** Retaining 1% of cattle that are easily marketable, such as one-year-old or young animals, provides flexibility. It has been observed that when forage availability is 60-70% of the total animals, from range resources, feed for the herd can be provided for 12 months.

Helping develop and balance forage availability across the year requires programs from the U.S. Soil Conservation Service, forestry services, and cooperative development. Their analysis of plant growth and its responses to drought are part of a management program in Nebraska by local cooperatives. This book explains the fundamentals of how to manage forage reserves and grazing for future drought conditions.

Grazing Behavior of Animals during Drought:

Grazing density relates to the total available forage and the daily consumption of animals based on time. Livestock numbers are adjusted to match the available quantity and quality of forage.

Overgrazing can occur even when the number of animals is low if there is insufficient forage per animal per acre. Therefore, livestock production should be adjusted based on the amount of consumable forage.

If plant growth does not occur, the available forage will decrease. As a result, animals tend to consume the higher-quality forage first, leading to a reduction in both the quantity and quality of forage during a drought period. Plant growth is typically slower during a drought, and this impacts the growth rate of animals (as shown in Table 5). A reduction in forage quality occurs when plants mature, and during drought periods, fat reserves in cows may be depleted as they rely more on milk production for calves.

Differences between tall and short grasses also impact livestock performance. Under optimal conditions, a pasture can support about 600 to 700 animal unit days per acre. By the end of the season, the remaining forage will be primarily stems, and weaker plants will struggle to survive, especially against erosion or strong winds. The rate of plant growth is crucial to animal performance. When the available forage does not meet the nutritional needs of the animals, it can lead to reduced milk production. Additionally, the weight of animals is closely linked to their maturity. Delayed calf growth prolongs grazing periods and delays the replacement of heifers. Malnutrition, in turn, negatively impacts pregnancy rates and can lead to fewer beef calves being produced.

Early weaning is one of the most effective management practices to maintain reproductive performance under nutritional stress. Drought can significantly reduce the available forage for livestock, but high-quality forage is often available early in the growing season. By mid-season, many plants may no longer be suitable for grazing. Overall, it is important to finish grazing by September to ensure maximum livestock performance during drought conditions.

Food Supplements

Supplements are used to compensate for food deficiencies, improve the ration's ingredients, and enhance its digestibility. Supplements can also be used for livestock. This approach can be effective when the livestock are in poor nutritional conditions. The economic efficiency of supplements increases when there is a quality difference in the available forage. Supplements, considering their price, improve animal performance. Generally, supplements are valuable during the first year of drought because, at this time, the amount of forage drastically decreases, and the role of supplements becomes crucial. It is important to consider the following:

1. What other rotations are available?
2. What type of supplements are needed?
3. How much do they affect animal performance?
4. How much do they affect pasture production?
5. How much will it cost to obtain the required supplements?

The amount of supplements should be such that the livestock still have an appetite for grazing. In figure 6, the appropriate amount of forage is shown. Overgrazing and mechanical damage during drought delay pasture restoration. Supplementing livestock daily with base food supplements, like grain, three to four times a day is crucial, depending on the animal's acceptance of replacements. Once forage reserves are exhausted, livestock should be transferred to smaller grazing areas to

minimize damage. In the diet, protein and energy are two essential factors that require the most attention. If sufficient forage is available but of low quality, a suitable food supplement should be used to compensate for the protein deficiency. Figure 6 shows that this decision is based on the ratio of plant components in the pasture, and the age of the forage is also an important factor. For instance, immature forage contains 12 to 15% less protein in dry matter, and this percentage can drop to 10 during the flowering stage. The protein content of leaves increases most when the plant is in its leaf and stem production stage. Generally, pastures with average forage contain about 4% protein. Another point is that pasture protein should be natural and include suitable nitrogen, so low-quality forage doesn't become its primary feed. When the protein content of the plant is adequate, the digestible forage quality improves, and animal performance also improves. Protein supplements typically provide good results over periods of 2 or 3 weeks. In such cases, supplements have been able to provide additional protein, improve the digestibility of the forage, and increase the energy gained.

However, when can it be said that sufficient forage is available? As long as the livestock consumes the supplemental protein ration, their condition remains optimal. But if the protein is insufficient, energy supplementation will only reduce forage digestibility.

For example, energy is rarely deficient in pasture grains, and they usually provide a good content for mature beef cattle. Often, supplements are used during forage shortages, and early weaning of calves is also somewhat effective, though not always. More information on this topic can be found in the Cooperative Development Office in Nebraska. For instance, reducing protein from 12% to 10% in cattle results in a 7% reduction in growth. Therefore, a forage source cannot always guarantee optimal milk production. Weaning calves results in a 30% increase in energy and a 50% increase in protein in cows (see Table 1). It is important to note that nutritional levels for energy and protein are focused on pastures. In any case, this research is generally recommended for the following reasons:

1. Using relatively poor and dense pastures is often not recommended.
2. The balance between protein and energy can only be roughly estimated, and we cannot measure it accurately.
3. Neglecting grazing and food supplements can lead to long-term pasture degradation.

During drought, vitamin A deficiency may occur. Vitamin A is found in green forage that has been around for at least 90 days, as well as in orange and red pigments in the green forage, which can be converted into vitamin A. When plants stay for too long, the yellow and orange pigment content (carotenoids) decreases rapidly. More information on this topic is available in the meat livestock ration in the Cooperative Development Office.

Drought-Related Toxicity

The potential for drought-related toxicity increases in all plants because desirable forage is limited, and this may even cause harm to livestock. Some species produce fewer leaves in drought conditions and are more drought resistant. For example, certain native species like *Ziziphus Spina-Christi* (Christ's thorn) are found in good condition in pastures. High levels of nitrate in forage during drought are another issue. During drought, high levels of this compound may accumulate in forage,

especially in summer cereals, which are used as emergency feed for livestock. This occurs when plant growth is halted or interrupted due to drought, leading to the production of protein by the plant, which in turn increases the production of nitric acid. If such plants are ingested, nitrites can interfere with oxygen transport in the blood and, at high levels, may cause abortion or suffocation death in livestock.

Recommendations for managing this issue in forage are presented in the basics section of this book. The use of magnesium in the diet can help reduce the symptoms of this disease. However, there are clinical consequences, such as poisoning from *Ziziphus spina-Christi*. It is advisable to transfer livestock to a suitable grazing area without this plant. If tetany symptoms occur, treatment should begin immediately. Additionally, during drought, the quality of water typically decreases, and soil pores become clogged with runoff, which often contains salts. Under high heat concentrations, the amount of incoming water is reduced, and the only water source available to livestock is the water present in the soil before evaporation. In cooler temperatures, livestock water needs are reduced, but when water is scarce, livestock tend to drink more water, which leads to a reduction in performance.

At this point, if livestock become thirsty, they may be forced to drink salty water. This situation can be dangerous, especially if livestock are forced to consume drought forage, which also contains high salt content, such as saltbush or woody plants. Additionally, harmful levels of blue-green algae may proliferate in the water. Algae grow rapidly in heat, and when they respire, toxic gases accumulate on the water's surface, reducing water quality and making it toxic at certain times. Livestock can drink this water one day before dying, and the cause of death is usually related to changes in their respiratory rate, which can be difficult to detect without testing the water for blue-green algae.

12. Optimizing Forage Production

If drought or overgrazing reduces the plant's capacity, it may decrease or delay productivity throughout the grazing season. The carbohydrates produced by leaf tissues are necessary for root and above-ground organ development, as was confirmed in previous years. A 1 to 2-week delay in the production period can result in a 10-20% reduction in forage production. Early use of the growing season can be done in several ways:

- a. Delayed Production through Extended Feeding Duration or by Moderate Grazing in Calm Seasons of Grasslands, Winter Grains, Spring Grains, or Semi-irrigated Meadows. Some sandy hill meadows contain a substantial amount of *Cyperus* plants that sprout early in the spring. Due to soil moisture conditions, vegetation in meadows has high potential for recovery after grazing. Livestock should be removed from the meadows by mid-May.
- b. Removing Livestock from Grazing Areas for 1-2 Weeks at the Start of the Grazing Season to Reduce Grazing Pressure. This may not be feasible with certain breeding programs.
- c. Concentrating Livestock in a Limited Number of Grazing Areas and Providing Early Delays to Balance Grazing Areas. Select grazing areas with moderate density and the highest mix of calm-season forage species for this practice and manage for 50% or less utilization. This

practice will increase forage production in heavily grazed areas. Delay grazing in specific areas until after frost or the seed-setting stage in key grass species.

Vegetation Recovery After Drought

When a drought ends, the recovery of vegetation should be the primary management goal. Grazing areas most likely to provide the greatest increase in forage production should be prioritized for management. Specific management practices that are most beneficial for plant recovery are classified below from most to least beneficial:

1. Resting the Grazing Area for an Entire Year.
2. Using Designated Grazing Areas Only for Winter Grazing for One or More Years When Conditions and Production Are Appropriate.
3. Using Concentrated Grazing Areas When Species Have Low Palatability, Such as Annual Bromus species, which are green and palatable. Move livestock as soon as winter begins or when livestock start grazing key species.
4. Delaying Grazing Until the Seeds of Key Grass Species Have Reached Sufficient Maturity. Control the productivity level at 50% or less.
5. Grazing Late in Spring After Abundant Growth, When Grasslands Are at the 4-5 Leaf Stage. Move livestock when key grass species reach the boot stage. Control the productivity level at 50% or less.
6. Grazing When Key Grass Species Have the Least Palatability for Livestock.