



United States Department of Agriculture

# Grazing Management and Soil Health



Keys to Better Soil, Plant, Animal, and Financial Health



unlock the  
**SECRETS**  
IN THE  
**SOIL**

Natural Resources Conservation Service  
Des Moines, Iowa  
October 2017



# The Basics



*Pasture is land cover comprised primarily of introduced or enhanced native forage species used for livestock grazing. Pasture vegetation consists of grasses, legumes, forbs, or a mixture, initially planted to provide preferred forage for grazing livestock.*

## WHAT IS PASTURE HEALTH?

Pasture health is the degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes of the pasture land ecosystem are balanced and sustained.

## WHAT IS SOIL HEALTH?

Soil Health is the continued capacity of the soil to function as a vital living ecosystem. It is measured in pastures by the soil's ability to sustain plant and animal productivity, maintain or enhance the quality of water and air, and support human health and habitation. Changes in the capacity of soil to function are reflected in soil properties that change in response to management or climate.

## Why Is Soil Health so Important to Pasture Health?

Changes in soil health that occur as a result of good pasture management:

- Increased soil organic matter increases the amount of water that is available for plant growth;
- improved water infiltration;
- more availability of nutrients for plant growth;
- better soil conditions needed for germination, seedling establishment, vegetative reproduction, and root growth;
- ability of the soil to act as a filter, protecting water and air quality;
- increased plant production and reproduction;
- reduced water erosion (sheet, rill, gully);
- sequestration of carbon from the air.

**Soils with good tilth and structure have granular, durable aggregates in the topsoil that leave large pore spaces between them.**

## How Are Soil Health and Pasture Health Related?

Pasture health and soil health are interdependent. Pasture health is characterized by the functioning of both the soil and the plant communities.

Properly functioning soils capture, store, and redistribute water; grow plants; and cycle plant nutrients. For example, a properly managed pasture with rotational grazing and longer rest periods will have less compaction than a continuously grazed pasture. The reduction in compaction will increase soil respiration, increase

the water infiltration rate, and help promote desired pasture plants.

Changes in vegetation may precede or follow changes in soil properties and processes. Significant shifts in vegetation generally are associated with changes in soil properties and processes.

Overgrazing is often associated with the changes in soil properties, allowing undesirable and invader species to gain a foothold. These changes continue spiraling downward as quality forage production decreases and the livestock forage requirements stay at the same level or increase.



## How Are Soil Health Indicators Integrated Into Pasture Assessments and Monitoring?

Pasture health is evaluated by soil and vegetation indicators affected by the functional status of soil and pasture.

Pasture health evaluations use the Pasture Condition Score sheet. Categories rated include: Percent Desirable Plants, Plant Cover, Plant Diversity, Plant Residue, Plant Vigor, Percent Legume, Uniformity of Use, Livestock Concentration Areas, Soil Compaction and Erosion.

These categories reflect current soil functions.

## Definitions

**Aggregate** - Soil aggregates are groups of soil particles that bind to each other more strongly than to adjacent particles.

Aggregate stability refers to the ability of soil aggregates to resist disintegration when disruptive forces associated with tillage and water or wind erosion are applied.

**Litter** - A layer of slightly decomposed organic material on the surface of the soil.

**Assessment.** Soil health indicators are used to improve the value and accuracy of pasture assessments and trend analysis. These assessments help identify areas where problems occur and areas of special interest. Land managers can use this information and other inventory and monitoring data to make management decisions, which, in turn, affect soil health.

**Monitoring.** Tracking trends in the soil functions and the plant community helps to determine the success of management practices or the need for management changes or adjustments. Regular measurement of soil health indicators at the

## Better Forage, Better Profit

Managing for better forage and an increased profit begins with developing and implementing a pasture management plan.

To improve pasture health, land managers must manage for soil health. As the soil improves, forage production will increase and fertility needs will decrease, leading to increased profits.

Improving forage requires land managers to assess their farm holistically—assessing plant and animal productivity, soil health, water and air quality.

Pasture and soil health, and the land manager's bottom line are interdependent.

same location can detect changes over seasons or years and provide early warning of future pasture vegetation changes.

**Desirable Plants** - Plants that are preferred by the livestock on the pasture.

**Undesirable Plants** - Plants that are not consumed by the livestock until after the desirable plants are not available. Undesirable plants may impact animal health.

**Invader** - Plants that move into pastures when given the opportunity. They and thistles are typically considered weeds. brush species are invaders.

**Organic Matter** - Soil organic matter is carbon-rich material that includes plant, animal and microbial residues in various stages of decomposition. A reservoir of nutrients and water in the soil, which aids in reducing compaction and increasing water infiltration.

**Soil Health** - The capacity of the soil to function as a vital, living ecosystem that sustains plants, animals and humans. Soil health has five principles: Plant diversity, minimize soil disturbance, keep plants growing all year, keep the soil covered and incorporate livestock.

# Four Natural Laws of Grazing Management

## 1 | Keep down the shoot, kill the root.

Roots anchor the plants to the soil, take up water and nutrients, and, if healthy, enable plants to survive stress from drought, cold, heat, and grazing. A basic problem facing livestock producers is not knowing how close to safely graze or mow plants and still obtain maximum productivity over an extended period.

A clipping study (Crider 1954) concluded that top growth of a grass plant is directly proportional to the root growth. About every year, one-third of the roots die and must be replaced. The amount of

leaf volume removed has a direct effect on the growth of new roots. When excessive amounts of the top growth are removed, roots are not replaced and the grass eventually dies. If the leaf area is left at an optimum length, the roots will support more growth.

Managing plants and root systems is key to more and better forage. To manage for plants and root systems, landowners should implement a prescribed grazing plan that defines the proper degree of grazing use for key forage species. It should also establish a grazing schedule that alternates multiple grazing units—deferring or resting pasture in a planned sequence over a period of years.

## 2 | Nature does not like bare spots.

Bare ground is soil not protected by plants, litter, or standing dead vegetation. Areas with bare soil, no matter how small, are at greater risk of runoff and erosion. Bare soil lacks protection from impacts of raindrops, detachment by wind, and temperature extreme.

With continued overuse of desirable plants decrease,

undesirable plants and invader plants increase and can overtake the pasture over time. When this happens, droughts are much more severe and grass production declines. Practices that keep soil covered protect it from erosive forces that disrupt aggregation, while also building organic matter. Any practice that increases soil organic matter and biological activity improves aggregate stability. However, it can take several growing seasons or years for significant organic matter gains. In contrast, management activities that disturb soil and leave it bare can result in rapid declines in soil organic matter, biological activity, and aggregate stability.

## 3 | Bare soils decrease moisture availability.

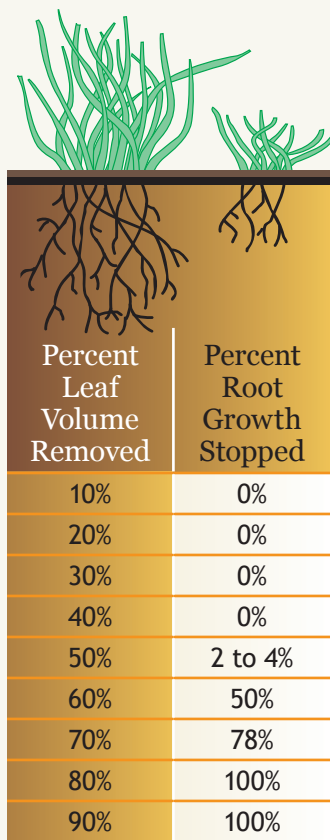
When pasture is dominated by undesirable and invader plants and more bare soil exists, runoff increases dramatically, less water goes into the soil, wind erosion increases, and water erosion increases due to the runoff from exposed soils. These issues result in less productive forage that is less resistant to drought and weeds.

During wind and water erosion, fine soil particles are washed or blown away while rocks and gravel may accumulate at the surface. Soil organic matter is extremely low and the soil surface temperature is extremely high. These high temperatures create an environment that is hot and dry and not conducive to productive grass. Undesirable and invader plants establish in these conditions. Weeds that can germinate quickly can increase dramatically on depleted land. The land becomes less fertile and better adapted to weeds than to desirable forages—increasing drought severity and frequency.

## 4 | If given a chance, nature would like to bring back best-adapted plants.

Nature will bring back the original, best adapted vegetation if two key elements exist:

- The line of no return—where the soil will no longer function—has not been crossed.
- Following a good grazing plan that balances nutritional needs of the livestock and the health of the forage.





# Applying Grazing Management Systems

## Improving Soil Health= Making Pasture More Drought and Weed Resistant

Farmers want to ensure their land is healthy enough to resist droughts and weed infestations and to produce high quality forage. To accomplish this, farmers need to ensure proper grazing management.

Managing pastures with soil health in mind will help improve aggregate structure which will improve infiltration. Increased organic matter improves the soil's ability to store water.



Conservation plans for grazing lands guide decisions for manipulating the plant community to manage the soil, water, air, plant, and animal resources. These five resources are clearly related and respond to each other interactively.

These plans outline proper use of the grazing and browsing animals to manage plant communities to achieve the desired results.

A well designed grazing system will provide the proper nutrition for grazing animals so they have high reproductive performance at the lowest cost.

## 4 basic keys to grazing management:

1. Balance Stocking Rate with Forage Production
2. Increase Livestock Rotation
3. Improve Utilization Rate
4. Lengthen Plant Rest and Recovery Time



# FOUR Basic Keys to Grazing Management

## 1. Balance Stocking Rate with Forage Availability

Stocking rate is defined as the number of animals on a given area of land during a certain period of time, generally calculated in Animal Days per Acre (AD/Ac). An Animal Day (AD) is the amount of forage required for one 1,000 lb. cow with calf for one day, equivalent to 30 lbs. of air-dry forage. Livestock forage needs of different breeds, classes, and/or sizes are all compared to the equivalent of one cow/calf pair.

On any operation, it is critical that the stocking rate match the available forage. Failure to properly stock an operation can lead to over and/or under-grazing, neither of which provides favorable outcomes.

Overgrazing can lead to significant long-term degradation and an overall reduction in pasture condition and potential yields. Effects from overgrazing can be

long-lasting and difficult or impossible to rectify. Properly stocking grazing animals is critical to the long-term viability of any grazing operation.

Determining stocking rate is simply a matter of collecting information on overall pasture production and balancing the

animal numbers with available forage. Since this is specific to your grazing land, you can request assistance from your local Natural Resources Conservation Service office to determine stocking rate.

significant benefits by improving how evenly pastures are grazed and reducing selective livestock grazing. As stock density increases, animals utilize forage uniformly. This results in a reduced tendency for livestock to ignore less desirable plants and overgraze desirable plants.

Pasture sizes and stock densities must incorporate the size of the area to be grazed, the amount of forage that is available, the number of animals you plan to graze, and the duration each area is grazed.

Care should be taken when increasing livestock density because animals bunched tightly together need to be monitored and moved more frequently to reduce the risk of removing too much plant material and reducing animal performance. To increase livestock density, existing pastures can be subdivided either with permanent or temporary fencing.

Most livestock operations that have increased their stock density and decreased the time spent grazing in each pasture or paddock have seen significant benefits in overall forage production.

This improvement can be contributed to improvements in soil health.

**An Animal Unit Month (AUM) is the amount of forage required for one 1,000-pound cow with calf for one month. This is equivalent to 915 pounds of air-dry forage.**

**Table 1. Estimated Cattle Stocking Rates on Typical Pasture Soils for 8 to 10 month grazing season**

Grazing System	Acres Needed per Cow/Calf Pair		
	Bluegrass	Cool season Grass	Cool Season grass & legume
Continuous Graze	3.24-4.5	3-4.25	2.5-3
Rotational Graze (2 Pastures)	2.75-4	2.5-3.75	2- 2.75
Rotational Graze (4 pastures)	2.5- 3.5	2.25-3.25	1.75-2.5
Rotational Graze (multi-paddock, 30 day rest)	2.25-3.1	1.75-2.75	1/75-2.25

Note from this chart that you have two ways to carry more livestock on fewer acres, by improving forages or rotating pastures. The best carrying capacity comes from doing both. Actual stocking rates may vary according to soil type, weather, soil fertility, type of cattle and management. Different variables will yield different carrying capacities.

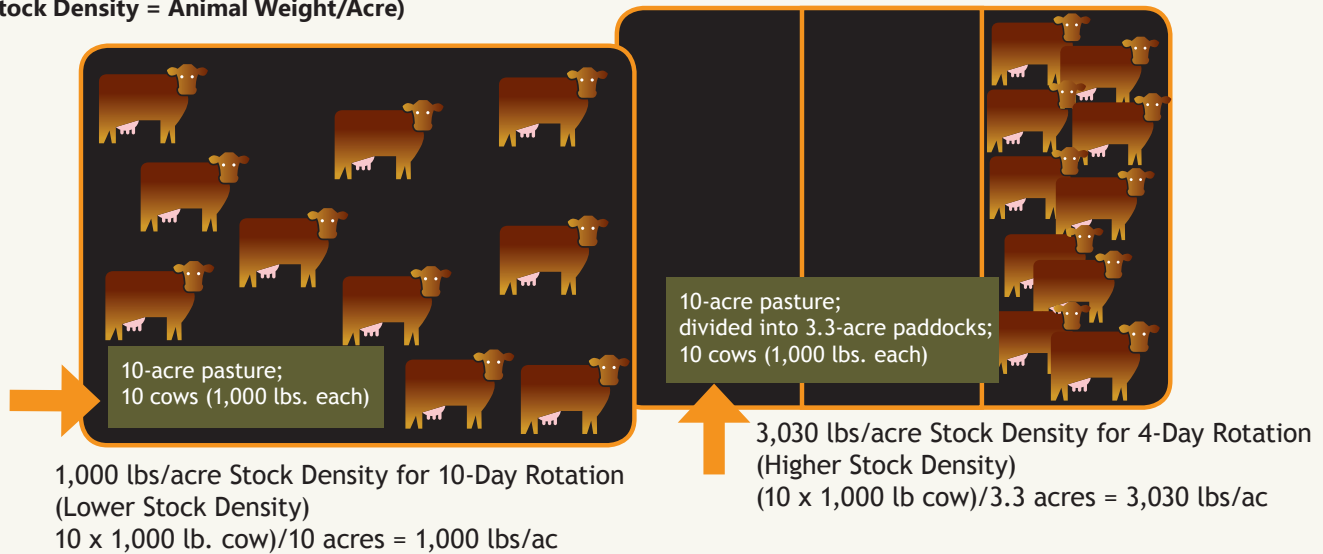
## STOCK DENSITY VS. STOCKING RATE

Stock density refers to the pounds of animals grazing a specific unit of area at a single point in time. Stock density is usually expressed in pounds of animals per acre. As the pounds per acre of livestock increases, stock density also increases. Many grazing operations do not adequately consider the impacts of stock density when planning and managing rotations. However, understanding the fundamentals of stock density is critical, on pasture lands.

In general, increasing the stock density can yield



**Figure 1. Stock Density in Action**  
 (Stock Density = Animal Weight/Acre)



## 2. Increase Livestock Rotation

Rotation includes managing when you graze, how long you graze, and how long you allow the area that is grazed to rest and recover before the area is grazed again.

Livestock have a tendency to graze selectively, choosing their favorite species first and grazing them harder and more frequently while avoiding less desired species. This selective grazing is exacerbated when livestock have access to larger grazing areas and are not rotated frequently enough.

During the growing season, when a plant is grazed it can begin actively growing again almost immediately. As plants begin to regrow, they place a significant amount of their energy into leaf



growth, which can slow down or even halt root growth if too much leaf area is removed. During the time when plants are just starting to regrow, livestock will often heavily target the plants due to their fresh, succulent growth. Grazing this fresh regrowth is extremely detrimental to plants and can cause roots to shrink and can eventually lead to plant death. During fresh growth, plant leaves can grow enough to be a fresh bite in three days.

Grazing plants without providing opportunity for recovery is by definition overgrazing and is the primary reason that pasture conditions deteriorate. Animals overgraze preferred plants repeatedly, while ignoring less desirable plant species. Over time, less favorable plant species, such as less productive grasses and weedy species, are able to out-compete favored species for water and nutrients, causing changes in species composition and a reduction in the

long-term productivity and palatability of the pasture. Many livestock operations improve their forage productivity by simply rotating their livestock more frequently and providing previously grazed pastures or paddocks longer rest and recovery periods.

On many grazing operations, pasture productivity decreases over time. Deteriorating pastures are then renovated (reseeded) or heavily fertilized. Pasture renovation is costly and time consuming, and often unnecessary if proper grazing management and livestock rotations are employed. In fact, if pastures are properly grazed, the pasture condition and productivity should actually increase over time, leading to long-term financial gains.



### 3. Improve Utilization Rate (Grazing Intensity)

Utilization rate refers to grazing intensity and is a term often used to describe how heavily an area is grazed.

Most grazing experts tend to recommend the old standby of “take half, leave half,” meaning when animals are allowed to graze, they should only be allowed to utilize half of the total plant biomass in a pasture. Ideally, every plant would be grazed to reduce its total volume by no more than 50 percent.

Grazing too hard and taking more than 50 percent (generally leaving plants shorter

than 4 inches) stops all above- and below-ground plant growth for a period of time (Figure 2). This slows plant recovery and overall plant production. If plants are grazed 50 percent or less and are left at or above the heights in Table 2 (page 10) after grazing, root growth is largely unaffected and plant regrowth begins at a rapid pace.

Although it may seem like common sense to graze plants short to extract

the most amount of forage grazing, this type of management ultimately reduces the total amount of forage produced on the pasture and can kill preferred forage species and increase less desirable plants. Keeping plants taller throughout the grazing season and rotating animals on a more rapid frequency allows plants to develop deeper roots, recover from grazing

faster, and produce far more forage over the course of the season.

Lighter levels of use allow livestock to receive a diet balanced for protein and energy that is essential

for livestock finishing on pasture. Don't be fooled into extracting the most possible forage out of each grazing event. Instead, manage your pastures so that they produce the most possible forage over the course of the growing season; you will end up far ahead in the long run.

What does 50 percent utilization look like? Generally, during the growing season when plants are actively growing, plants should never be grazed shorter

than the “Graze no Closer Than Height” in Table 2 on page 10. Obviously, it is unrealistic to expect every plant be grazed uniformly at a 50 percent level. In general, the larger the pasture and lower the stock density, the more variation there will be with regard to the grazing

intensity within a pasture (think spot grazing where some areas are grazed heavily and others lightly).

Pastures with low stock density will have lots of spot grazing, whereas pastures with higher stock density will be more uniformly grazed.

**“Take half, leave half” is a valuable and proven metric; however, in truth, utilization rates should vary based upon time of year, type of pasture, forage available, and overall management goals and expertise.**

**Figure 2. Plant Root Response to Grazing - Percentage of Leaf Material Removed**



If 80% of plant leaf material is removed, plant root growth can cease for 12 full days, which slows plant regrowth considerably (Dietz, 1989). If only 10% to 40% of plant leaf material is removed, plant root growth doesn't stop and the plant regrows faster and remains healthier.



Increasing the uniformity of grazing patterns and reducing spot grazing will lead to higher efficiencies, improvements in pasture and plant conditions, and an increase in financial returns.

## SEASONAL GRAZING CHALLENGES

Early spring grazing creates a new set of challenges. In the spring, plants are just beginning their seasonal growth and are extremely susceptible to overgrazing. Overgrazing plants in the spring can set back growth for the entire growing season. Many grazers make the mistake of grazing plants too hard or too early in the spring and the result is often a significant reduction in overall pasture yields over the course of the year.

Waiting to graze a field in the spring allows the plants to develop deeper roots that can better access water and nutrients in the soil profile. This also allows the plants to build more leaf area to capture more sunlight and increase their rate of growth.

If early spring grazing is unpreventable, supplemental hay may need to be fed on the pasture to reduce the

risks of overgrazing young plants. If a pasture is grazed early in the spring, make sure the following year that same pasture is not grazed until later in the season. Finally, when grazing early in the season, and not quickly rotation, always allow the pasture additional rest (>40 days) before grazing again.

A better strategy for managing early spring grazing is to rotate animals quickly between pastures, utilizing less than 50 percent to avoid overgrazing. This quick rotation when utilized on cool season grass or cool season grass-legume pastures can be grazed again in as little as two weeks due to rapid growth during this season. As

**Ideally, spring grazing should not begin until the grass has reached the four-leaf stage or about 8-inch minimum height—typically in early or mid-May.**

the year progresses, return to a slower rotation or increase stock density by sub-dividing pastures.

When grazing during the dormant season (November through February), utilization rates can be increased to 65 percent with at least 2 to 4 inches of grass remaining on average, depending on the species composition of the pasture. During the dormant season, plants are no longer actively growing and can tolerate heavier grazing pressures.

However, care should be taken to ensure that plants are not grazed too severely, which can harm plant growing points and weaken or kill plants.

Maintaining residue on the soil surface during

the winter protects the soil from temperature extremes, improving soil health.



**Allow your forages to rest and recover, and you will be rewarded with higher producing pastures and healthier, faster-gaining animals.**



## 4. Lengthen Plant Rest and Recovery Time

After grazing, pastures should rest for at least 30 days during the summer growing season. Warm season grass pastures will require longer rest periods. The length of rest depends on many factors (season, weather, plant species, utilization rate, stocking rate, livestock class), so it will be up to the livestock manager to learn to recognize when plants have fully recovered and can be successfully grazed a second time. NRCS can help you consider your options and provide some helpful advice as you plan your rotations.

As a general rule, it is best to wait until your desirable forage species are at the begin grazing height listed on Table 2.

**Table 2: Forage Guidelines**



Forage	Full Seeding rate #/ acre	Begin grazing at:	Graze no closer than:	Cut for hay at:	Allow regrowth to this height before killing frost
<b>Cool Season*</b>					
Kentucky bluegrass	5-10	4-6"	2"	Not Recommended	4"
Orchardgrass	8-12	6-10"	4"	Boot to early head	6"
Reed Canarygrass	8-12	8-10"	4"	Early boot	6"
Smooth Bromegrass	10-16	6-12"	4"	Med. to full head	6"
Tall Fescue	8-15	6-10"	4"	Boot to early head	6"
Timothy	4-8	6-10"	3"	Early head	5"
<b>Warm Season*</b>					
Switchgrass	5-7	16-20"	6"	Early head	6"
Indiangrass	10-12	12-16"	6"	Boot	6"
Big Bluestem	10-12	10-16"	6"	Boot	6"
<b>Legumes*</b>					
Birdsfoot trefoil	5-8	6-10"	4"	Early flower	6"
Red Clover	8-12	1/4 bloom	3"	3/4 to full bloom	8"
Alfalfa	10-15	full bud	3"	Late bud	10"
Crownfatch	8-15	8-10"	3"	Use grass timing	6"
* Seeding rates are Pounds of Pure Live Seed Per Acre. <b>Notes:</b> Cut for hay is for first cutting.					

## High Stock Density Grazing

High Stock Density (HSD) grazing is one of the most effective methods of grazing management.

HSD grazing takes on many forms and names: MOB grazing, Management Intensive Grazing (MIG), and others. Don't be confused with the names, as all of these forms of grazing model the same general themes of High Stock

Density grazing and many of the points previously outlined in this document. The important point to remember is that to implement any of these systems effectively and correctly, you must follow the four keys to grazing management (stocking rate, livestock rotation, utilization rates, and rest/recovery).

HSD grazing management involves concentrating animals into a smaller areas (often called paddocks), for a shorter amount of time (from 1-3 days, for example), and consuming 50 percent or less of available forage. Following grazing, long rest periods are provided (>30 days) to allow plants to recover before being grazed again. By following

a HSD grazing system, the quality and amount of forage grown can increase substantially over time.

High Stock Density grazing may not be right for everyone, but for most grazing operations, there are areas for meaningful improvement.

Are there ways that you could make simple changes to your rotations that could allow you to







better accommodate the four keys to grazing management?

Try High Stock Density grazing in a small area or for just a certain time of the year. Perhaps some pastures could benefit from some additional cross-fencing to improve rotations.

The end goal of grazing management should be to improve animal performance, increase plant productivity and associated soil health, reduce winter feeding and other input costs, and ultimately, be more profitable. There are

many methods to improve grazing management. The key is to find a suitable method that works for you and improves the quality of life for you and/or your family.

When making improvements to grazing management, always refer to the four keys to grazing management (stocking rate, livestock rotation, utilization rates, and rest/recovery), as they are the cornerstone to effective grazing. If you are interested in High Stock Density grazing, NRCS can assist you with sizing your paddocks and managing your rotation,

## 5 Key Points of a High Stock Density Grazing System

### 1. Utilization Rate:

HSD systems only graze the top 1/3 to 1/2 of the plants. By grazing primarily the top growth, animals graze only the choicest portions of the plants, which leads to improved animal performance and increased rates of gain. Much of the plant material that is left is actually trampled and laid flat on the soil surface. At first glance, this may appear wasteful, but this trampling of material improves nutrient cycling and water retention.

It also keeps the soil surface cooler, which reduces evaporation, and allows plants to focus on regrowth, instead of just basic survival.

Soil organisms are provided the ideal environment, including food in the form of manure and grass residue that has been trampled. These soil organisms are an

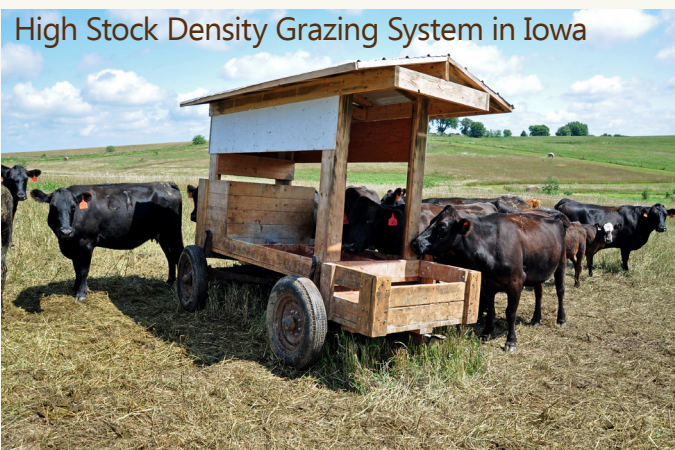
underground livestock herd and they are one of the key drivers fueling pasture recovery.

Grazers using HSD grazing have seen significant increases in yields (often doubling production) without the use of fertilizers or other costly, synthetic inputs.

### 2. Controlled Access and Improved Forage Utilization:

Livestock access is controlled and restricted to improve utilization of plants and reduce both overgrazing and spot grazing. This allows all plants (including weeds) to be grazed more evenly while the remainder of the pastures are allowed to rest and recover.

With HSD grazing, animals become more competitive, and their behavior begins to change, causing a decrease in their selectiveness when grazing. They begin grazing all species more uniformly, which allows the higher yielding and favorable forage species to better compete and increase in density



**This Iowa farmer uses a mineral cart to provide livestock with the needed minerals and salt in each paddock. He locates the cart in a different location on each return**

over weeds and less desirable plants. Animal performance may go down initially, but improve over time as animals adapt to the change.

Grazers using this practice have seen significant reductions in weeds and an increase in desired plant species without the use of herbicides.

### 3. Smaller Paddocks:

Concentrating animals into smaller paddocks results in manure piles located more closely together and more evenly distributed. In a large, undivided field, manure piles tend to concentrate in select areas such as near water or loafing areas. When rotations are one day or less, and paddocks are sized correctly, manure is trampled into the soils

and litter, speeding up nutrient and carbon cycling.

Manure serves as natural fertilizer that helps feed the soil and improve fertility. Most High Stock Density grazers have eliminated the use of fertilizer from their pastures, while at the same time benefiting from an increase in forage production.

### 4. Longer Rest Periods:

Longer rest periods of 30+ days allow palatable, tall-statured grasses and legumes the opportunity to recover and increase in abundance. These plants increase in density because their root systems are able to access water and nutrients deeper in the soil profile and out-compete lower producing plants.

Re-grazing of previously grazed pastures should not occur until the time specified in the Forage Guidelines table.

Pastures improve over time as taller statured forage species increase in abundance while short growing plants and undesirable weeds decrease.

### 5. Extended Grazing Season:

High Stock Density improves efficiency of forage utilization across the entire grazing operation. This allows grazers to plan and allocate forages more accurately throughout the year. Some areas may be left ungrazed later in the growing season (often called stockpiling forage), to be grazed during the

dormant season, thus allowing for a reduction in supplemental hay.

In addition, when using HSD systems, more forage can be produced, which helps extend the grazing season. With a continual focus on improving long-term pasture productivity, feeding areas and mineral supplements are rotated during the winter within and between pastures to spread nutrients, feed the soil, and better distribute animal impacts. Some HSD grazers have cut months off of their winter feeding requirements. Reducing hay feeding time and costs can quickly improve financial gains.

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