grazing

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Soil Management For Intensive Grazing

K. L. Wells and C. T. Dougherty

Recycling of plant nutrients is of major concern in managing paddocks in pasturefields for intensive grazing. Redistribution of nutrients present in fecal and urine deposits is an important issue in growing climatically and seasonally-adapted forage species and for efficient conversion of herbage into animal products while adding to the sustainability of the system. Some of the questions that arise in managing soils for intensive grazing are discussed below.

● How Soil Affects Other Factors in the System

Requirements of the photosynthetic and growth process of pasture plants include air, water, and nutrients ... 16 specific nutrients, 95% by weight originating from air and water (carbon, hydrogen, and oxygen) and 5% by weight coming from soil minerals and organic matter (the remaining 13 nutrients). With the exception of carbon, nearly all the other 15 nutrients are obtained by plants either from or through the soil. To best operate any soil-plant system, the manager needs to know the basic physical and chemical characteristics of soils in terms of their capability to provide air, water, and nutrients for plants and to anchor and support them. Then, armed with a thorough understanding of the growth habits and requirements of the plants being grown, he can most effectively match specific plant requirements to specific soil characteristics so as to render his soils as least limiting as possible and give plants the opportunity to strive for their productive potential. Climatic factors, recognizing that their range can be fairly extreme, must also be considered in management of each grassland ecosystem. Seasonal growth/productivity patterns of grasslands are a good illustration of the significance of climatic factors that influence management.

Variability of soil characteristics and microclimate results in several distinctive sites within and among fields that may require somewhat different management on the same tract of farmland. The importance of a good working knowledge of soil-plant-climatic factors acting on a specific land tract cannot be overemphasized, because these factors exert monumental control over total forage production, and thereby, animal carrying capacity.

To this basic framework of specific fields on the farm being uniquely managed for production of specific plants, the producer adds forage-consuming livestock as a means to generate added values. Potential forage production and seasonal yield distribution per unit area basically controls livestock production per unit area, which in turn, exerts much control over economic returns per unit area. This further adds to management complexities and results in a system of 4 major components ... soil, climate, plants, and animals. For further purposes of this discussion, only the effect of cattle on soil management will be considered. Their major diet consists of living plants, which they must harvest from the landscape, retaining some 65% of total biomass for their metabolism and recycling the remainder. The major management concepts involved are:

(1) Manage to maximize forage production relative to soil capabilities. This involves establishment of field boundaries based on the potential productivity of the soils while maintaining soils in a sustainable productive state.

(2) Manage cattle to achieve desired consumption of the forages produced in each field. This requires following a management rationale that treats grazing cattle herds as biologic mowing machines and that utilizes sound grazing management to maximize utilization of the forages produced.

(3) Evaluation of the effectiveness in managing soils, pastures, and livestock in this manner in terms of units of animal output (pounds of beef or milk) per unit of land area (acre).

● The Effect of Grazing Cattle on Soil Management

Cattle can exert both beneficial and detrimental effects on a grazed field. The greatest detrimental concerns, perhaps, are the physical effects of treading. The interaction of several factors will determine the amount of potential damage that may result. Soil moisture content, soil physical properties, type of forage, stocking rate, and number of days grazed all interact greatly in managing paddocks to minimize treading damage. The most basic concept to keep in mind is that application of weight (cattle) to soil which is wet, will compress more soil into smaller volumes, thereby increasing bulk density of soil (weight per unit volume). The effect of compaction is to diminish the volume of soil in the plant rooting zone that can store oxygen and water (pore space), thereby limiting rooting volume of the plants. The remaining pore space remaining will likely be affected by having relatively fewer large pores (those which store air) and relatively more small pores (those which hold water). Because the effect of treading is greatest at the soil surface, this can lead to decreased soil permeability of both air and water. Lowered rates of water infiltration may lead to higher rates of surface runoff dudring heavy rains and to greater soil erosion, a problem often related to overgrazing.

Nature of the forage can also affect the rate at which treading damage occurs. Established forages that have a prolific rooting system in the top 6 to 10 inches of soil (form a good sod), can absorb more treading energy than those forages that do not form a dense rooting mass, thereby slowing the rate at which soil damage can occur. However, the forage plant itself may be physically affected by treading, and the nature of the species (how it recovers) may also have an effect. Non-rhizomatous, non-stoloniferous species (e.g. orchardgrass) can more easily be damaged than rhizomatous/stoloniferous species (e.g.

bermudagrass). And, of course, the stocking rate and how long the animals are kept there will influence the degree of treading damage.

Management to minimize potential treading damage should be aimed at keeping cattle off fields when the soil is too wet, or if that is not possible, putting them onto well-sodded fields at a lowered stocking rate (more acres). Alternatively, at such times, cattle could be moved to "sacrifice" fields (stubble fields/run-down pastures/drylots, etc.).

From the positive standpoint, large quantities of dung and urine are deposited within paddocks as a result of intensive grazing management. In addition to nutrient recycling, organic matter in the dung will increase the rate of organic matter buildup in the soil, which also leads to improved soil physical properties.

● The Effect of Grazing Cattle on Plant Nutrient Recycling

One of the obvious consequences of using cattle to harvest forages, so as to give them added value, is that nutrient content of ingested forages may be transported from some parts of a field to other parts and re-deposited in urine and feces. In addressing the issue of how nutrient recycling by grazing cattle affects sustainability (also utilization) of forages growing in that field, a few behavorial aspects of grazing cattle behavior should be kept in mind.

● The Proportion of Nutrients Ingested by Grazing Cattle Excreted in Urine and Feces.

Most estimates indicate that about 25%, 20%, and 15%, respectively, of nitrogen (N), phosphorus (P), and potassium (K) contained in forages consumed by grazing cattle is retained in their bodies for support of their various metabolic processes. This means that about 75%, 80%, and 85%, respectively, of N, P, and K passes through the animal and are excreted in urine and feces. Most of the nutrients ingested are, thereby, recycled by the animals, perhaps many times. On grazed fields, these recycled animal nutrients are, or can become, available as plant nutrients. One point of concern, though, is that urination and defecation patterns of grazing cattle do not result in recycling of nutrients uniformly over the field. Grazing practices affect the distribution of recycled nutrients. From the perspective of a pasture, nutrients in the soil are non-point sources while those in dunghills and urine spots are point sources.

● Quantification of Urine and Fecal Deposits in Pasture Fields.

In order to determine recycling patterns, it is useful to know the frequencies of defecation and urination per day, and the area covered per elimination. A rule-of-thumb value would be 10 defecations per bovine animal per day, each covering about 1 square foot, for a daily total of 10 square feet per head. Urination events are harder to quantify because they leave no visible short-term deposit on the surface. Some researchers estimate that the daily number of urinations are about the same as defecation, and are deposited very similarly over the field. There is a key difference in the nutrient content of feces and urine. About half the N eliminated from the animal's body is in urine and the remainder in feces. This proportion can increase to nearly two-thirds in urine if cattle are grazing on a high N-containing forage (grass, well-fertilized with N, or legumes) which provides excessive amounts of their N requirements. Nearly all the N in urine is present as urea, which when deposited onto the field, behaves just as commercial urea fertilizer (some surface volatilization occurs). The N content of feces exists in various organic structures (including microbial and plant protein), some of which break down fairly quickly to ammonium N ($NH4+$), and others which are very resistant to decomposition, and may remain in the soil for weeks, months, or even years.

In contrast to N, most of the P is contained in feces, largely bound in organic compounds, which, even though they are not immediately available for plant uptake, contribute very effectively to increasing soil test levels of P. Consequently, all the P in feces is credited to soil buildup of available P within a year after deposition.

And, in contrast to P, most of the K passing through the animal is in the urine. It is as effective as fertilizer K and is immediately available for plant uptake after deposition.

- **Factors Affecting Patterns of Fecal and Urine Deposits.**

Several factors have been shown to affect the pattern of nutrient recycling by grazing cattle. Perhaps the most notable of these are landscape features, such as shade, field shape, and topography of the landscape. Shade tends to promote loafing areas for cattle, so that more defecations and urinations occur in shaded than unshaded areas. Similarly, the presence of depressions on the landscape, such as swales, hollows, draws, etc., results in more animal use of such areas, with resulting increased urination and defecation patterns there. It has been reported that soil test K levels in these special areas increased 4 to 10 fold over that from the remainder of the field.

Cattle also tend to defecate more during the night in areas where they rest, than during the day while they move about and graze. However, they tend to urinate more frequently during the daytime. These differing patterns are related to the rapid rate of absorption and excretion of water, compared with the slow rate of passage of undigested plant herbage through the digestive tract, and may also contribute to uneven distribution of recycled plant nutrients.

Source of water is another factor having major impact on elimination patterns by cattle. Concentrations of feces and urine are greater around water sources. Supplemental feeding sites (hay, mineral, and concentrate feeders) within the field have a similar effect. One study of intensive rotational grazing practices showed that if animals have to travel through a lane at distances greater than 450 feet to get to water, nearly one fourth (22%) of the total manure deposits were made in the water lane.

Another factor impacting patterns of dung and urine deposition is stocking density. The more animals per acre, the more uniform will be the distribution. Duration of grazing must also be considered. If the field size is large enough to provide several days, or weeks, of grazing by the number of animals present, manure deposits will not be as uniform as if field size is restricted to provide only a few days grazing. Missouri studies suggest that if paddock size or animal numbers are restricted to provide less than 6 days feed to the number of cattle present, and if water is available in the paddock, manure distribution will be fairly uniform over the paddock. This would represent the optimum situation for managing grazing cattle to recycle nutrients uniformly over the grazed area. Otherwise, and to varying degrees, as influenced by the factors discussed above, recycling will result in a net movement of nutrients from within the field to areas where cattle congregate, thereby non-uniformly re-distributing them and increasing the potential for increased nutrient, fecal material, and fecal bacteria runoff into surface water sources, following rainfall.

● Are Commercial Fertilizers Required on Fields Grazed by Cattle?

If fertility levels of fields are low, it should be obvious that grazing will not raise overall fertility levels. It is quite likely, though, at low fertility and at low stocking rates, that grazing cattle will concentrate nutrients in special areas of the field, with the result that soil fertility in some areas of the field may be depleted while other areas are enriched. On the other hand, if soil fertility is or has been built to desirable levels (medium to high) and if management is designed to concentrate animals onto areas with no more than a few days (less than 6) of grazing (intensive grazing), and are provided water within the area being grazed, recycling of nutrients will be fairly uniform, and existing fertility levels may be maintained for several years before additional commercial fertilizer is needed. Above and beyond the uniformity of defecation and urination which can be obtained by confined, mob grazing of a few days duration, additional benefits in uniformity can be attained rather economically by use of a chain drag harrow, perhaps following clipping of ungrazed stubble, within a few days after removing cattle from the paddock. A soil testing program of sampling each paddock to a depth of 4 inches every 3 to 4 years should be sufficient to monitor soil fertility levels so as to maintain sustainability of the paddock.

For larger fields with low grazing pressure and in which areas exist where cattle congregate, avoid sampling (or at least sample separately) within and around such areas because they will test higher in P and K than the remainder of the field. Also, avoid spreading P and K fertilizers in such areas. Confine P and K applications to the lower testing areas of the field. For legume-grass mixtures, manage fertilizer applications to favor legumes, rather than grasses. This means development of medium to high soil test levels of P and periodic liming to maintain soil pH around 6.5. Urination and defecation by grazing livestock has little effect on soil acidification.

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