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Organic and Grass-finished Beef Cattle Production

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Market demand is rapidly increasing for sustainably raised and organic beef products. Pasture-based or grass-based livestock production relies on biodiversity and ecological complexity to maintain production with the use of less costly inputs. Cattle producers recognize that grazing and pasture access can lower production costs, reduce animal stress, and boost the animal's immune system. This publication highlights the practices producers are using to provide customers with nutritious food from pasture- and rangeland-based farms and ranches. Resources are included for further reading.

Beef calves on fescue pasture in Missouri. Photo: USDA-NRCS.

Introduction

Cattle are natural grazers. They possess the remarkable ability to digest plant carbohydrates that are generally indigestible for most other mammals. Cattle have developed a symbiotic relationship with rumen microorganisms (Phillips et al., 2009), which makes the animals particularly adept at converting the nutrients in forages into digestible nutrients—in the form of meat and dairy—that humans can use.

Historically, cattle production was an integral part of diversified family farms. Diversified farms could utilize farm-grown crop residues and incorporate animal manure into the soil to fertilize crops. The farm family would have beef for the year, and the surplus would be sold off the farm to contribute to satisfying the food needs of the community. At the end of World War II, grain was no longer needed for the war effort, so a surplus of corn, combined with low fuel prices, helped to bring about the cattle-feeding industry. This fostered a shift in how livestock were fed, housed, and finished. The two decades following World War II saw the development of the beef-feedlot industry we have today.

Grass-based production systems are inherently more resilient to market-price fluctuations because of their significant reliance on renewable

pasture resources. This is exemplified by farmers and ranchers who see themselves principally as grass farmers. Under this model, cattle become grass-harvesting tools used to maintain pasture health and to provide meat and milk for the market. Farmers and ranchers rely on this naturally low-input system in which feed costs are reduced, animal health is maximized, and a wholesome product is provided to the customers.

Livestock producers can reduce costs, maximize animal health, and realize significant financial returns only if they are using low-input production systems. The norm for most producers, however, is a high-input system in which the applications of high levels of chemical fertilizers, pesticides, and herbicides—along with high machinery costs for haying, mowing, and seeding—significantly reduce the margin of profitability.

Allen Williams, a beef-cattle specialist with Tallgrass Beef, Inc., notes that farm and ranch data (from Integrated Resource Management/ Standardized Performance Analysis) indicates that many beef producers nationwide have more investment in machinery than they do in cattle. The data also indicates that 70% to 80% of most producers' total cost of production is in feedstuffs. Williams notes that producers who are willing to use grazing methods that do not rely on high-cost inputs can realize positive economic impacts as well as such ecological benefits as improved soil fertility, forage diversity, and carbon sequestration (Williams, 2010). Managing cattle using high-stock-density grazing is a method to achieve the benefits of low-input animal agriculture, and it is covered later in this paper as well as in other ATTRA publications, including *Rotational Grazing* and *Pasture, Rangeland, and Grazing Management.*

Related ATTRA publications

Beef Farm Sustainability Checksheet

Beef Marketing Alternatives

Building a Montana Organic Livestock Industry

Dairy Beef

Natural Livestock Feasibility Study

Ruminant Nutrition for Graziers

Grazing Contracts for Livestock

Paddock Design, Fencing, and Water Systems for Controlled Grazing

Pasture, Rangeland, and Grazing Management

Pastures: Going Organic

Pastures: Sustainable Management

Rotational Grazing

Consumer Perception and Market Demand for Organic and Grass-finished Beef

The demand for grass-finished beef, natural beef, and organic beef is growing in the United States. Demand for natural and organic meat has historically outstripped supply in most U.S. markets. Although the volume of natural- and organic-beef sales declined between 2008 and 2009, natural and organic meat's share of the U.S. market in 2009 stood at 2.7%, up from 2.5% in 2007 (Huntrods, 2009). Sales of natural and organic foods declined in the recession of 2009; however, sales are expected to increase again by 28% to 30% between 2010 and 2012 (Mintel, 2009). Continued growth in demand for these meat products is expected, especially through direct local sales of carcasses and retail cuts to families via farm visits, farmers markets, and mail-order. Many market analyses suggest the possibility of a viable market well into future years.

Demand for grass-fed and grass-finished beef swelled in 2010, and the major grass-fed meat companies are scrambling for a supply of quality cattle. There has been significant growth—not only in the direct-marketing sector, but in the retail, restaurant, and food-service sectors as well. A recent report by the United States Department of Agriculture's Agricultural Marketing Service (USDA AMS) puts the U.S. grass-fed beef market at 3% of the total U.S. beef market, having grown at a rate of about 20% per year for the past few years (Mathews and Johnson, 2010).

For more information on consumer-demand issues in meat marketing, see the Agricultural Marketing Resource Center's (AMRC) website *www.agmrc.org.*

Organic Cattle Production

Organic cattle production is regulated in the United States by the USDA's National Organic Program (NOP). According to the NOP, organic production is a system that responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biological diversity (USDA, 2006a).

The holistic principles of organic agriculture are derived from two complementary perspectives. First, organic agriculture is characterized as being a biologically oriented production system based on ecological principles and demonstrating a high degree of sustainability. In addition, it is a system that endeavors to preserve the integrity of organic production by guarding against contamination from prohibited substances and against commingling with nonorganic products. In order to meet the biological and ecological demands that define organic agriculture—and to ensure compliance with laws and regulations that serve to foster organic-system integrity—an Organic System Plan (OSP) must be written and submitted to the certifier. Organic certification

of the land requires a transitional period of three years from the last application of a restricted substance. However, inspections and updated applications must be completed annually for the land to remain in compliance.

Prospective organic producers should contact an organic certifier when they are ready to begin the transition process. A list of organic certifiers is available on the Rodale Institute's New Farm website *www.rodaleinstitute.org/certifier_directory.* The certifier is an agency authorized by the NOP to certify farms and food processors under NOP regulations. The certifier will provide an application packet, which when filled out will become the OSP.

In organic livestock production, it is important to build the organic portion of the pasture soil. Most soils contain between 2% and 5% organic matter, depending on soil texture, moisture, and climate. Organic matter serves as the basic food substrate for millions of bacteria, protozoa, fungi, insects, and earthworms, which in turn make the nutrients readily available for plants to use. Organic matter also acts like a sponge to help the soil retain water. Since the soil and the organic matter contained therein represent the foundation of an agricultural ecosystem, it becomes clear that the best way to develop soils for human food production is to feed the soil and let the soil feed the plant. This is in contrast to conventional thought, in which soluble fertilizer is simply applied to meet the needs of a growing crop.

The organic portion of pasture soils is developed especially well by livestock and pasture-plant diversity. In addition, organic matter is added to the soil by the natural action of plant root death. As plants are grazed or harvested, a portion of the root mass is naturally sloughed off, contributing to soil pore space (for oxygen and water infiltration) and nutrient availability. The main point here is that by utilizing these "natural services," producers can significantly reduce expensive off-farm inputs, and the agro-ecosystem can be strengthened to supply the needed resources to sustain agricultural production.

As an organic livestock producer, excellent nutrition and pasture access are the most formidable disease-prevention tools you have to keep cattle healthy. Antibiotics, synthetic dewormers (with exception of Ivermectin in some situations, which is discussed below), growth-promoting hormones, and ionophores are not allowed in organic production, so the producer has the benefit of designing a balanced ecosystem to reduce the incidence of disease and injury. As it turns out, a balanced ecosystem is the cheapest, most healthful way of producing livestock. Grazing animals that harvest their feed from pasture, calve and live most of the year outside of barns and confining enclosures, and are exposed to a wide assortment of naturally occurring bacteria are generally more healthy, experience less death loss, and supply a more consistent return on a marginal investment than conventionally produced livestock.

Some of the basic principles of organic health management include fostering natural immunity in animals by increasing animal and plant biodiversity; balancing nutrition through pasture-grazing management; using mineral supplementation; and providing high-quality stored forage when pastures are dormant. The natural living conditions of pastures and the shade from arbors decrease the animals' stress and remove unnecessary burdens on their immune systems. Also, other practices, such as sanitation, vaccination, the quarantine of new animals, and the use of probiotics in young animals, can foster a healthier environment for livestock. Some ailments are genetically inherited, and the herd can be "bred up" to be disease free through selective breeding and by culling offending animals.

Probiotics are microbes that protect their host and prevent disease. The best-known probiotic is *Lactobacillus acidophilus,* which is found in yogurt, acidophilus milk, and supplements. It is often used for young calves that are prone to scour, giving them a shot of helpful bacteria to get their digestive systems going again.

Most conventional treatments, such as the use of antibiotics, are not allowed in organic production. However, there are appropriate alternative treatments that are effective. For example, foot rot can be successfully treated with copper sulfate, iodine, and/or hydrogen peroxide, which are all listed as approved substances for organic livestock production. It is counter to the intent of NOP organic regulations to withhold treatment from an animal to maintain organic certification. In fact, if an animal were to decline to the point of obvious impairment and suffering, and if conventional treatment were the only recourse, the treatment should be administered and the animal removed from the organic herd.

Organic regulations require access to outdoor areas, shade, shelter, space for exercise, fresh air, direct sunlight, and pasture for grazing of ruminant livestock. Confinement is allowed in case of inclement weather, specific health and safety needs of the animal, or risk to soil or water quality. NOP regulations also specify that organic cattle must be slaughtered and processed at a certified organic facility. More information on processing is found later in this publication.

Organic ruminant animals must graze pasture during a grazing season of at least 120 days per year and obtain a minimum 30% average of their dry-matter intake from pasture over the course of the season.

NOP regulations state that "livestock products that are to be sold, labeled, or represented as organic must be from livestock under continuous organic management from the last third of gestation" (USDA, 2006a). In addition, livestock used as breeder stock "may be brought from a non-organic operation onto an organic operation at any time: Provided, that, if such livestock are gestating and the offspring are to be raised as organic livestock, the breeder stock must be brought onto the facility no later than the last third of gestation" (USDA, 2006a).

The NOP has developed, in cooperation with organic livestock producers and organic-industry professionals, a pasture rule for organic ruminants that went into effect in June 2010 (USDA, 2010). Organic ruminant animals must graze pasture during a grazing season of at least 120 days per year and obtain a minimum 30% average of their dry-matter intake from pasture over the course of the season. In addition, ruminant animals must have year-round access to pasture; all roughages used for bedding must be certified organic; producers must have a pasture-management plan; and producers must manage pasture as a crop to meet the feed requirements for the grazing animals and to protect soil and water quality. Ruminant animals must be grazed throughout the entire grazing season for the geographical region, which shall be not less than 120 days per calendar year. Due to weather, season, and/or climate, the grazing season may or may not be continuous.

There are many excellent resources to help farmers and ranchers complete the tasks required to make the transition to organic production—including grazing-management planning and complying with the NOP Pasture Rule. There are many ATTRA livestock and pasture publications, available at *www.attra.ncat.org/attra-pub/livestock/production.html,* that will help producers who are considering organic livestock certification. Be sure to check the ATTRA website at *www.ncat.attra.org* for updated and new publications. ATTRA publications are available free of charge, either by downloading them from the ATTRA website or by calling 800-346-9140.

Grass-Fed and Grass-Finishing

The USDA has established a grass-fed standard that basically defines grass-fed as 100% forage intake for the life of the animal (USDA, 2007). Grass-finished is a different term; it identifies an animal that was fed a forage diet (pasture) during the finishing phase to an extent that an "end finish"—subcutaneous (backfat) cover and adequate intramuscular fat content—was reached. For adequate finishing, an animal must have enough backfat for nutrients to be partitioned for the deposition of intramuscular fat.

A grass-fed animal may not necessarily reach this end finish (i.e. marbling). Grass-finishing is primarily a question of managing to obtain a certain carcass quality. Using appropriate genetics and grazing and forage management, grass-finishing can allow the animal to be finished to high Select or Choice grade. Jim Gerrish, a forage consultant in May, Idaho, notes that an animal should be gaining more than 2 pounds per day for at least 60 days on grass to finish high Select or Choice, given the right genetics (Smith, 2006).

Quality Grade and Its Relation to Grass-Finishing

Conventionally (grain-fed) finished cattle require a backfat of at least 0.3 inches and a USDA quality grade of high Select to low Choice to be profitable. This usually means a finished live weight of 1,200 pounds or greater. To reach a quality grade of high Select or better in a grass-finished regime, more time will be needed during the finishing phase—in addition to the animal having the right genetics to finish well on grass. Most grass-finishing producers utilize smaller-frame cattle that mature earlier, but there is a trade-off between early maturity and end live weight after finishing. Most cattle just will not grade well until they reach a live weight of over 1,100 pounds. For direct-marketing purposes, lighter market weights will often work fine, even though they may not make the USDA quality grade of high Select or better. For producers considering marketing to the retail sector (e.g., grocery, restaurant, and food service), lighter market weights (1,050 to 1,100 pounds) may not provide the necessary yield and quality grade. This is why obtaining animals with the right genetics to finish on grass is so critical.

Grass-finishing, as was mentioned above, requires careful attention to forage and cattle management to produce an acceptable carcass. The selection of an appropriate breed type is important as well. (See Selecting Appropriate Animals for Grass-Finished Cattle Production, below.) This paper goes into detail on cattle management and provides further resources for managing a forage base for producing cattle on pasture.

Here are some basic considerations for managing grass-finished cattle:

- Determining appropriate genetics and good forage and animal management. Within any breed there are bloodlines that will work well and others that will not work well for grass-finishing.
- Allowing longer times to reach market weight. Research suggests that grass-finished cattle take 60 to 80 days longer than conventionally raised beef to reach a market weight of 1,050 to 1,100 pounds and grade Select or better (Smith, 2006).
- Understanding that possible land-use changes may be needed to maintain an adequate forage base. The changes could include converting grain fields into permanent pastures and using cropped land for winter or summer annuals in rotation.
- Understanding the "winter challenge" and the use of winter annuals, grass silage, alfalfa hay, and stockpiled summer pasture for winter grazing. A good forage-sequencing program is necessary for adequate year-round finishing of grass-finished cattle.
- Thinking in terms of sustainability. Consider how the farm or ranch can achieve long-term sustainability, economically and ecologically, by relying on forages instead of purchased or farm-grown grains.
- Most important, having a marketing plan in place prior to starting. A marketing plan is the most critical factor in the entire system. You can do everything else right, but you will not be successful if you do not have a good marketing plan in place.

Forage sequencing is the practice of using various forages in sequence to provide adequate dry-matter intake on pasture throughout the grazing season. For example, overseeding annual ryegrass in a summer Bermudagrass pasture provides high-quality forage in the fall, winter, and spring, depending on the location. Other examples of forage-sequencing regimes are grazing warm-season annuals (e.g., sorghum-sudan) in the summer when the growth of cool-season perennials slows down, and grazing forage brassicas in the late summer and fall months. Stockpiled forages can be grazed in the winter; however, this requires foresight in the late summer. Ample time must be given for the forages being stockpiled to attain enough dry matter to provide grazing in the winter. Using various forages in sequence will ensure adequate grazing throughout the year.

Selecting Appropriate Animals for Grass-Finished Cattle Production

Matching the right animal or plant with the appropriate environment leads to healthy animals and a productive and successful farming system. Knowledgeable farmers understand that organisms adapted to the climate and habitat do much better than those placed into situations nature might not have intended. Selecting the right genetics for pasture-based production is therefore of utmost importance.

In general, you want an animal that combines maternal traits such as adequate milking ability with early maturity and meat tenderness. These three traits are important because a cow must calve on pasture and raise a thrifty calf that grows quickly. The carcass should yield high-quality beef that provides a positive eating experience for the customer. For this reason, the moderate-body-type English breeds usually fit best with grass operations. However, it is important to remember that there is wide variability in the expression of the traits important for pasture-based systems, even within breeds. Select for particular production traits in breeds such as Angus, Red Angus, Hereford, and Shorthorn, as well as rarer or more obscure breeds such as Devon, Dexter, American Low-Line, Galloway, Murray Grey, and British White.

The three most important traits to select for are *adaptability*, *fertility*, and *longevity*. These three traits have the greatest influence on profitability. Discuss these traits with your seedstock producer before purchasing seedstock or stocker cattle. There are other traits to select for as well:

- Average milking ability, which is best for low-input type cattle; milking ability that is too high requires high maintenance costs.
- Soundness of feet and legs.
- Udder quality (i.e., well-placed teats, symmetrical quarters, and adequate support).
- Good carcass characteristics (i.e., the ability to finish on a high-quality forage diet), carcass yield, and meat tenderness.
- Early maturation.
- Low maintenance.

Carcass quality is very important and is often overlooked by new grass-finished beef producers. Many of the "grass-finished" beef cattle produced today are actually under-finished. A more accurate term for these cattle is "grass-fed." The end product from these cattle has little backfat and not enough marbling, and it can be dry and tough when cooked.

Red Angus cattle grazing on a rotational grazing system in Rio Arriba County, New Mexico. Photo: USDA-NRCS

Important breeds in the humid South and Southwest are Brahman and such Brahman-cross composites as Beefmaster (one-half Brahman, one-quarter Hereford, and one-quarter Milking Shorthorn); Santa Gertrudis (three-eighths Brahman and five-eighths Shorthorn); Brangus (three-eighths Brahman and five-eighths Angus); and Braford (approximately one-half Hereford and one-half Brahman). Brahman cattle are very tolerant of heat, humidity, and parasites, and they have excellent maternal traits. However, they do not have the carcass characteristics and marbling that consumers have come to expect. For this reason, some producers in the southern U.S. keep the Brahman influence in their cow herd to one-quarter or less and no more than one-eighth Brahman breeding in terminal (market) calves.

It is not necessary to have Brahman genetics in your herd if you live in the southern U.S. as long as you select cattle that are adapted to your climate. Red-hided cattle are well-suited for the southern U.S. and perform well in heat and humidity. Alternates for Brahman to cross-breed with British breeds are Senepol, Tuli, and Bonsmara.

Brahman cows in College Station, Texas. Photo: Lee Rinehart, NCAT

Animal Selection Guidelines

For grass-finishing, select animals from herds that have mature weights around 1,100 pounds, since these will most likely finish better. Grass-finished beef cattle are usually marketed when they are between 22 and 30 months old. Selecting body type is more important than the breed type for grass-based operations. The following qualities should be selected for in animals, including herd bulls:

- Dual-purpose breed types. These are breed types that were historically bred for both milking ability and meat. Examples of breeds in this category are Shorthorn and Devon.
- Medium frame. Frame Score 2.0 through Frame Score 5.0 is the target. (See *Table 1*.)
- End weight geared toward the targeted market. Nine hundred to 1,100 pounds end weight may be appropriate for direct marketing. For marketing through retail channels, however, 1,150 to 1,300 pounds of end weight is more appropriate. Some retail markets discriminate against cattle with lighter end weights because they typically yield much less than the heavier cattle.
- Slaughter age. Grass-finished beef cattle are usually marketed at 22 to 30 months old.
- Early maturation. Cattle that reach mature weight relatively quickly compared to other cattle tend to finish quicker as well. Keep in mind that cattle finished on grass take several months longer to finish than do conventionally finished cattle.
- Low maintenance requirements. Cattle that are smaller framed with average milking ability and good adaptation to the region tend to have lower maintenance costs.

Table 1: Frame sizes for projected cow weight and slaughter weight at USDA Choice Quality Grade

BIF Numerical Frame Score	USDA Feeder Calf Frame Size	Mature Cow Weight	Steer Slaughter Weight	Heifer Slaughter Weight
2	Small	955	850	700
3	Small	1030	950	800
4	Medium	1100	1050	900
5	Medium	1175	1150	1000
6	Large	1250	1250	1100
7	Large	1320	1350	1200
8	Large	1395	1450	1300
9	Large	1470	1550	1400

Source: Dhuyvetter, 1995

Buying Cattle: Feeder Calves and Breeding Stock

Spend some time researching prospective seedstock producers before committing to a particular breed or type. Get to know not only the producer but their entire program, and determine if their cattle are truly raised in a low-input, grass-based production system. Visit several recommended seedstock producers who have good reputations for producing cattle that consistently do well on grass. If their cattle are not raised on a low-input, grass-based system, they will not work for your grass-based system. Ask to see the entire herd and observe the animals at all stages of maturity. Also, ask to see the relatives of the animals you are interested in. Look at the soundness of their cattle out on pasture. Things to look for include good feet, legs, udders, and eyes. Make sure the cattle are adapted to their environment, and try to buy cattle only from seedstock producers in your region of production.

Select animals from seedstock producers who have a good reputation for producing cattle that consistently do well on grass.

For more information on livestock breeds, see the Oklahoma State University (OSU) Animal Science website, *http://139.78.104.1/breeds*. Information on rare breeds can be found at the American Livestock Breeds Conservancy (ALBC) website, *www.albc-usa.org*.

Cattle Nutrition

Cattle require consistent sources of protein, energy, minerals, vitamins, and water to maintain productivity and health. For detailed information on ruminant physiology and nutrition, see the ATTRA publication *Ruminant Nutrition for Graziers.*

There are ways the producer can determine an overall picture of the nutritional status of the herd:

- Using body-condition scores
- Assessing individual animal weights and Average Daily Gains (ADG)
- Assessing pasture condition
- Using soil- and plant-tissue testing to determine mineral and nutrient content

Feed intake is regulated by an animal's energy needs. Therefore, producers should consider energy concentration first when attempting to balance animal diets. Adequate energy concentration in the diet allows cattle to utilize other nutrients such as protein, vitamins, and minerals. Here are some of the major determinants of an animal's energy requirements:

- Weight
- Body-condition score
- Milk production
- Rate of growth
- Level of activity
- Impacts of climate (e.g., heat, cold, and humidity)

The energy requirements of growing or lactating cattle can be met with fresh pasture or with high-quality grass-legume hay in the winter. Dry cows can subsist on lower quality feedstuffs, but they must be maintained at an acceptable body-condition score in order to be successfully bred and deliver a healthy calf.

Determining the nutritional status of finishing cattle

Producers who are finishing cattle on grass should pay particular attention to actually weighing cattle and not merely rely on body-condition scores. Body-condition scores (BCS) are great for evaluating brood cows, but BCS values can vary between different producers and buyers. There is no better way to get a firm grip on what your average daily gains are than by weighing the animals. When producers weigh finishing cattle periodically, they can track average daily gains and better estimate when the cattle are actually finished.

Forages have the ability to supply all the energy needed to maintain highly productive cattle throughout the grazing season but only when the forages are managed well. A legume-grass pasture has adequate protein and high digestible-energy levels during the vegetative stage. The nutrient value lowers as plants mature. Consider getting your forage analyzed to determine its nutrient content and concentration. Your local Cooperative Extension office can assist in sampling forage.

The Relationship of Forage Maturity to Grass-Finishing of Cattle

Forages for finishing cattle should be just about balanced between soluble carbohydrates and crude protein. Anibal Pordomingo, an animal scientist from Argentina who has done work in grass-finished beef production, suggests this balance should be a ratio of about 1 to 1. Protein

is required by rumen microbes, and the microbial protein that is produced in the rumen provides protein to the animal. Readily digestible soluble carbohydrates are needed by the rumen microbes to utilize the nitrogen released in the rumen during protein digestion (Kopp, no date). A 1:1 ratio of carbohydrate to protein is thought to be the best ratio to ensure adequate energy for protein metabolism in the animal.

The ratio between carbohydrates and protein can be managed by monitoring the maturity level of the forages and allowing cattle to graze forages at the proper stage. According to Williams (2010), the best forages for finishing cattle are those that are slightly mature and are not too lush. If forage protein is too high (when the forages are very young and vegetative), the rumen microbes may not have enough energy to utilize the excess protein. This will result in inefficient utilization of forage and possible energy-utilization problems in the cattle. Forages for finishing cattle should be less than 16% crude protein—and preferably no more than 14%.

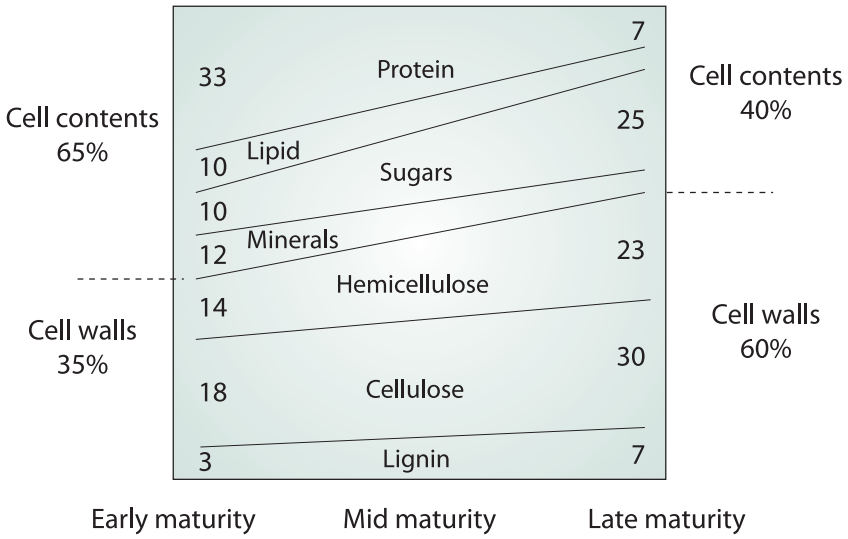
Table 2 illustrates the variation in nutrient composition as forages mature. As forage plants mature, some nutrients decline while others actually increase. Producers often make the mistake of trying to finish cattle on forages that are too immature. It is clear from *Table 2* that forages that are young, lush, and vegetative do not necessarily provide the highest levels of ALL nutrients.

Energy levels in forages also change according to the time of day. As the day progresses, plants are photosynthesizing and transporting nutrients into their leaves. Consequently, the percentage of nonstructural carbohydrates (on a dry-matter basis) in forages harvested in the afternoon can have as much as one and one-half times the energy as the same plants in the morning. Turning cattle onto fresh pasture in the afternoon, then, can have a significant impact on the animals' gains.

Nutrient Requirements: Protein, Minerals, and Water

Cows generally require crude protein in the range of 7% to 14% on a daily dry-matter intake basis. Dry cows require less, and pregnant and lactating cows require more. Growing cattle, including replacement heifers and steers, require from 10.5% to 14% protein in their daily dry-matter intake.

Table 2: Effects of Forage Maturity on Nutrient Composition. Source: Balsom and Lynch, 2008



Calcium and magnesium are the principal minerals of concern for cattle on growing forages. Others to consider are salt, phosphorus, potassium, selenium, copper, and sulfur. These minerals are very important for cellular respiration, nervous-system development, protein synthesis and metabolism, and reproduction. Vitamins are important for the formation of catalysts and enzymes that support growth and body maintenance in animals. Vitamin A is an important supplement for grazing animals. Vitamin A supplementation should be included in the mineral mix at about 1,200 to 1,700 International Units (IU) per pound of dry matter in feed intake per day. Green forage, high-quality hay, and cereal grains are typically high in Vitamin E. Mineral and vitamin supplements are available in many formulations. Because soils differ in mineral content from place to place, recommending a mineral mix that works everywhere is not possible. Check with your local Extension agent or veterinarian to determine the mineral and vitamin mixes and recommendations common to your area. Mineral supplements should be provided on a continuous basis to all classes of cattle.

Cattle require from 3 to 30 gallons of water per day. Factors that affect water intake include age, physiological status, temperature, and body size. A rule of thumb is that cattle will consume about 1 gallon of water per 100 pounds of body weight during winter and 2 gallons per 100 pounds of body weight during hot weather.

In general, double those estimates for lactating cattle. Water should be clean and fresh; dirty water decreases water intake. Remember that all other nutrient metabolism in the body depends on water, and if a cow stops drinking, nutrient metabolism (e.g., maintenance, growth, and lactation) will decrease.

Water quality is of considerable importance for maintaining animal performance. Water should be clean and free of manure. Manure in livestock water may allow for the growth of blue-green algae, which produces a toxin that can poison livestock. Also, water that is high in nitrates can interfere with an animal's ability to absorb oxygen. High salinity in livestock water can cause dehydration, and the presence of bacteria may cause such diseases as leptospirosis and brucellosis (USDA, 2006b).

Feeding rumen microbes is important in maintaining cattle health and productivity.

Water can be supplied to livestock from wells, ponds, municipal supplies, streams, or springs. If you are using a surface source of water, give careful attention to water quality. Water from ponds or streams may be more prone to some of the contaminants mentioned above. In addition, producers should protect surface-water sources from degradation that may be caused by livestock when they come for a drink. The Natural Resources Conservation Service (NRCS) publication *Watering Systems for Serious Grazers* (USDA, 2006b) suggests some ideas for developing watering points in ponds and streams to lessen the deterioration of their banks when the animals congregate. One of the ideas is to use floating PVC pipe and electric polywire to section off a small portion of the water body and create a watering point. The ground in and around the watering point and leading into the water is covered with gravel or rock to prevent animals from muddying the waters and contributing to water contamination. The publication is available online at *www.mo.nrcs.usda.gov/news/pubs_download/out/Watering%20Systemslow.pdf.*

Grazing Nutrition

As was discussed above, cattle are adapted to use forage because of the natural population of microbes in their rumen. Therefore, feeding the rumen microbes is important in maintaining cattle health and productivity. The rumen microbes feed the animal, particularly by supplying microbial protein and volatile fatty acids from rumen fermentation that are absorbed in the small intestine. The nutritional needs of cattle will change depending on age, production stage (e.g., lactating cows, bred cows, stockers, feeders and heifers) and environmental conditions.

The nutritional composition of forages changes depending on plant maturity, species, season, moisture, and the grazing system being used. In general, the younger a plant is, the more digestible it is. Plants begin to increase in fiber and decrease in cellular solubles as they mature. Cool-season species are more digestible than warm-season species at the same stage of growth, and annuals are usually more digestible than perennials. Clovers are more digestible than grasses. It is, however, important to remember that digestibility is not the only issue with forages, and there is a balance between young and mature plants for optimum nutrient availability in forages. Younger, immature plants are typically higher in moisture and lower in dry matter than more mature plants. They are also relatively higher in protein and lower in plant sugars. This creates imbalances in the ratio between carbohydrates and crude proteins, as was discussed above. Letting forage plants mature slightly to balance out energy and protein before turning cattle onto the pasture can increase forage utilization and maximize animal gains.

Grazing forages when they are slightly mature (grasses at boot stage) has a number of benefits:

- Maximizing sugar (energy) content
- Balancing energy with protein
- Taking advantage of adequate forage digestibility
- Grazing when availability of quality forage is maximized

As a rule of thumb, the best time to turn finishing cattle onto a pasture is when the grasses are nearing the boot stage, or just when the seedhead is about to emerge from the stem sheath. At this point, plant nonstructural carbohydrates (digestible sugars for energy) are just about maximized. However, a much more reliable method of determining carbohydrate concentration is to use a refractometer. A refractometer is an instrument that measures Brix, the soluble-sugar content of forage-plant sap. Producers can monitor forage Brix on a

weekly basis and document the rise in plant sugars as the forage matures. When the plant sugars are at their maximum, it is time to turn the cattle in. Monitoring Brix and turning cattle onto the pasture accordingly will assure a better ratio of nonstructural carbohydrates and crude proteins in the forage. Detailed information on Brix and refractometer use is available from Balsom and Lynch (2008).

Keep in mind that the boot stage of plant production, when seed heads are just about to emerge, occurs at different times depending on the species of grass being grazed. Also, in the spring many graziers turn cattle out to pasture when the grass is vegetative, well before boot stage for some species. This may be an acceptable and recommended practice for some animals, such as cows and cow-calf pairs. However, for a grass-finished operation, a forage sequencing program whereby forages can acquire slight maturity before grazing might be a better way to allocate nutrients to animals in the finishing phase on pasture.

In general, here is the hierarchy of forage digestibility (at equal stages of development) from lowest quality to highest quality:

1. Warm season perennial grasses
2. Warm season annual grasses
3. Cool season perennial grasses
4. Cool season annual grasses
5. Legumes

A word on supplementation…

Many beef producers provide supplements of grain or high-quality hay when grass is short, too mature, dormant, or when animal needs require it. However, excessive grain supplementation may reduce the ability of the rumen microbes to digest forage—in addition to disqualifying cattle from being marketed as grass-fed or grass-finished.

Supplementation is not necessary in a well-managed grass-finishing production system. Rather than relying on grain for energy supplementation, graziers can take advantage of forage-sequencing systems and diverse forages that include multiple species of grasses, forbs, legumes, and herbs, instead of monocultures. High-stock-density grazing systems coupled with adequate pasture-rest periods are crucial for managing the intake of adequate nutrients from pasture. Forage- and grazing-management strategies are covered below in the Pastures and Grazing Management section.

Cattle grazing on cool-season pasture in Ida County, Iowa. Photo: USDA-NRCS

Forages are usually deficient in salt, and many producers provide salt mixed with such essential minerals as calcium and phosphorus, depending on the soil's mineral content.

Health and Disease Management

Cattle health management focuses on disease-prevention strategies:

- Fostering natural immunity in animals by increasing animal and plant biodiversity on the farm
- Balancing nutrition through pasture and grazing management and mineral supplementation
- Reducing animal stress through appropriate facility design and pasture access
- Providing high-quality stored forages in the dormant season

The natural living conditions of pastures decrease animals' stress and remove unnecessary burdens on their immune systems. Other practices such as sanitation, quarantine of new animals, and the use of probiotics in young animals

can also foster a healthier environment for livestock. Disease prevention is the best health plan for your herd, and a well-planned pasture-based system effectively eliminates many disease vectors and alleviates many nutritional disorders.

Calves are subjected to many simultaneous stresses when they are weaned, castrated, dehorned, inoculated, and offered unfamiliar hay and grains. Calves exposed to these stressors become particularly prone to respiratory infections. However, calves that are castrated early, naturally dehorned with a polled bull, and weaned on grass tend to be healthier and gain weight more rapidly with fewer health problems.

Disease

The first line of defense in parasite control should be maintaining optimal livestock nutrition.

Disease is a condition that usually occurs when an infectious agent comes in contact with an immuno-compromised animal. Stress factors usually underlie compromised immune systems. Stress factors in cattle production include hunger, heat, cold, dampness, wind, injury, fatigue, and rough handling. Infectious agents include viruses and bacteria, which cause many of the disease conditions common to beef cattle. For more detailed information on cattle diseases, refer to your local county Extension agent. Many state cooperative Extension services offer free publications on the diseases endemic to their area. The Merck Veterinary manual also is a very good reference on animal diseases, prevention, and treatment. Refer to the Resources section of this paper for information on how to obtain a copy of the manual. Producers should cooperatively develop a herd-health plan with their veterinarian.

Plant Toxicity

Livestock producers must pay careful attention to the negative health effects that certain plants can cause in livestock. There are a number of common and economically important disorders:

- Bloat
- Grass tetany
- Prussic acid poisoning
- Nitrate poisoning
- Fescue toxicosis
- Consumption of poisonous plants

These conditions are covered in detail in the ATTRA publication *Pasture, Rangeland, and Grazing Management.* Other good sources of information on plant toxicity are your local Cooperative Extension office (see the accompanying box) and various popular books such as *Southern Forages* (Ball et al., 2007).

Your Local Cooperative Extension Office

Contact your local Cooperative Extension office for information on poisonous plants, forage-nitrate testing, and locally adapted forages. The USDA maintains an online database of local Cooperative Extension offices on its website: *www.nifa.usda.gov/Extension/index.html.* The phone number for your Cooperative Extension office can be found in the county-government section of the local telephone directory.

Internal and External Parasites

Internal parasites are a problem in many parts of the U.S., notably in warmer, more humid regions such as the South and East. Parasitism is manifested in cattle in a number of ways:

- Reduction in milk production
- Weight loss
- Lowered conception rate
- Rough coats
- Anemia
- Diarrhea

The first line of defense in parasite control should be maintaining optimal livestock nutrition. The second line of defense is to establish specific management strategies that can reduce the incidence of parasitism. These strategies include the following:

- Pasture rotation
- Grazing pastures no shorter than 3 to 4 inches in height
- Dragging or clipping pastures
- Multispecies grazing, including poultry
- Monitoring with fecal samples
- Barn sanitation

Many producers have come to recognize that internal parasites cease to be a problem as animals become adapted to a diverse ecosystem and have their nutritional needs met. Good health and natural immunity go a long way toward reducing the incidence of both disease and parasitism.

Mass treatment of cattle is not necessarily warranted in grass-based systems because of this natural immunity. It is much easier to determine which animals have natural immunity if they are treated individually as symptoms become apparent. Animals showing symptoms of parasitism can be treated, and repeat offenders can be culled. In this manner, the natural immunity of the herd can be selected for over time.

For more in-depth information, see the ATTRA publication *Integrated Parasite Management for Livestock.*

A Word on Parasiticides

Beef producers have historically relied on parasiticides (chemical dewormers) to combat such parasitic pests as the brown stomach worm, which can cause significant health and economic damage to a cow herd when infection is severe. A common practice is to alternate applications of different paraciticide products to reduce the chance that the parasites will become immune to a particular treatment. Many injectable and pour-on types of parasiticides are available. Some dewormers are not biodegradable and remain active in manure. These products become a part of the pasture environment, and several are thought to kill dung beetles and may have other unintended side effects as well. If you plan to use a dewormer, your veterinarian can recommend an appropriate application schedule for your area.

For organic producers, the use of synthetic parasiticides (Ivermectin) is restricted to breeding cattle before the last third of gestation and at no time during lactation. See the section on Organic Cattle Production for more information.

Vaccines

Vaccination against disease is an accepted practice in modern cattle production, including organic production, and should complement other preventative health management practices such as reducing stress, ensuring a balanced ration, and providing pasture access.

Some "natural" cattle producers question vaccination and assert that providing for the development of natural immunity through farm bio-diversification protects animals better than a vaccination regime. Vaccines are seen by these practitioners as a bypass of natural immunity. Regardless, vaccination is a tool that should be carefully considered by the producer and the veterinarian, but it is not meant to take the place of good animal management.

However, vaccination is a recommended practice especially for producers who sell live animals rather than marketing beef products directly off the farm or ranch. Animals that are not vaccinated and are subsequently co-mingled with other animals after being moved to another facility will necessarily come into contact with pathogens that may reduce their ability to perform. Some beef cooperatives and companies that market live animals from producers require specific vaccination regimes.

Producers should develop a vaccination program to address the risks of diseases endemic to their region. Consult your veterinarian to determine the types of vaccines recommended for your area. For more information, see *General Principles of Vaccination and Vaccines*, in the *Cow-Calf Management Guide and Cattle Producers' Library* listed in the Resources section of this paper.

Integrating Cattle into Cropping Systems

Cattle have the potential to give value to cover crops in rotation when the crop otherwise might not yield an economic return (Bender, 1998). Many farmers utilize legume cover crops in rotation to build soil and increase soil nitrogen for subsequent crops. Cover crops greatly

Cattle combine well with mixed cropping, as on this diversified farm in Maryland. Photo: USDA-NRCS

benefit small-grain and vegetable yields without the use of soluble fertilizers. However, most cover crops are used as green manures and incorporated into the soil in preparation for subsequent crops. Cattle grazing on cover crops can benefit the farm system economically and ecologically. Either by selling fed steers or by custom grazing yearlings, producers can make a financial return on the land. Furthermore, soil fertility can be enhanced through increased nutrient cycling (dunging and urine deposition, especially on intensively rotated paddocks).

Here is a word of caution for graziers of crop residues: land that is tilled annually for row-crop production and subsequently grazed is at risk of soil compaction due to the impact of the animals. Tillage is known to destroy soil structure, and when livestock impact is added, soil compaction becomes a serious side effect. Row-crop farmers can ameliorate soil-compaction problems by grazing when the soil is dry. Also, discing to a depth of no more than 6 inches prior to planting the next crop can remedy soil compaction (Samples and McCutcheon, 2002).

If you are considering adding a grazing component to an existing cropping system, note that the cost of electric fencing and water delivery can eat up profits quickly unless these structures are already in place. Consider grazing more valuable animals, such as steers or replacement heifers, instead of cows. Steers and heifers are generally maintained for a short period of time, and you will not have to cover the yearly maintenance costs associated with keeping a cow herd.

Nutrient Cycling

Grazing cattle return 70% to 85% of the nutrients they consume back to the pasture in the form of manure and urine. However, the type of grazing system being employed has a huge effect on how the nutrients in manure and urine are dispersed throughout the pasture. Nutrients are returned to the soil in a much more uniform manner when a highly managed, and highly animal-dense, rotational grazing system is used. The strategic placement of water, shade, and mineral sources helps distribute cattle as well. Unless a high-density grazing system is used, nutrient application throughout the pasture will be spotty at best, with some areas having high concentrations and others very little.

When manure applications are combined with nutrients from the dead leaves and roots of pasture plants, the nitrogen contribution to nutrient cycling can approach 280 pounds per acre each year in a moderately managed grass-and-clover pasture (Bellows, 2001). Pastures with a legume component of 20% to 45% are more sustainable than monoculture grass pastures because the legumes contribute significantly to nitrogen fertility. For more information, see ATTRA's *Nutrient Cycling in Pastures*.

Stocker cattle under an intensive grazing system in Oklahoma. Photo: USDA-NRCS

Stocker Cattle Production

Stocker cattle have been defined as young weaned cattle, usually weighing 500 to 700 pounds, grazing on grass prior to finishing in a feedlot. This enterprise can allow producers to take advantage of livestock weight gains on relatively inexpensive feed (i.e., pasture). In most livestock operations, feed costs are the greatest expense, but labor and health costs are often greater in stocker operations (Powell and Troxel, no date). A typical stocker operation is one in which cattle are received in the spring, placed in a receiving program (to acclimate them to the new operation), and then placed on pasture. In the fall, cattle are sold through order-buyers, sale barns, or other avenues such as video sales. (For example, see Superior Livestock Auctions at *www.superiorlivestock.com*.) Other opportunities include wintering the cattle and finishing them the following year on grass to produce grass-finished beef. As has been discussed above, this option requires some foresight in the area of marketing.

Receiving programs

If you purchase calves from a sale barn, you likely will not know the health history of the animals. If this is the case, a good receiving program should be in place to get them over the stress of shipping and of finding themselves in a new environment. A good receiving program will get them on their feet quickly, so they can begin grazing and gaining weight as soon as possible. Vaccinations and proper cattle-handling techniques are

very important during this time to minimize stress and decrease death loss during the stockering period. The publication *Stocker Cattle Management: Receiving Health Program* from the University of Arkansas Cooperative Extension Service (Powell and Troxel) will be helpful here since it details vaccinations and other health-management practices you might need to consider if you are dealing with new calves on your ranch. In addition, the Noble Foundation has a paper that explains its procurement of stocker cattle for its Controlled Rotation Grazing Unit and Pasture Demonstration Farm in Oklahoma (Dalrymple, no date). See also Beef Stocker USA at *www.beefstockerusa.org* for detailed research reports, cost calculators, fact sheets, and news on the stockering business.

Production Variables for Grazing Operations

You may want to evaluate a prospective grass-finished operation from an economic standpoint to figure out a break-even price and determine whether finishing cattle is a viable option for you. To do this, you will need to write a budget. The ATTRA publication *Grazing Contracts for Livestock* contains a simple beef-cattle budget you can use for this purpose. Another good resource for developing a budget is *Stocker Enterprise Budgets for Grass-based Systems* from the University of Wisconsin, which is available online at *http://learningstore.uwex.edu/pdf/A3718.pdf.*

Determine these costs on a per-animal basis to figure a break-even price for your animals. Any income over the break-even price is considered a profit, and income under the break-even price is a loss.

Montana State University has a simple online calculator that allows you to easily input your production costs to figure a break-even price and net return per head for a grass-finished or stockering operation. The Excel spreadsheet is available at *www.montana.edu/softwaredownloads/software/grassfat.xls.* In addition, OklahomaState University has an online Excel stocker break-even calculator available at *http://beefextension.com/new site 2/sccalc.html*, and Iowa State University has calculators online at *www.extension.iastate.edu/agdm/livestock/html/b1-21.html.*

Production Variables for a Grazing Budget

- **Animal costs:**
  - purchase price
  - labor
  - veterinary costs
  - supplemental feed and/or minerals
  - insurance
  - marketing costs
- **Pasture costs:**
  - seed
  - fertility
  - equipment
  - baling costs for hay
  - labor
  - land costs
  - property taxes
  - insurance

Pastures and Grazing Management

A pasture is "a complex inter-relationship of plant, temperature, light, soil, organisms, nutrients, water, and livestock that make the pasture a continually changing (dynamic) ecosystem" (Murphy, 1995). Pastures are the foundation of sustainable livestock production. They are best maintained by developing a planned grazing system that conserves the soil and plant resources while maximizing productivity within the natural limits of the particular ecology of the farm.

Soil fertility is the first thing to consider in establishing or maintaining productive pastures. Phosphorus, potassium, and calcium levels, as well as soil pH, are important for pasture-sward quality, quantity, and persistence. Having the soil tested prior to establishing pasture, as

Warm season grassland in Litchfield County, Connecticut. Photo: USDA-NRCS

well as periodic tests every 3 to 4 years, will help develop a baseline of information on soil fertility and will help you develop and implement a fertility-management plan.

Nitrogen is an important nutrient in pasture and forage systems. Nitrogen is much more volatile than other nutrients, and its management is a little different. For instance, phosphorus and potassium can be applied during tillage to incorporate them into the soil profile prior to planting. These nutrients will be available all season long to support good quality and high yields. Nitrogen, however, travels more readily from the air to the soil and into plants. Using such legumes as clover and alfalfa to supply nitrogen to pasture plants is probably one of the most economical practices—and most sustainable from an ecological standpoint. According to Gerrish (2007), some legumes can fix enough atmospheric nitrogen to provide the nutrient in amounts equivalent to around 200 pounds of nitrogen fertilizer per acre. In this case, the limiting nutrient is often phosphorus, which is required for legume production. Soil pH is another concern for legume-based pastures. Legumes need a pH of 6.5 to 7 to be fully productive and to persist in grassy pastures.

Some legumes can fix enough atmospheric nitrogen to provide the nutrient in amounts equivalent to around 200 pounds of nitrogen fertilizer per acre.

Proper seeding—including the time of planting, the depth of planting, seed-to-soil contact, and weed competition—is also critically important for pasture establishment. Cool-season species such as annual ryegrass and white clover can be successfully seeded in the spring or fall simply by broadcasting the seed over a perennial sod, especially if the sod is grazed heavily to allow the seed to work itself into the soil. This works best if you broadcast the seed and then heavily graze with the cattle. The hoof action of the cattle helps to incorporate the seed into the soil. Other species, especially the native warm-season perennial grasses like switchgrass and big bluestem, have low seedling vigor and are best established by being drilled into a well-prepared seedbed. Weed control is critically important in all forage establishments, but especially for native grasses. Planting at the proper time, tilling, mowing, and using nurse crops can all help alleviate the negative effects of weeds on emerging forage seedlings.

Finally, the selection of appropriate plant species must be considered in order to establish and maintain a productive forage crop. This is very site and use specific. For instance, in the dairy grazing country of the Northeast and Midwest, orchardgrass, perennial ryegrass, bromegrass, alfalfa, and red clover are appropriate. Tall fescue is an important grass in the upper regions of the humid Southeast and Midwest, and bermudagrass, bahaigrass, and dallasgrass are well adapted to the beef cow-calf operations in the deep South. Kleingrass and lovegrass work well in the Southwest, and for the semi-arid regions of the western mountain states, cool-season perennial grasses such as the wheatgrasses are well adapted. And producers in the prairie states graze acres of oldworld bluestems, grama, and other introduced and native grasses. Here are some of the main plant characteristics to consider when choosing a forage species:

- Soil type, including drainage, soil texture, fertility
- Fertility regime (e.g., availability of fertilizers and organic certification)
- Adaptability of the forage species to the region
- Competition from other species
- Productive use (i.e., hay, silage and grazing)
- Animal enterprise (i.e., stocker steers, beef cow-calf operations and grass-finishing)

Choose certified forage seed when establishing new pastures. Certified seed has been germination tested, and it will have both a germination percentage and a purity percentage on the label. The weed-seed percentage also will be listed. Percent germination and percent purity help in determining pure live seed (PLS) for planting purposes.

Pure Live Seed (PLS)

The PLS seeding rate is determined by multiplying the purity percentage of the seed by its germination percentage. The PLS seeding rate is then used to determine the amount of seeds to use for a correct seeding. Say, for example, that the PLS seeding rate of a particular seed is 80%. In that case, you would divide 1 by .80, giving a proportion of 1.25. That means if you need to plant 10 pounds per acre of a forage seed with a PLS seeding rate of 80%, the 10 pounds would be multiplied by 1.25, equaling an actual seeding rate of 12.5 pounds per acre.

A Word on Season Extension

In many regions of the U.S., producers are using different plant species at different times to extend grazing beyond the summer grazing season. In the humid South, annual ryegrass is an excellent species, providing high yields of digestible energy and protein well into the fall and winter and again in the spring. In other areas, such as the lower Midwest and the upper southern states, tall fescue can be stockpiled and strip-grazed well into the winter. Forage brassicas such as turnips, radishes, and kales can be planted in the spring and strip-grazed in the fall for either lactating cows, stocker steers, or finishing cattle. Offered as strips, grain and stalks left in corn or milo fields after harvest provide another source of good-quality feed into the winter months. And in the cool-season-grass regions of the northern latitudes, the summer can be hard on grasses such as orchardgrass and ryegrass. Warm-season annuals like sorghum-sudan or pearl millet can fill the summer gap when the cool-season grasses decline. By the time the annuals have been grazed, fall rains and cooler temperatures usually result in a rebounding of cool-season grasses.

In some regions, providing excellent grazing through the hottest summer months is the biggest challenge. Native grasses, summer annuals, and interseeded legumes can offset this slump. However, the costs of establishment—in time and money—are justified only if the resulting increase in livestock production translates into sufficient profit.

Rotational Grazing; Pastures: Sustainable Management; and *Pasture, Rangeland, and Grazing Management,* are companions to this ATTRA publications that provide further information on this subject. For detailed information on extending the grazing season, see the Grazing Land Conservation Initiative (GLCI) publication *Extending Grazing and Reducing Stored Feed Needs,* available online at *www.agry.purdue.edu/Ext/forages/pdf/ExtendingGrazing-Auburn.pdf.*

Pasture Monitoring and Assessment

Pasture monitoring is a critical step in managing productive pastures. Monitoring helps producers analyze and assess their management practices by observing the effects these practices have on the pasture resource – including plants, soil, water, and organic matter. There are many ways to monitor pastures. The simplest method may be using photo points and comparing photographs of the same pasture each year to look for trends. Other methods such as line transects take more planning but provide crucial information on how a pasture is responding to a grazing system. Range and Pasture Monitoring, in the Further Resources section of this paper, lists several good resources to help producers design and implement an appropriate monitoring system.

Grazing Systems

A grazing system rations out forage according to animal requirements, allowing full plant recovery while minimizing forage waste (Murphy, 1995). A sustainable grazing-management system has a number of elements:

- Proper timing of grazing to correspond to plant physiological stages
- Proper intensity of grazing (duration on the pasture)
- Residue or plant height after grazing
- Plant recovery time after grazing
- Adaptive management of grazing time depending on pasture recovery rates (For example, grazing time on a pasture may increase during less-productive times of the year to allow for more plant-recovery time after grazing.)

Pasture monitoring is a critical step in managing productive pastures.

An example of a good grazing system is one that employs a rotation in which animals are placed on a paddock (pasture subdivision) at a high density and moved to another paddock at the appropriate time. Most rotational grazing systems utilize 10 or more paddocks to best achieve the benefits of the system. This type of rotational grazing has been called planned grazing, cell grazing, controlled grazing, management-intensive grazing, high-density grazing, and intensive rotational grazing. Whatever the name, the main point of this system is that it allows for more effective forage use through increased forage quality and through decreased grazing selectivity due to highly dense numbers of animals.

Intensive rotational grazing is a management system designed to maintain forages in their growing stage throughout the grazing season. Forage grasses are grazed prior to the reproductive

(seed) stage of development and allowed adequate rest for regrowth prior to being grazed again. This is done to maintain the competitive nature of grasses in a forage system by preventing them from getting too mature. Grazing grasses before they go to seed also encourages tillering. Tillering occurs when new grass shoots grow from the base of the plant, resulting in more leaf area and a more dense forage sward. So a strategy of grazing grasses before their reproductive stage and leaving adequate leaf area for regrowth is an important way to manage pastures for quality, quantity, and weed resistance.

As was mentioned above, finishing cattle should be grazed on slightly mature forages. Grazing forages when they are slightly mature contradicts much of what we have learned about intensive grazing, in which cattle graze young forages that are highly digestible. However, since forages that are nearing the boot stage of development have a better energy and protein balance than younger forages, finishing cattle will be better able to obtain all their nutrients from pasture, and grain supplementation becomes unnecessary.

So rotational grazing systems that combine the basic elements of timely cattle movement, adequate pasture rest, and grazing forages at their proper physiological stage can offer a successful strategy for finishing cattle on grass.

Rotational grazing systems are appropriate for temperate pastures as well as rangeland pastures. However, grazing systems on rangeland in the western U.S. require more attention to timing, intensity, and frequency of grazing to maintain rangeland health. Gadzia and Sayre (2009) discuss three factors—timing, intensity, and frequency—and offer expert advice on developing grazing systems on rangeland in the *Rangeland Health and Planned Grazing Field Guide,* developed by the Quivira Coalition. The guide is available online at *http://quiviracoalition.org/Detailed/QC_Publications/Field_Guides/Rangeland_Health_and..._83.html.* See the Resources section of this paper for further details.

Overgrazing results in low forage and animal productivity and sustainability. Photo: USDA-NRCS

Overgrazing

Many times we are tempted to assume that overgrazing occurs when too many animals are on the pasture. However, overgrazing is the result of how much time animals are on pasture, not the number of animals. In other words, overgrazing is caused by allowing animals, whether many or few, to remain on a pasture for too long.

Cattle select the most nutritious plants in a pasture while they are grazing. Once a grass plant is grazed, it begins to regrow from growing points close to the base of the plant. If animals are left on a pasture for more than a few days, cattle are likely to graze off the new growth, causing stress to the plant. As plants are grazed successively in this manner, the grass's root system will begin to decline, and the plant will eventually die. Grazing management is a matter of keeping an animal from grazing new regrowth until it has had a chance to grow several inches and renew the root system's energy stores.

A grazing system allows adequate time for forage leaf and root regrowth. If not, an overgrazed pasture is the result. There are a great many well-prepared resources available to assist producers in designing and implementing a controlled grazing system. ATTRA offers the following publications:

- Paddock Design, Fencing, and Water Systems for Controlled Grazing
- Rotational Grazing
- Nutrient Cycling in Pastures
- Assessing the Pasture Soil Resource
- Pastures: Sustainable Management
- Managed Grazing in Riparian Areas
- Pasture, Rangeland, and Grazing Management

Also see the Resources section at the end of this publication for more books and websites on pastures and grazing management.

Developing a Grazing System

When developing a new grazing system or making a change in grazing management, a logical first step is to conduct an inventory of the farm's resources. An aerial map of the farm is useful to mark fences, water supplies, and existing forage resources. Writing down farm and family goals in this process makes it easier to stay on course with management decisions. When a salesperson is applying pressure, for instance, it helps to be able to evaluate the cost of the product against some chosen goal.

Implementing rotational grazing requires subdividing the land into paddocks, providing access to water, adjusting stocking rates, and monitoring grazing duration. These decisions may seem overwhelming at first. Some of the reference materials listed at the end of this paper offer information about setting up paddocks to fit the landscape, calculating stocking rates, and estimating forage yield and availability. For more information, see the ATTRA publications *Rotational Grazing,* and *Paddock Design, Fencing, and Water Systems for Controlled Grazing.*

Seasonal Adjustments

Rotational grazing gives the livestock manager flexibility in responding to the changing forage supply. During periods of rapid plant growth, cattle are moved quickly through paddocks. Alternatively, if equipment is available or the work can be hired out, excess forage can be harvested for feeding later. During periods of slow plant growth, delayed rotation allows plants in each paddock a longer time to recover after each grazing period.

The Grazing Plan

A grazing plan is useful in evaluating forage productivity and in allocating the available forage supply based on the demands of the grazing livestock. The plan also can help producers keep good grazing records as well as visualize and anticipate the various changes that occur during the grazing season. Some of the factors to track in a grazing plan could be included in a grazingland inventory, such as the number of acres, the number of paddocks, and the forage yield.

Rest periods for various grasses and legumes are important when planning grazing. Rest periods are necessary for maintaining adequate recovery—both of above-ground plant growth and root growth. For cool-season grasses and legumes, the rest period is approximately 20 to 45 days, depending on the season and precipitation. For warm-season grasses, the rest period should be between 30 and 60 days, again depending on the season and precipitation. Rest periods should be adequate to allow the forages to regrow sufficiently before the next grazing event. Rest periods are also an important consideration when calculating the size and number of paddocks.

Designing a grazing system is a matter of determining how much forage is available in a pasture to meet the needs of grazing livestock and matching the forage resource to the livestock's dry-matter forage demand. Pastures must be of a sufficient quality and quantity for livestock to graze throughout the grazing season. Calculating dry-matter forage availability and livestock demand helps producers to determine the allocation of forage resources throughout the grazing season. It will also help producers further plan and document their pasture management.

Table 3: Pounds of forage available per inch (dry matter)

Forage species	Dry matter pounds/acre/inch	
	Average	Range
Alfalfa and grass mixes	225	75-400
Arrowleaf clover	200	100-300
Bermudagrass	260	150-500
Caucasian bluestem	180	75-350
Crimson clover	200	100-300
Kentucky bluegrass	160	100-175
Native warm season grasses	100	50-250
Orchardgrass	180	75-300
Orchardgrass + clover	200	100-300
Red clover	220	100-300
Annual ryegrass	250	75-400
Oats, wheat, rye	150	75-250
Tall fescue	210	100-350
Tall fescue + clover	190	80-325

Source: Ball et. al., 2006

Forage availability, or yield, can be determined with a pasture ruler. A pasture ruler, which is calibrated in inches, is placed end-up on the ground. Each inch of forage height equals anywhere from 150 to 350 pounds of dry matter per acre, depending on such factors as the location, season, soil moisture, forage density and forage species. To be accurate, this measurement should be calibrated for local conditions through a "clip-and-weigh" method. Forage is clipped in a predetermined area and weighed, adjusted for percent moisture, and the resulting weight is multiplied by a constant to arrive at forage yield on a pound-per-acre basis. Publications on this method can be obtained through your local Cooperative Extension service. *Table 3* (on page 19) shows estimates for several forage species. In addition, your local NRCS or Cooperative Extension agent will likely have estimates of forage yield for your area.

Local NRCS or Cooperative Extension agents will likely have estimates of forage yield for your area.

The following formulas are used to help determine paddock sizes and the length of the grazing period:

1. The total forage height in inches minus the grazing-residue height equals the grazable-forage height.
2. The grazable-forage height in inches multiplied by the forage yield in pounds per acre inch equals the grazable forage in pounds per acre on a dry-matter basis.
3. The number of animals multiplied by the animals' average weight, which is then multiplied by the percentage of dry-matter intake (or a forage-utilization measure), equals the daily dry-matter forage demand in pounds of the grazing livestock.
4. The grazable forage (from step 2 above) in pounds divided by the daily forage demand (from step 3 above) equals the number of days animals can graze a paddock.
5. The daily forage demand multiplied by the number of grazing days, which is then divided by the grazable forage, equals the paddock size in acres.
6. The rest period in days divided by the number of days in the grazing period, which is then added to the number of herds, equals the number of paddocks.

Forage Utilization Values

The percentage of dry-matter intake is expressed as a percentage of animals' body weight. For example, beef cattle consume between 2% and 3% of their body weight per day. Some producers choose to include in that percentage an accounting of forage wasted through, among other occurrences, trampling, wildlife grazing, and insect activity. The wasted forage is usually equivalent to about 0.5% of animal body weight. Therefore, producers who consider forage utilization to be both dry-matter intake and wasted forage may adjust estimates of dry-matter intake.

The preceding formulas make it easier to set up paddocks appropriate for your herd and to allow for variation as the grazing season progresses. Worksheets using these calculations are available by contacting the author via ATTRA at 800-346-9140.

Many state GLCI organizations have developed pocket-size pasture-record books that include useful forms for evaluating and documenting your grazing plan. A good example is the Texas Grazing Notebook, developed by Texas GLCI. The notebook is available to be downloaded online at *www.texasglci.org/docs/grazing.pdf.* A list of other state GLCI coalitions is available on the national GLCI website at *www.glci.org/links.htm.*

Also available is the Minnesota Extension publication *Grazing Systems Planning Guide,* which is online at *www.extension.umn.edu/distribution/livestocksystems/DI7606.html.* In addition, the NRCS Grazing Lands Team has many online tools and publications to assist producers in documenting a grazing plan. The NRCS Grazing Lands website is *www.glti.nrcs.usda.gov.*

Handling Cattle Successfully

By the very nature of animal agriculture, cattle must be handled from time to time in every segment and phase of the production chain. Recently, much attention has been given to the importance of minimizing the accidents in handling and shrink in transportation that cut away at a producer's profit. A well-designed handling system takes a number of factors into account: the welfare and behavioral tendencies of the animal; ease of movement; efficient and safe operation by handlers; and the overall image of livestock production as seen by the consumer. It is important then to consider the elements of proper cattle handling and the components of

Livestock-handling systems should be designed with consideration of the following factors:

- Animal stress factors
- Animal behavior
- Safety and ease of handling by the operator

a well-organized cattle-handling system in the overall management of a beef farm or ranch.

Temple Grandin, a livestock-handling consultant who has done extensive work on livestock psychology and its implications on handling, has a website that provides useful information on animal behavior and how it affects livestock handling. Grandin's website is *www.grandin.com.*

Cattle Facilities

Handling facilities must be constructed on level ground. Handling is very stressful, and accidents are more likely to happen in the pens than on the pasture. If your farm is on very hilly land, the facility will need to be placed carefully. Choose the most open area you have, and grade it with a dozer or other appropriate equipment to achieve the most level working yard you can. There really is no alternative to constructing a safe, workable, and appropriate livestock-working facility on open, level land.

Working-chute dimensions for mature cattle should be 26 to 28 inches wide with a minimum length of 20 feet. If the producer builds a working chute with sloping sides, the width at the bottom should be 16 inches. The fence for the working chute should be about 50 inches high, compared to 60 inches for the corral fence. Crowding pens, which are used to force cattle into a chute, should be built to allow a density of 10 square feet per head. Holding pens should allow 17 square feet per head. Longer chutes tend to cause crowding and trampling at the forward end, so they should be divided into sections with sliding gates. The sides should be solid, and the crowding pen should be half as long as the working chute and up to 12 feet wide at the open end.

According to Grandin, round pens or corrals were used for gathering herd animals more than 11,000 years ago in the Middle East. Grandin's research in animal-handling-facility design has suggested that corrals constructed with round holding pens, diagonal sorting pens, and curved alleys enable more efficient cattle handling by eliminating corners where animals could bunch up. In addition, curved alleys and chutes with solid sides facilitate better animal movement by shielding their view from activities outside the chutes. This makes the animals think they are returning to their starting point.

Curved races facilitate the movement of cattle through the cattle handling facility. Photo: Temple Grandin (www.grandin.com)

Detailed information including plans and specifications on livestock-handling systems can be obtained from Grandin's website at *www.grandin.com.*

Low-stress techniques of livestock handling have been gaining much attention due to the work of Bud Williams, a longtime cattle-handling expert who has developed a method of low-stress handling. Low-stress livestock handling is a method of controlling cattle movement by utilizing the behavioral tendencies and herding patterns of cattle. The handler's mindset is of utmost importance in such a method. Handlers must observe livestock behavior, looking for signs and "tells" that communicate how stressed the animals are, and approach and move them accordingly. Practitioners of low-stress handling realize that it take time to learn to handle cattle this way. To be successful, low-stress handling takes observation, patience, and a willingness to learn.

The following websites have extensive information on low-stress handling:

- Bud Williams Stockmanship *http://stockmanship.com*

- Hand in Hand Livestock Solutions *http://handnhandlivestocksolutions.com/*
- *Stockmanship: Improving rangeland health through appropriate livestock handling,* by Steve Cote *www.grandin.com/behaviour/principles/SteveCote.book.html*
  More information on this book can be found in the Further Resources section below.

Beef Cattle Record-Keeping Systems

Production records are important to cattle producers because they are a helpful tool for evaluating animal performance and pasture usage.

The lack of processors has become a bottleneck in the organic- and small-scale meat industry.

Some of the important records to keep for a beef herd include the following:

- Animal identification
- Breeding and calving information
- Health and vaccination information
- Pregnancy testing
- Culling information
- Weaning and yearling weights and averages
- Rates of gain
- Pasture condition and monitoring
- Pasture usage
- Hay and forage yields

In addition to production records, financial records should be kept. Here are some important items to keep track of for financial analyses:

- Animal inventory
- Purchasing records
- Sales receipts
- Mineral supplement bills and feeding records
- Pasture and hay costs

There are many very good record-keeping resources available to help cattle producers keep track of and analyze their productivity. The National Cattlemen's Beef Association (NCBA) offers a pocket-size record book called the Redbook that can be used to record calving activity, herd health, pasture usage, and cattle inventory. The NCBA also has a desk record, which is a loose-leaf binder of forms to help you analyze the data captured in the Redbook. For those who would like to use electronic spreadsheets, the Redbook is available as a CD or for download. These NCBA materials are available online at *www.beefusa.org/prodredbooksandothertools.aspx* or by calling the NCBA at 800-525-3085.

Slaughter and Meat Processing

Processing includes everything from slaughter to cutting and wrapping to storage. For most sales, meat must be processed in a federally or state-inspected processing plant, and the plant must be organically certified if the beef is to be sold as certified organic. This, unfortunately, has become a bottleneck in the organic- and small-scale meat industry. There are many farmers and ranchers who can and want to produce organic, and/or grass-finished beef. There are many customers, as well, who would like to purchase sustainably raised animal products. But very few small-sized processors remain who can create the link from farm gate to retail outlet, especially for small farmers who would like to direct-market their products.

Small processors are particularly hard hit when it comes to government regulation. Food-safety regulations, important as they are, remain heavily influenced by and developed for large-scale meat processors. Many small-scale processors operate on very tight margins just to stay in business, and just do not have the scale or size to absorb the structural and equipment costs often associated with large-plant-oriented food-safety regulations. But local food advocates, including farmers and consumers, suggest that food safety can best be assured through the small-scale, community-oriented linkages that occur between a single farmer and the customers who purchase their product. It is a matter of knowing where one's food comes from, knowing the farmer who raises it, and understanding how they produce it that is the strength of local food systems.

The **USDA Food Safety and Inspection Service** has a website providing outreach information to small and very small plant operators. *www.fsis.usda.gov/Science/Small_Very_Small_Plant_Outreach/index.asp*

An alternative that some producers are developing is a small, mobile processing plant that can be towed from farm to farm for slaughter and initial cutting. The Lopez Community Land Trust (LCLT) in northwest Washington State has a website with information on mobile processors. For more information on mobile processors and LCLT visit *www.extension.org/pages/Island_Grown_Farmers_Cooperative.* In addition, the Niche Meat Marketing Network has resources available online to assist interested parties in developing mobile slaughter facilities and can be accessed at *www.extension.org/pages/Mobile_Slaughter%2FProcessing_Units.*

It is important to note that mobile facilities are mostly slaughter facilities and do not provide cut-and-wrap services. It is therefore necessary for the producer to transport the carcasses to a USDA-inspected facility that can perform further processing. In addition, the per-head costs associated with most mobile facilities are generally higher than the costs associated with a stationary facility.

One avenue that might be feasible is to sell live animals directly to customers and offer them information on a local custom processor. The customer can pay the custom processor directly for their cutting order. This method is especially promising for producers who sell very few animals each year.

Where to find a small beef processor

Interested producers can search for processing plants through databases accessible from the Niche Meat Processor Assistance Network, available online at *www.nichemeatprocessing.org.* This website offers links to USDA-inspected plants and state-inspected plants as well as resources for meat-processing regulations and mobile processing units. It also has information for prospective plant owners and operators.

Interstate Shipment of State-Inspected Meat

Finally, another issue has arisen from recent federal-law changes that would allow beef producers to sell state-inspected processed products across state borders. A program was established in the 2008 Farm Bill to allow for such a possibility. Unfortunately, however, there is a pending rule (as of December 2010) that has not yet been released by the USDA Food Safety and Inspection Service (FSIS) to redress this issue. In the past, even though state-inspected processors had to meet federal standards, producers have not been able to sell their state-inspected products in larger market areas, which may be just across the state border from where the closest state-inspected processors are located. Generally speaking, there are more state inspection facilities than USDA inspection facilities. And because there are fewer USDA facilities, transportation and processing costs go up for beef producers—who end up having to travel long distances to get their products processed. The mobile processing plant described earlier was developed because, prior to its creation, livestock producers had to transport their products over 300 miles to a USDA-inspected processing facility. That made it too costly for them to garner the added value that would have been possible if a processor had been more close-by.

The FSIS is, as of this writing, reviewing comments to a proposal that would allow interstate shipment of state-inspected meat. Information on the proposal can be found on the FSIS website at *http://origin-www.fsis.usda.gov/News_&_Events/NR_091509_01/index.asp* and on the National Sustainable Agriculture Coalition website at *http://sustainableagriculture.net/publications/grassrootsguide/local-food-systems-rural-development/interstate-shipment-of-state-inspected-meat.*

Marketing Overview

Demand is growing for organic and grass-finished beef. However, marketing has been one of the most daunting challenges farmers have encountered. For most producers, learning to market their products requires new skills and considerable time. Some will choose direct-marketing venues such as farmers markets and direct sales, while others will opt for cooperative marketing. Becoming a member of a cooperative is very attractive to many farmers because cooperatives give the farmer the ability to sell products in much the same way as in the commodity market, but often with a premium. For detailed information regarding alternative marketing of beef products, see ATTRA's *Beef Marketing Alternatives* as well as *Building a Montana Organic Livestock Industry,* which includes a cost-of-production survey and an examination of how organic beef producers in Montana

Proper marketing is a time-consuming, ongoing process and probably the most important part of a successful grass-finished beef operation.

are accessing regional and national markets. In a broader sense, this report provides an understanding of the value chain of the organic grass-finished beef market from the producer to consumer. The report is available online at *www.attra.ncat.org/attra-pub/summaries/summary.php?pub=203.*

Also available from ATTRA is the *Natural Livestock Feasibility Study,* which explores the feasibility of producers developing alternative markets for livestock in Inyo and Mono counties of California. This report is available online at *www.attra.ncat.org/attra-pub/summaries/summary.php?pub=202.*

A marketing plan must account for all costs of production, including processing, packaging, cold storage, label approval, label design and printing, advertisement, transportation and labor, as well as other considerations such as website development. In this way, a producer can determine wholesale or retail pricing to set an adequate margin. Margins of return allow the producer to be paid back for their investment, for re-investment into the operation, and for profit. Also of crucial importance is a clearly identified target market. Proper marketing is a time-consuming, ongoing process and probably, as was stated earlier, the most important part of a successful grass-finished beef operation.

In addition to the above-mentioned ATTRA resources, the SARE publication *How to Direct Market Your Beef,* available online at *www.sare.org/publications/beef.htm,* is a very useful tool. It portrays how one couple used their family's ranch to launch a profitable grass-based beef operation focused on direct-market sales. From slaughtering to packaging, through labeling and advertising, the authors transform their real-life experiences into a compelling narrative rich with practical tips.

For additional information on marketing see the Further Resources section.

Acknowledgement
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Case Study: Forks Farm, Orangeville, Pennsylvania

By Hannah Sharp, NCAT Agriculture Intern

Forks Farm, located in Orangeville, Pennsylvania, was started by John Hopkins in 1986. The farm, which began with just a few cows, has become a year-round, 100% grass-fed beef operation that now also offers poultry, pork, and lamb. The 86-acre farm includes 50-70 acres of pasture, of which 35 acres are high-quality pasture. Hopkins comes from a traditional-agriculture background in Colorado. When he started the farm with only six cows, Hopkins discovered that the conventional route just wasn't economical. He had a lot of learning to do about grass-finished beef and direct marketing; he began by reading books by farmer, lecturer and author Joel Salatin. After some success finishing beef on grass, Hopkins became a 100% grass-fed and grass-finished beef producer. He produces his beef in sync with the other animals and the ecology of the farm. For example, the cows eat the grass down, letting the clover grow in. Then the chickens go through to spread the manure, eat the clover, and allow the grass to take over. The cattle eat the grass, and the next cycle begins. The chickens also provide fly and worm control.

The key to Hopkins' herd-health plan is providing good-quality pasture, keeping the animals outside and moving in a good environment, and keeping an eye on them. He hasn't wormed the herd in several years because they seem to have developed a resistance that makes it unnecessary. He feeds the animals kelp, salt, and a commercial mineral mix to keep them healthy. Simply observing the animals is also a crucial component. For example, if he suspects that an animal has worms, he will worm it using Basic H and diatomaceous earth for parasite control.

Pastures: the foundation of grass-fed production

Hopkins practices intensive rotational grazing, and he focuses on grazing and pasture management, with serious consideration given to the animals' genetics because some breed-types of cattle are better for grass-fed operations than others. Invasive species such as knotweed and Japanese stilt grass are the biggest pasture problem at Forks Farm. These species affect the pasture ecology by competing for resources with important forage species. Hopkins mows the invasive species and digs some out by hand to give the desirable species an opportunity to grow. In addition, Hopkins uses pigs to root up some of the invasive species and renovate pastures for the beef cattle. After the pigs leave a pasture, he overseeds the disturbed area with a pasture-seed mix and allows the cattle to trample it in. What results is a pasture for cattle the following year.

Direct Marketing

Forks Farm initially began selling to friends and local customers. Hopkins began working with customers through buying clubs in 2007. Club customers in a particular region send their orders, which are packed and delivered to each buying club on a monthly basis. This enables Hopkins to know what to pack in advance, as opposed to going to farmers markets, where sales can vary greatly. Hopkins charges 25 cents per pound for packing, which covers some fuel costs, and requires a $1,000 order per club per drop. As its markets have grown, Forks Farm has essentially become a year-round operation. Hopkins hosts an on-farm market for locals twice a month, to which he also now invites some of his friends to sell such products as eggs and vegetables, which broadens the appeal for customers.

Processing: the largest obstacle to direct marketing

A lack of access to processing facilities is the biggest challenge for Forks Farm. There used to be a lot of local butchers, many of whom would come out to the farm to do the processing, which meant less stress for the animals. There is a second-generation butcher just 6 miles away from the farm. Unfortunately, however, he can only do custom orders. To sell individual cuts, producers need to take their animals to a federal inspection facility, which is costly and difficult. The local butcher is only state-inspected, so Hopkins must drive his animals two hours to the nearest federal inspection facility. The demand for grass-fed beef is now so high that he has to make his appointments one year in advance. Trucking the animals to the facility is expensive, and it creates a lot of stress for them. As of this writing, he sells his beef for $3.40 per pound, $1 of which goes to shipping. In addition to processing, the price of land in the area is an issue. Because of land prices, many people simply can't afford to buy a farm. The Marcellus Shale gas drilling in Pennsylvania has had a huge impact on this as well.

The biggest opportunity Hopkins foresees lies in the market. He says that if you can secure processing and have a good marketing plan in place, there has never been a better time to be a grass farmer or a direct-market farmer. Grass farmers have never had better tools, including solar water pumps, more in-depth knowledge of genetics, and new varieties of grasses. In addition to the market, some of the best opportunities Hopkins has experienced have come from the relationships and friendships he has made by dealing directly with customers.

Visit John Hopkins's Forks Farm Market online at *www.forksfarmmarket.com*.

Grass-based cattle production is inherently resilient because of reliance on renewable pasture resources. Photo: USDA-NRCS

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Further Resources

Animal Health

Alternative and Herbal Livestock Health Sourcebook. By Tom Morris and Michael Keilty. Northeast Regional Sustainable Agriculture Research and Education Program
www.cag.uconn.edu/plsc/plsc/ahlh%20sb-web.pdf

Alternative Treatments for Ruminant Animals. 2004. By Paul Dettloff. Acres USA, Austin, TX.
1-800-355-5313 *www.acresusa.com/books/closeup.asp?prodid=1236&catid=12&pcid=2*

A natural, sustainable approach to ruminant health. Each chapter discusses interrelated biological systems, including digestive, reproductive, respiratory, circulatory, and musculoskeletal.

Merck Veterinary Manual,
Merck Publishing Group, Merck & Co., Inc.
P.O. Box 2000 RY84-15,
Rahway, NJ 07065
732-594-4600
www.merckbooks.com/mvm/index.html
www.merckvetmanual.com/mvm/index.jsp

The online text version is an authoritative reference for animal health, disease, and management information.

Beef Cattle Production

Beef Cattle Resources
Virtual Livestock Library, Oklahoma State University
http://pods.dasnr.okstate.edu/docushare/dsweb/View/Collection-242

The site offers online publications on cattle management, including health, reproduction, and marketing, among other topics.

Cow-Calf Corner
http://cowcalfcorner.okstate.edu

Timely management tips of interest to cow-calf producers.

Cow-Calf Management Guide and Cattle Producer's Library
University of Idaho
Moscow, ID 83844-2330
208-885-6345
www.avs.uidaho.edu/wbrc

Developed by the Western Beef Resource Committee. Produced by the Animal and Veterinary Science Department, College of Agricultural and Life Sciences of the University of Idaho. Collection of fact sheets in manual form. Available in print, CD, or online.

Grass-Fed Cattle: How to Produce and Market Natural Beef. 2006. By Julius Ruechel. Storey Publishing.
210 MASS MoCA Way
North Adams, MA 01247
413-346-2100
www.storey.com/book_detail.php?isbn=9781580176057&cat=Animals

This book is a comprehensive work covering all aspects of pasture-based beef production from a practical standpoint. Well-written and full of anecdotes on the reality of beef-cattle farming and ranching, it is a must for anyone considering raising and selling sustainably raised beef.

Beef Marketing Coops, Processors, and Firms

Niche Meat Processor Assistance Network
Arion Thiboumery
Iowa State University
Ames, IA 50011
415-260-6890
www.nichemeatprocessing.org

Rules and regulations; mobile slaughter/processing plants; niche meat processor case studies; business development; workforce management; plant design and construction; webinars; and videos.

Coleman Natural Foods
1667 Cole Blvd
Building 19, Suite 300
Denver, CO 80216
800-442-8666
www.colemannatural.com

Dakota Beef, LLC
507 E. Highway 34
Howard, SD 57349
605-772-5339
www.dakotabeefcompany.com

Laura's Lean Beef
1517 Bull Lea Road, Suite 210
Lexington, KY 40511
899-299-7707
www.laurasleanbeef.com

Organic Valley Family of Farms, CROPP Cooperative
507 W. Main St.
La Farge, WI 54639
888-809-9297
www.farmers.coop

Organic dairy and beef cooperative.

Ozark Pasture Beef
15204 Cincinnati Rd
Fayetteville, AR 72704
479-409-8772
www.ozarkpasturebeef.com

Tallgrass Beef Company
Corporate Mailing Address:
Tallgrass Beef Company, LLC
103 East Main Street, Suite 1
Sedan, KS 67361
877-822-8283
www.tallgrassbeef.com
Grass-fed and grass-finished beef marketing firm.

Livestock Housing, Equipment, and Handling

Beef Housing and Equipment Handbook. 1986. NRAES.
www.nraes.org/nra_order.taf?_function=detail&pr_id=144&_UserReference=72DF675E08F7E5D34B4212A7
NRAES Cooperative Extension
P.O. Box 4557
Ithaca, NY 14852-4557
607-255-7654
Current agricultural engineering recommendations for beef producers are summarized in this complete housing guide. Essential components for an efficient operation, such as building design, operation size, and equipment are discussed. Drawings, tables, and discussions to help improve, expand, and modernize an operation are included. Topics include cow-calf, cattle-handling, and cattle-feeding facilities; feed storage, processing, and handling; water and waterers; manure management; farmstead planning; building construction, materials, ventilation, and insulation; fences; gates; and utilities.

Fencing Systems for Serious Graziers. 2005.
Missouri NRCS
www.mo.nrcs.usda.gov/news/pubs_download/out/MO%20NRCS%20Electric%20Fencing_low.pdf

Livestock Behaviour, Design of Facilities and Humane Slaughter. By Temple Grandin, Ph.D.
Grandin Livestock Handling System, Inc.,
2918 Silver Plume Drive, Unit C3
Fort Collins, CO 80526
970-229-0703
www.grandin.com
Grandin is America's foremost expert in livestock psychology and handling-system design. Her website is full of resources to assist producers in laying out and building livestock-handling facilities with the animal in mind. The Beef Cattle Behaviour Handling and Facilities Design Book (2nd edition) also can be ordered from the website.

Stockmanship: Improving rangeland health through appropriate livestock handling. By Steve Cote.
P.O. Box 819, 125 So. Water St.
Arco, ID 83213
208-527-8557
Also available online at:
www.grandin.com/behaviour/principles/SteveCote.book.html
Livestock handling techniques to improve rangeland and pastureland health. Stockmanship, published by NRCS and the Butte Soil and Water Conservation District, is based on Cote's many years of experience studying low-stress livestock handling.

Watering Systems for Serious Graziers. 2006.
Missouri NRCS
www.mo.nrcs.usda.gov/news/pubs_download/out/Watering%20Systemslow.pdf

Marketing and Economics

Agricultural Marketing Resource Center
www.agmrc.org
National information service for value-added agriculture. Section on marketing of natural beef located at *www.agmrc.org/commodities__products/livestock/beef/natural_beef.cfm.*
Extensive resources in marketing and processing, including numerous case studies.

How to Direct Market Your Beef
USDA Sustainable Agriculture Research and Education (SARE) program.
www.sare.org/publications/beef.htm
SARE Outreach Publications
PO Box 753
Waldorf, MD 20604-0753
301-374-9696
This 2005 publication portrays how one couple used their family's ranch to launch a profitable grass-based beef operation focused on direct-market sales. From slaughtering to packaging, through labeling and advertising, Jan and Will Holder transform their real-life experiences into a compelling narrative rich with practical tips.

The Legal Guide for Direct Farm Marketing.
By Neil D. Hamilton.
The Agricultural Law Center, Drake University
2507 University Avenue
Des Moines, IA 50311
515-271-2065
An up-to-date, well-written primer on all the legal considerations related to direct marketing of agricultural products. Underwritten by a USDA SARE grant, this publication includes a chapter on the marketing of meat. This publication is available for $20 through the Agricultural Law Center. Please include your name, address, and phone number. Someone will contact you to finalize billing information. Volume discounts may apply.

Periodicals

Beef Magazine
http://beefmagazine.com
7900 International Drive, Suite 300

Minneapolis, MN 55425
952-851-9329
Publishes 12 monthly issues for cow-calf operators, stocker-growers, cattle feeders, veterinarians, nutritionists, and allied industries.

Graze
P.O. Box 48
Belleville, WI 53508
608-455-3311
www.grazeonline.com/index.html
A monthly publication dedicated to promoting the practice of intensively managed grazing.

Hay and Forage Grower
7900 International Drive, Suite 300
Minneapolis, MN 55425
952-851-9329
http://hayandforage.com
This magazine covers a wide range of forage-related topics, from stand establishment to harvesting and marketing. It includes information on alfalfa as well as all other forage crops for use as hay, silage, or rotational grazing.

In Practice
Holistic Management International
1010 Tijeras Ave. NW
Albuquerque, NM 87102
505-842-5252
www.holisticmanagement.org
Bi-monthly publication of Holistic Management International.

Rangelands
Online version available at:
www.srmjournals.org
Society for Range Management
10030 W. 27th Avenue
Wheat Ridge, CO 80215
A publication of the Society for Range Management. It features scientifically based information in a user-friendly format.

The Forage Leader
American Forage and Grassland Council
P.O. Box 94
Georgetown, TX 78627
800-944-2342
www.afgc.org
A quarterly magazine published by the American Forage and Grassland Council.

The Stockman Grass Farmer
P.O. Box 2300
Ridgeland, MS 39158-9911
601-853-1861; 800-748-9808
http://stockmangrassfarmer.net
One of the nation's premier publications on the art and science of grass farming. A free sample copy is available.

Rangeland Management

Foraging Behavior: Managing to Survive in a World of Change; Behavioral Principles for Human, Animal, Vegetation, and Ecosystem Management. By Fred Provenza, Ph.D., Utah State University.
www.behave.net/products/booklet.html
Highlights, with the use of case studies, some simple strategies that use knowledge of behavior to improve the efficiency and profitability of grassland agriculture; the quality of life for managers and their animals; and the integrity of the environment. The scientific research and real-life situations presented in this booklet provide insight into why animals act as they do, and how understanding their behavior can improve operations in any part of the country.

Grazing Management: An Ecological Perspective.
By Rodney K Heitschmidt and Jerry W. Stuth. 1991.
Timber Press, Portland, OR.
Available online at *http://cnrit.tamu.edu/rlem/textbook/textbook-fr.html*
This book was written to help resource managers broaden their perspective relative to the management of grazing animals and to heighten their awareness of the role they play in maintaining the integrity of ecological systems (from the foreword).

Holistic Management International
1010 Tijeras Ave. NW
Albuquerque, NM 87102
505-842-5252
www.holisticmanagement.org
HMI is a goal-oriented decision-making system for ecological management of resources, people, and capital.

Intermountain Planting Guide
The USDA Agricultural Research Service, Utah State University, (USU) Logan, UT.
Order from USU Extension Publications, 435-797-2251
Also available online at *http://extension.usu.edu/htm/publications*
Guidelines on the establishment and management of dryland and irrigated pastures in the Intermountain West, including planting tables for various range sites.

Ranch Management Consultants, Inc.
953 Linden Ave
Fairfield, CA 94533
707-429-2292
www.ranchmanagement.com/index.html
RMC provides high-quality education and support programs for the livestock industry. The Ranching For Profit School and Executive Link programs provide the knowledge and

support farmers and ranchers need to improve their land, their lives and their bottom line.

Rangelands West
Western Rangelands Partnership, Agriculture Network Information Center, University of Arizona.
http://rangelandswest.org
Web-based educational tools and information to assist resource managers to improve rangelands and maintain sustainability.

Quivira Coalition
1413 Second Street, Suite 1
Santa Fe, NM 87505
505-820-2544
www.quiviracoalition.org/index.html
Publications on ecological resource management, including range management, grazing, road construction, monitoring, and managing resources at the urban-rural interface.

Temperate and Humid Pasture Management

Grazing Systems Planning Guide. By Kevin Blanchet, University of Minnesota Extension Service; Howard Moechnig, Natural Resources Conservation Service, Minnesota Board of Water & Soil Resources; and Jodi DeJong-Hughes, University of Minnesota Extension Service. University of Minnesota Extension Service Distribution Center
405 Coffey Hall, 1420 Eckles Avenue
St. Paul, MN 55108-6068
The guide can be viewed or downloaded at *www.extension.umn.edu/distribution/livestocksystems/DI7606.html*
Delineates the components of a grazing system by taking the farmer through the grazing-management planning process.

Extending Grazing and Reducing Stored Feed Needs. 2008. By Don Ball, Ed Ballard, Mark Kennedy, Garry Lacefield, and Dan Undersander. A Grazing Lands Conservation Initiative publication.
www.agry.purdue.edu/Ext/forages/pdf/ExtendingGrazing-Auburn.pdf
A must for producers who need to reduce feed inputs by using grazing to meet the needs of livestock. The publication details various techniques such as using species of differing growth habits and season in tandem to lengthen the grazing season. It also addresses species selection, stockpiling, manipulating stocking rate, crop rotations, and using stored forages more efficiently.

Understanding Forage Quality. 2001. By D. M. Ball, M. Collins, G. D. Lacefield, N. P. Martin, D.A. Mertens, K. E. Olson, D. H. Putnam, D. J. Undersander, and M. Wh. Wolf. American Farm Bureau Federation Publication 1-01, Park Ridge, IL
www.aces.edu/dept/forages/hay/ForageQuality.pdf
This publication provides information about forage quality and forage testing that can be used to increase animal performance and producer profits.

Management-Intensive Grazing: The Grassroots of Grassfarming. By Jim Gerrish, Green Park Publishing. This book can be obtained through The Stockman Grassfarmer's Bookshelf at 800-748-9808 or online at *www.stockmangrassfarmer.net/Bookshelf.html*
The industry standard for growing and managing pastures for sustained livestock production.

Missouri Grazing Manual. By James R. Gerrish, College of Agriculture, Food and Natural Resources; and Craig A. Roberts, College of Agriculture, Food and Natural Resources. Order from University of Missouri Extension publications, 573-882-7216.
http://muextension.missouri.edu/explore/manuals/m00157.htm
This manual is designed to acquaint readers with the principles on which successful grazing management is based. It brings together a group of researchers, educators and producers with broad experience in land management and forage/livestock systems to provide a comprehensive guide to understanding and managing grassland ecosystems.

Southern Forages. 4th Edition. 2007. By Donald Ball, Carl S. Hoveland, and Garry D. Lacefield. International Plant Nutrition Institute, Norcross, GA. Available for $35 from:
International Plant Nutrition Institute.
Suite 110
655 Engineering Drive
Norcross, GA 30092
(770) 447-0335
http://ppi-store.stores.yahoo.net/soutfor.html
This is a classic of forage-management literature. It provides information on fertility, haying and silage systems, establishment, weed control, grazing management, and the selection of forage species. It also features great tables and charts to help the reader synthesize and understand the concepts.

TAMU Overton Research Center – Forages.
Texas A&M University.
http://overton.tamu.edu
Although a site addressing principally East Texas pastures, the information researched, developed, and presented by the researchers and specialists at Overton has a wide applicability, especially for southern humid forage systems. Information is available on legume production, variety trials, grazing systems, and supplementation on pasture.

Range and Pasture Monitoring

Grazing Lands Technical Publications, USDA NRCS Grazing Lands Technology Institute
www.glti.nrcs.usda.gov/technical/publications/index.html

- Guide to Pasture Condition Scoring. Developed by GLTI in May 2001, the guide is used to inform landowners as well as professionals about the 10 indicators of pasture condition and the six causative factors affecting plant vigor, with a procedure to assess each indicator.
- Pasture Condition Score Sheet. A tool to record the condition of the indicators and evaluate the pasture. This goes with the Guide to Pasture Condition Scoring.
- Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Developed with the ARS Jornada Experimenal Range, this manual describes how to monitor three rangeland attributes: soil and site stability, watershed function and biotic integrity. Nearly everything we value about rangelands depends on these attributes. Monitoring these three attributes is like monitoring the foundation of our rangeland ecosystems. The measurements used to monitor these attributes also can be used to generate indicators relevant to specific management objectives, such as maintaining wildlife habitat, biodiversity conservation or producing forage.
- Interpreting Indicators for Rangeland Health, Version 4. Technical Reference 1734-6, dated 2005, is a booklet developed through inter-agency coordination between the BLM, NRCS, ARS, and USGS. It provides land specialists with the tools to do a preliminary evaluation of soil/site stability, hydrologic function, and integrity of the biotic community on rangelands.
- Sampling Vegetation Attributes. Developed by an interagency group, this reference material will help you determine what kind of sampling technique to use and how to set up and run monitoring studies.

USDA NRCS Web Soil Survey Database
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Database for Inventory, Monitoring and Assessment, USDA, ARS, Jornada Experimental Range
http://usda-ars.nmsu.edu/monit_assess/db_main.php

The Rangeland Database and Field Data Entry System is a Microsoft Access database that can be easily used without Access knowledge. The database was developed to increase data entry speed and precision in both field and office. Data can be rapidly entered in the field with user-specified choice lists. The database can be easily customized to suit the user's needs. It has many applications including: monitoring, collecting quantitative data to support rangeland assessments, collecting qualitative data to assess range health, and documenting ecological site descriptions.

Conservation Stewardship Program (CSP) Pasture Condition Score Sheet, USDA NRCS
www.agry.purdue.edu/forageday/2005/article/PSC-Handout%20only.pdf

Easy to use single-page assessment that scores various attributes, such as percent cover, plant diversity, residue, plant vigor, and soil compaction, among others.

Wyoming Range Monitoring Manual, University of Wyoming Cooperative Extension
http://ces.uwyo.edu/PUBS/B1065.pdf

Guidebook for selecting the appropriate methodology for gathering rangeland monitoring information, tracking management, and interpreting of results.

Organic and Grass-finished Beef Cattle Production
By Lee Rinehart, CGP
NCAT Agriculture Specialist
Published February 2011

Rich Myers, Editor
Amy Smith, Production
This publication is available on the Web at:
www.attra.ncat.org/attra-pub/cattleprod.html
or
www.attra.ncat.org/attra-pub/PDF/cattleprod.pdf
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