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Dairy Production on Pasture: An Introduction to Grass-Based and Seasonal Dairying

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In an era of high feed costs and uncertain milk prices, many dairy producers are using pasture to provide most if not all dry matter for lactating dairy cows during the growing season. This publication addresses aspects of pasture production beginning with animal selection and forage resource assessment, grazing, facilities, animal health, organic production, and seasonal economics. Included are extensive resources for further reading.

Jerseys grazing highly productive cool-season perennial pasture in Vermont. Photo: Courtesy of USDA NRCS

Introduction

Grass-based dairying is best described as a method of marketing forage through milk products. Success with grass-based dairy farming requires a high level of management, observation, and skill in growing and grazing high-quality forages—and enough of them to meet the dry-matter intake needs of lactating cattle. It requires livestock that are adapted to grazing and a high-forage diet. Grass-based producers ensure that forages provide the energy and protein needed to produce milk by providing high-quality pasture during the grazing season and enough stored digestible forages in the dormant season. If supplementation is needed, it is provided to cattle based primarily on energy needs, as high-quality pasture tends to be high in protein, and energy is required to nourish rumen microorganisms and enable them to metabolize high-protein forages.

Sustainable grass-based dairies utilize an ecological approach to health care by relying on natural immunity that comes with pasture access and exposure to increased biodiversity. This is accomplished by developing an agroecosystem that displays a high degree of resilience, weathers the extremes that is inherent in a natural ecological system, and ensures a high level of balanced nutrition to soil, plants, and animals. Developing a low-input farming strategy that uses natural ecological services instead of purchased inputs as much as possible also reduces production costs.

Grass-based dairies take advantage of nutrient cycling for soil fertility, keeping nutrients on the farm and completing the soil cycle by supplying natural fertilizers in manure and urine directly on the pastures while cattle graze, as well as through judicious applications of barn manure. This level of nutrient management requires strict attention to pasture management, which in grass-based dairies includes rotational grazing systems to maximize forage intake and pasture health. Attention will be given to grazing management in this publication, and more detailed information can be found in the ATTRA publications *Rotational Grazing; Ruminant Nutrition for Graziers;* and *Pasture, Rangeland, and Grazing Management.*

Related ATTRA Publications
www.attra.ncat.org

Dairy Farm Sustainability Checksheet

Dairy Beef

Irrigated Pastures: Setting Up an Intensive Grazing System That Works

Why Intensive Grazing on Irrigated Pastures?

Pasture for Organic Ruminant Livestock: Understanding and Implementing the National Organic Program (NOP) Pasture Rule

The Economics of Grass-Based Dairying

Dairy Resource List: Organic and Pasture-Based

Raising Dairy Heifers on Pasture

Ruminant Nutrition for Graziers

A Brief Overview of Nutrient Cycling in Pastures

Assessing the Pasture Soil Resource

Managed Grazing in Riparian Areas

Pasture, Rangeland, and Grazing Management

Pastures: Sustainable Management

Pastures: Going Organic

Paddock Design, Fencing, and Water Systems for Controlled Grazing

Rotational Grazing

Organic Livestock Documentation Forms

Managed Grazing Tutorial

Basic Concepts

Pasture is the basis of a sustainable grass farm and can provide the main source of nutrition for the milking herd, dry cows, and developing heifers during the grazing season. However, lactating dairy cows need special attention if relying on pasture alone. In order to provide the main source of nutrition for these cows, you should first establish a baseline of information by conducting a systematic assessment of the grazing resource. A grazing plan can then be implemented and periodically assessed with a pasture-monitoring program to ensure the herd is getting enough high-quality forages to meet their nutritional and reproductive needs.

Grazing management is a technique of allotting pasture to cattle and ensuring animal intake of high-quality forages. This includes pasture system design such as fencing and water-delivery systems, appropriate grazing rotations with variable recovery periods, and hay management. Grazing management requires a very high degree of observation and adaptive management, as pasture quality and quantity changes given precipitation, day length, temperature, rest periods, plant species, and much more. ATTRA's *Managed Grazing Tutorial* discusses these topics in an online, interactive course designed to help producers improve soil health and pasture condition while maximizing income potential through grazing.

Access ATTRA's *Managed Grazing Tutorial* on the ATTRA website at https://attra.ncat.org/tutorials/grazing/index.php.

NCAT specialists teach this course based on cutting-edge grazing principles and their experience in managing their own grazing systems. Topics covered in the tutorial include:

- Grazing Management: Inventory
- Managed Grazing Infrastructure: Fencing and Water
- Managing the Mature Stand
- Intensifying Managed Grazing
- Stockpiling Grass

Stress can result in disease, low productivity, and increased costs. Pasture access, ease of handling, and good nutrition are very important for reducing stress in animals and farm operators.

Dry cow management, or a **dry cow program**, is a year-long systematic plan that involves preventative health care, nutrition, observation, proper milking procedure, a commitment to animal welfare, and treatment when conditions warrant.

Seasonal breeding involves a 12-month calving interval, estrus detection, light culling, and manipulation of day length and endocrine functions.

Providing high-quality pasture as the principal feed source is not simple, as conditions and situations are always changing. Planning for change is key to adaptive management. Conduct a resource inventory to lay the groundwork for continued adaptive management of the grazing system and overall farm plan. Detailed information on this important topic is provided later in this publication.

Switching to grass-based dairy production provides many benefits, whether you choose to milk year-round or seasonally. When you graze cows without feeding any concentrates, you can reasonably expect a decrease in gross income due to reduced milk production. If the herd is not well adapted to a forage-only diet or pasture quality is not excellent, it may also be very difficult to get cows bred back in the desired calving window. However, producers in Pennsylvania have noticed a subsequent decrease in cow cost. Coupled with an increase in cow health and the efficiencies of working a herd with fewer workers, producers have realized an increase in net income, even with reduced milk production (GLCI, 2005).

Producers who are thinking about going grain-free should approach grass-only dairying with caution. Some dairy farms have experienced very negative health impacts due to zero-grain feeding before their herd and their pastures were ready. This can result in some disastrous situations, so cow nutrition and body condition should be closely observed if transitioning to grass-only feeding to ensure the cows breed back on time and continue to produce milk sustainably.

Adaptive Management

Grass-based dairy farming requires a level of acumen and observational sophistication not approached on most conventional farms. It is critically important that farm owners and employees develop an appreciation for the rigor of adaptive management. Adaptive management is characterized by:

- Resource assessment
- Planned implementation
- Observation
- Adjustment to suit new conditions

New Zealand-Style Dairying

Ninety percent of the milk produced in New Zealand is exported at world market prices, with no government subsidies or incentives. Since feeding grains and concentrates in New Zealand is 6 to 12 times as costly as grazing, producers tend to be extremely proactive in developing low-cost production technologies. Intensive pasture management, rather than milk production, is the focus and careful attention is paid to grass management to ensure high levels of animal intake.

By using frequency (how often) and intensity (how long) of grazing, producers can provide enough high quality forage to meet animal demand. Intake of sufficient quantity and quality of forages ensure sustained animal performance, and New Zealand-style dairying achieves this by maximizing pasture cover and managing grazing intensity.

Some of the tangible benefits of New Zealand-style grass-based dairying may include:

- Sustainable return to the farmer
- Low cost of feeding, housing, manure disposal, and machinery
- High production per person, ideal for family dairies
- Flexibility in milking system design
- Flexibility in grazing system design
- Increased pasture quality
- Increased water quality in streams
- Increased fat and protein in grass-fed milk products
- Cleaner cows

(Holmes et al., 2007; and GLCI, 2005)

New Zealand-style milking parlors, ideal for graziers, are open, simple, relatively low-cost, easy to clean, and designed for milking efficiency. Photo: Forrest Stricker

Some things to think about if you're going grain-free:

Sarah Flack, a Vermont-based organic dairy and pasture consultant, recommends taking a look at how going grain-free will affect your farm and family goals:

- Will the decrease in total milk production still allow enough cash flow to cover farm and labor costs?
- Is the quality of the winter stored forage and summer grazing excellent and consistent?
- Are the manager's grazing and feeding skills high enough?
- Is there a system to allow supplementation with enough minerals?
- Is there enough market demand and is the price for products high enough?

(Flack, 2004)

Grass-based and seasonal dairies, like all dairy operations, rely on healthy, fertile cows of high genetic value.

Grass-based dairying requires a sober look at the weaknesses of grazing, as well. In addition to low productivity, you can reasonably expect a yearly variability in milk production and profitability, as grass-based systems rely on weather and forage growth to maintain productivity. In addition, there are the inherent inefficiencies of seasonal milk supply to processors that should be taken into account (Holmes et al., 2007). That being said, grain-free dairying is possible and can be done. But it's not an enterprise to enter without first becoming a serious grass manager and selecting the right animals for the job. This publication and the resources referenced should help a producer in making the critical decision of going grain-free.

Breeds and Animal Types

The dairy industry in the United States has been under very intensive consolidation and industrialization pressure to maximize the efficiencies that come with large-scale production. Since the 1950s, dairy farms have been getting bigger and have been relying on harvested grain and forages to provide high-quality feedstuffs to support enormous milk yields. Modern Holsteins can produce more than 60 pounds of milk per day, and many farms report herd averages in excess of 20,000 pounds per lactation.

According to the Livestock Conservancy, grass-based dairy farming is on the increase, and this necessitates a very different type of animal. Low-cost, grass-based dairies often cannot support the high nutritional requirements needed by large-framed, high-producing cattle. Grass-based dairy producers are utilizing breeds like Ayrshire and Jersey for their ability to maintain condition, milk production, and reproduction on forage. These cattle types are typically smaller framed and have lower nutrient requirements than Holsteins. Again, there is wide variability in the expression of the traits important for pasture-based systems, even within dairy breeds. A good example is the Holstein genetics that are being developed through selection by grass-based producers in New Zealand.

Grass-based and seasonal dairies, like all dairy operations, rely on healthy, fertile cows of high genetic value. A cow's productivity is determined by its management, especially feeding, health, and milking, and by its own inherent capabilities, including genetic merit (Holmes et al., 2007). Selection of appropriate animal genetics for grass-based systems is therefore an important factor in the adaptive management process.

New Zealand dairy farmers seek to improve genetic merit in cow herds by culling cows of inferior merit and replacing them with cows of superior genetic merit. Some of the important traits in dairy production, such as milk fat and protein yields, are heritable (Holmes et al., 2007). Heritability is a characteristic of those traits that are successfully transmitted from one generation to the next. Selecting bulls and cows that have these heritable traits is the foundation of improving the genetics of a herd over time. Detailed information on using heritability for improving

Factors Influencing Genetic Merit in Dairy Cows

- Milk production potential
- Percent fat and protein
- Feed conversion efficiency
- Health and reproduction traits
- Cow longevity, or the ability to consistently produce large quantities of milk during a long lifetime of lactations

(Holmes et al., 2007)

the genetic merit of dairy herds can be found in Virginia Cooperative Extension's fact sheet *Using Heritability for Genetic Improvement,* available online at https://pubs.ext.vt.edu/404/404-084/404-084.html.

For more information on livestock breeds, see the Oklahoma State University Department of Animal Science website at www.ansi.okstate.edu/breeds/swine/spots/cattle. Information on rare breeds can be found at the Livestock Conservancy website at www.livestockconservancy.org.

Taking an Inventory of Resources for Grass-Based Dairying

A total farm asset inventory is the first step in adaptive management. Inventory and monitoring of all aspects of the farm are critical for sustainable dairy production, especially on a farm that relies on pasture for a significant portion of feed for high-producing dairy cows. ATTRA has a dairy sustainability checksheet that is designed to stimulate critical thinking in planning a farm on which a primary enterprise is milk production. It contains a series of questions intended to stimulate awareness and define strong areas in your farm management as well as areas that might be enhanced. The Dairy Farm Sustainability Checksheet can be accessed on ATTRA's website or by calling ATTRA at 800-346-9140.

Darrell Emmick, a grazing specialist with New York National Resources Conservation Service (NRCS), has suggested some steps to evaluate resources when considering a new grazing operation. First, identify your goals. What is it you expect to do and get out of grazing cows? Then, identify problems to overcome and opportunities you can take advantage of. List your on-farm assets as they are now, such as land, livestock, forages, water, lanes, buildings, machinery, and wildlife (NRAES, 2006a).

When the initial resource inventory is done, match your grazing goals to the resources you have on hand to determine the feasibility of a new transition. Adaptive management comes to play as you begin to orient your existing resources to the new grazing venture, evaluate successes and problems, and adapt to new changes. For detailed information on resource inventory, see chapter 2 in *The Grazing Systems Planning Guide* (Blanchet et al., 2003).

An inventory will allow you to match your resources with your grazing goals. Photo: Courtesy of USDA NRCS.

Forages and Grazing

The foundation of grass-based dairying is, of course, the forage resource. Forage diversity and grazing management are the overriding principles that grass managers need to ensure cattle get enough high-quality forage to make grass-based dairying successful.

Fertility, Legumes, and Nutrient Cycling

Legumes like clover, alfalfa, birdsfoot trefoil, sainfoin, and vetch have the ability to convert atmospheric nitrogen to the plant-available form of nitrogen through the symbiotic work of Rhizobium bacteria, which occur naturally in a healthy soil. A composition of 30 to 50 percent legumes in pastures combined with nutrient cycling from high-impact grazing will provide all the nitrogen the pasture needs to be sustainably productive under optimum conditions (Gerrish, 2007). Jim Gerrish, former Missouri pasture researcher and now a grazing consultant, has noted that, based on your environment, you can run your pasture program entirely on nitrogen coming from nitrogen-fixing legumes. In less favorable environments, added inputs of lime and other soil nutrients may be needed to allow legumes to thrive (Gerrish, 2007). For pastures under high-density grazing systems, 70 to 85 percent of the nitrogen taken in by the animals is returned and cycled back to the soil in the form of feces and urine. Thus, a diverse pasture with a significant

legume component, which is managed intensively with heavy stocking and frequent moves, has the potential to become a stable, closed system, especially with periodic applications of barn manure.

Grazing Systems: Plant Recovery and Grazing Period

If given a choice, livestock will eat the highest-quality, most palatable plants in a pasture. These tend to be the youngest, most succulent plants in the field. A producer must make sure that these plants are protected and have the ability to regrow for the next grazing period. Letting these plants rest after grazing is known as the *recovery period.*

Some producers will say that the recovery period is the single, most important element in designing a grazing system. When grazed before they have had the ability to recover, plants will eventually decline and die, and perhaps be overtaken by less desirable plants.

In order to ensure adequate recovery time and plant diversity, it is necessary to control the timing and intensity of grazing.

Grazing should be planned based on the plant recovery period you need, depending on the forage species and the season. For example, in the spring, cool-season grasses are growing quickly in cool temperatures with adequate moisture, and need about 14 days to recover from grazing. In the summer, as the temperature warms up and there is less moisture, the recovery period for cool-season grasses increases to at least 35 days.

Warm-season grasses like bermudagrass and bahaigrass begin their period of growth when the soil temperature is above 60 degrees and thrives on atmospheric temperatures above 75 degrees. Given adequate moisture, they can be productive all summer and decline in the fall when temperatures reach the 40s. Recovery periods for warm-season grasses during the grazing season are based more on water availability than on temperature.

Table 1: Optimal rest periods for forages

Species	Cool weather/Days	Hot weather/Days
Cool season grasses	14	35-50
Warm season grasses	35-40	21
Legumes	21-28	21-28

Blanchet, K., H. Moechnig, and J. DeJong-Hughes. 2003. Grazing Systems Planning Guide. University of Minnesota Extension Service.

In rotational grazing systems, plant recovery time is of crucial importance to pasture health and to the provision of high-quality forage to lactating cattle. Plant recovery periods between grazing events should correspond to seasonal changes in plant growth rates (Murphy, 1995). Pasture plants grow faster in the spring than in the summer, and cool-season plants have a second growth period in the fall. Managing grazing according to plant growth and recovery is crucial to successful rotational grazing. Bill Murphy, a Vermont grazing expert and author, cites an example of a farm in Vermont that has successfully negotiated the changes in pasture recovery rates to feed 75 dairy cattle on just over 49 acres (Murphy, 1995). See the information box below for details on how 49 acres of pasture can provide fresh forage during the growing season, as well as ensiled forages for the winter.

In order to ensure adequate recovery time and plant diversity, it is necessary to control the timing and intensity of grazing. This means controlling animal numbers, how long animals are in a pasture and the length of the recovery period the pasture is given before grazing

Managing Spring-to-Fall Pasture Recovery Periods Though Rotational Grazing

Vermont grazing expert Bill Murphy relates a story about a successful grazing dairy farm in Vermont in his chapter "Pasture Management to Sustain Agriculture" in Miguel Altiera's book *Agroecology: The Science of Sustainable Agriculture.* On the farm, 60 lactating Holsteins and 15 dry cows and heifers were fed on six hectares (14.83 acres) of pasture from April 29 to about June 15. Total pasture size is 20 hectares (49.42 acres). In late May, the Hansons harvested and ensiled surplus forage from the remaining 14 hectares (34.59 acres). In June, six hectares (14.83 acres) of the machine-harvested land was brought into the grazing rotation. In July, a second crop of forage as hay was harvested from the other eight hectares (19.77 acres). In September, all 20 hectares (49.42 acres) were included in the rotation. Cows grazed until mid-October; heifers and dry cows grazed until about November 1 (Murphy, 1995). It is important to remember that this scenario is pretty close to an ideal situation and grazing is always dependent on rainfall and other climate-related conditions.

again. Rotational grazing systems are the tools used to manage these elements, and takes full advantage of the benefits of nutrient cycling as well as the ecological balance that comes from the relationships between pastures and grazing animals. High-density stocking for short periods followed by adequate recovery periods helps to build soil organic matter and develops highly productive, dense, resilient pastures.

For more information, see the ATTRA publications *Rotational Grazing* and *Pasture, Rangeland and Grazing Management* or review ATTRA's grass farming publications.

Another important part of grazing planning is the amount of time the animals spend grazing a specific paddock or pasture, and this is known as the grazing period. In a rotational grazing system, animals are moved from paddock to paddock based on recovery period and grazing period. The important thing to consider in determining the grazing period is the time it takes for a plant to begin to regrow after being grazed.

Rotations are key for obtaining the correct grazing period and plant recovery time. Photo: Lee Rinehart, NCAT.

When a grass plant is grazed, it uses energy to recover and begins to regrow in about two to four days after defoliation. A plant that is grazed after it begins to regrow will quickly use its available energy to try to keep up with continued defoliation.

Ecology, Climate, and Grass-Based Livestock Production

Proponents of grass-based dairying have long asserted the tangible benefits the system has on the environment and the welfare of the cows. It is obvious to many that grazing, when managed appropriately, has a positive impact on the land by increasing biodiversity and enhancing soil health through a symbiotic relationship between cows and soil organisms. With more interest in grass-based production, as evidenced by consumer demand and grassfed labels and standards, universities and agencies are putting research dollars to work to determine objectively if grass systems do indeed deliver the goods.

Grass systems provide sustainable dairy products with a more closed-system approach, relying on natural, ecological services instead of purchased, off-farm inputs. According to the University of Vermont Center for Sustainable Agriculture, the biological diversity that is fostered in a grass-based system, through the dynamic biological interactions between species and communities on an ecologically-rich farm, has been shown to improve the well-being, health, and productivity of livestock. These farms are characterized by minimally disturbed soils, diverse and high-quality forage mixes, and access to clean water for livestock. Managing for increased biological diversity helps to improve soil health, optimizes forage utilization, rumen activity, milk composition and quality, reduce costs, and increase net farm income (Alvez, 2015).

While human-managed animal impact on the land can have an observable, positive impact on ecosystems, ecosystems themselves don't operate as intentional agents. Mother Nature just doesn't care how much effort you put into designing a resilient, productive grazing system. As changes occur to terrestrial ecosystems due to climate change, farmers are going to have to adapt to new precipitation patterns, frequency, and intensity.

Grass-based dairy farmers have become proficient at adapting to seasonal changes throughout the grazing season. However, they are still vulnerable to the effects of climate change because they rely principally on forage and pasture for feed. Farmers must seek options for adaptation that allow them to "take advantage of new opportunities and minimize any negative impacts of climate change," note Lee et al. in a report on climate change and its effects on grass-based dairy systems. "In many regions, annual pasture production is predicted to increase due to carbon dioxide fertilization and warmer temperatures during winter/spring. Production may decline, however, in regions with either reduced rainfall or severe flooding. Should this occur, farmers could strategically use supplementary feed, reduce stocking rates, irrigate, or sow alternative plant species with greater drought tolerance" (Lee et al., 2013).

More research is needed, particularly on the effects climate change has on cow health and productivity. Most of the research on climate change in agriculture has centered on crops and has occurred in relatively few regions, creating a wide gap in our knowledge of the agricultural impacts we might expect from climate change in most parts of the world (Martinsohn and Hansen, 2012). Identifying and prioritizing realistic adaptations is important for farmers, researchers, and policy workers to substantively deal with climate change effects.

This is harmful to the plant and compromises its ability to sustain itself. Root mass declines and the health of the plant becomes compromised. Overgrazing is the result of grazing periods that are too long, where animals are allowed to re-graze plants. A sustainable grazing period is one where cattle are in a paddock long enough to take one bite of a grass plant and move on. If a plant is grazed more than once during a grazing period, overgrazing is a likely result.

The ATTRA fact sheet *Irrigated Pastures: Setting Up an Intensive Grazing System that Works* provides detailed information on recovery and grazing periods, as well as steps and guidelines for planning a rotational grazing system.

Forage Management During the Summer Slump

When the summer slump arrives, producers need to be able to extend the recovery periods to give these pastures time to regrow.

Cool-season perennial grass and legume pastures will often begin to decline in late July and August. Most of their growth occurs in the spring and early summer, when you can have good forage yields and excellent grazing for dairy cattle. But when the summer slump arrives, producers need to be able to extend the recovery periods to give these pastures time to regrow. Animals should be on a high plane of nutrition and should be maintained without expensive feed inputs.

There are some very practical things a producer can do to get animals through this downtime in the summer when grazing cool-season grasses:

1. Graze cool-season pastures closely in the spring, leaving about a two-inch stubble. Be careful to rotate at the right time so animals do not have the time to graze the re-growing shoots before the plant recovers or you will begin to deplete the root reserves. Close grazing in the spring causes cool-season grasses to tiller, or send out side shoots that grow into new leaves and more forage later on in the season.

2. As the temperature increases and plant growth declines, leave a little more residue on cool-season grasses if you can. Move cattle when the grass is from three to four inches in height. This will make more leaves available to capture sunlight and supply nutrients the plant needs to regrow.

3. Slow the speed of your rotation when growth slows. Grazing removes older leaves and allows newer, more nutrient-dense leaves to take their place. However, grazing plants that are not fully recovered from the previous grazing will damage plants. Watch your residue height.

4. Add additional land into the grazing rotation by taking an early cut of hay from some fields, then allowing them to regrow before grazing them.

5. Consider warm-season annual crops to fill in during the summer slump. Millets, sorghum x sudangrass, crabgrass, and several varieties of brassicas such as turnips are available and can be spring planted and grazed during late summer. Warm-season annual grasses are generally more nutritious than warm-season perennials and can maintain the cattle on a high plane of nutrition through the summer until the cool-season grasses recover. Especially for pastures in the southern United States, crabgrass can be an excellent forage that exceeds the quality of perennials like bermudagrass and bahaigrass. Although technically an annual, crabgrass reseeds very well and almost acts like a perennial in southern pastures.

Extending the Grazing Season

Stockpiling is defined as letting forage grow during the summer and deferring grazing to the fall or winter. This is an effective way to provide winter forage in some areas and it can reduce the need for harvested forage. If it reduces hay use at all, significant savings can be realized. This system works well for early winter when spring-calving cows are in mid-pregnancy. Stockpiled grazing can be followed with meadow feeding of high-quality alfalfa hay prior to calving.

Stockpiling has been shown to work well given appropriate pasture management and efficient allocation of dormant pasture during the winter. Many grass species will maintain a relatively high nutrient content and palatability for several months after dormancy begins. In the Intermountain West, Altai wildrye has been suggested for stockpiling due to its large stature, ability to stand up under snow, and ability to maintain nutrient quality and palatability well into the winter. In the Midwest, Pacific Northwest, and Northeast, tall fescue is a good choice as it has very high resistance to breaking down after a killing frost. For the humid south, where warm-season grasses dominate, bermudagrass and bahaigrass can be

stockpiled, but it's best to graze these grasses in the late fall before a killing frost to use them while they retain optimum quality. Other species to consider are reed canarygrass and alfalfa. The use of stockpiling as a fall or winter feeding strategy may not work in all climates or on all soil types.

Two extra months of grazing can significantly reduce the costs associated with producing and feeding hay. In some cases, producers have been able to utilize stockpiled forage and eliminate the need for hay feeding altogether. This usually works better in climates where the dormant grass can be preserved longer under adequate snow cover or because of reduced microbial decomposition caused by low temperatures and limited moisture.

Stockpiled forages can either be limit fed (allowing only so many hours of grazing per day) or fed by strip grazing with a movable electric wire or poly tape. Other options for feeding stockpiled forages are to swath them with a hay mower and then rake them into windrows. Termed swath grazing, cattle graze directly off the windrow during the winter by using an electric wire or tape to ration hay on a daily basis. This is similar to strip grazing in that the wire is moved each day to expose a predetermined amount of forage for grazing. This method, while still relying on a tractor to cut and windrow the hay, reduces the amount of fuel, materials, and hay equipment needed for baling and feed hay by eliminating the baling process altogether. Swath grazing works best in drier regions where weathering is less likely to reduce the nutritional quality and palatability of the hay.

Corn and Grass-Legume Silage

Corn silage can be fed to cows on pasture when the forage energy content is inadequate, and if it is cost-effective to make and feed silage. Otherwise, corn silage is probably not worth it. Corn silage is superior to grass silage for cattle grazing high-quality pasture. Feeding a high-protein, low-energy supplement, such as grass or grass-legume silage, to cows on high-quality pasture causes cows to reduce their grazing intake. However, high-energy corn silage has the opposite effect. Consider grass silage for winter feeding in addition to high-quality hay. Grass silage can be cut, baled, and wrapped much like hay. This is referred to as haylage, and the ensiling process is completed within the wrapped bale.

Grass or alfalfa silage requires less energy inputs than corn silage, due to the perennial nature of these crops. Grass or alfalfa silage does not require annual tillage or planting. However, the ratio of energy output per unit input is slightly lower than corn silage.

Table 2: Types of Silage

Type	Crude protein	Fiber	Energy
Grass and small grain silage	High	High	Low
Corn silage	Low	Low	High
Legume silage (clovers, alfalfa)	High	High	Low

Silage can be an excellent source of supplemental nutrients. Allow pasture to be the primary feedstuff for the cattle and feed the supplement later in the day after the cattle have grazed for several hours. Protein tends to increase forage utilization by grazing livestock, but feeding too much protein can reduce pasture intake and result in inefficient pasture utilization.

Unwilted, long-cut grass has been successfully ensiled in piles and covered with white plastic. According to Allan Nation (2005), editor of *Stockman Grass Farmer,* the grass is cut with equipment such as an Alpha-Ag Lacerator and blown into a wagon, then stacked, covered, and vacuumed. Silage made this way can produce high-quality feed and will not spoil during feeding as long as it is fed out every day. The New England Small Farm Institute and the Connecticut Cooperative Extension System have also done some research with this system and many farmers in New England have successful used this technology (Markesich, 2002).

Dairy Housing

In cool climates, dairy barns are a necessity. Free-stall barns are common in the north and northeast, especially when feeding a total mixed ration. In warmer climates, extensive barns aren't as needed, and are generally not used, especially with pasture-based systems. Shade structures or a simple loafing shed in addition to a parlor are common in grass-based systems in the south.

Modernization of the following systems provides the most cost-effective means of reducing energy use on the farm, including the dairy barn itself:

- Water-heating and space-heating systems
- Lighting
- Ventilation fan motors
- Milking equipment, including pre-coolers, energy-efficient compressors, variable-speed pumps
- Electrical components, because dirty contacts waste energy and pose a fire hazard
- Timers on heating components

After addressing these areas of concern, you can begin to determine other areas that need treatment, such as installation of solar fencing, solar- or wind-generated water pumps, and more efficient manure handling techniques.

Compost Bedding Dairy Barns

Compost bedding dairy barns are an integrated approach that solves many farm problems, including the problem of manure handling. This design also utilizes the heat of aerobic fermentation to heat the barn space. Compost is spread on fields seasonally, and there is much less nutrient loss than with spreading raw manure. However, the compost bedding process requires aeration twice a day and ventilation to remove moisture. Maintaining a compost bedding space requires constant attention and sufficient equipment to aerate the bedding pack twice daily. Aeration can be accomplished with a modified compost turner, a front end loader, or a bobcat. Some producers even use pigs to aerate bedded compost. Compost bedding barns reduce the need to purchase and ship bedding materials such as wood shavings, which represents not only a cost savings but an energy savings as well. Marcia Endres and Kavin Janni of the University of Minnesota suggest the following practices to ensure a successfully composted bedding pack:

- Provide at least 80 square feet per cow for Holsteins and similar-sized breeds and 65 square feet for Jerseys. Some producers provide 100 square feet per cow.
- Use fine, dry wood shavings or sawdust for bedding. Alternative bedding materials are being investigated.
- Aerate the pack twice daily 10 inches deep or deeper to keep it aerobic and fluffy. Biological activity helps dry the pack.
- Add bedding when it begins to stick to the cows. Have bedding supply available so you don't end up adding fresh bedding too late.
- Enhance biological activity to generate heat to drive off moisture and ventilate the barn well to remove the moisture.
- Use excellent cow preparation at milking time (Endres and Janni, 2012).

Whether a compost bedding barn or a conventional barn with timely manure removal is more efficient depends on several elements, such as frequency of manure removal, available land for disposal, pasture nutrient load (namely phosphorus), and personal preference. In addition to considering the energy and monetary cost of inputs such as bedding and time, consider the amount of tractor time needed to remove manure versus aerating compost bedding twice daily.

For assistance with determining energy-efficiency practices, access the NRCS Energy Estimator for Animal Housing online (http://ahat.sc.egov.usda.gov). This interactive tool will allow you to input your farm data and energy costs and then recommend practices to conserve energy and estimate savings based on your location.

Paddocks can be divided with a single strand of electric wire. Photo: Lee Rinehart, NCAT

Fencing and Water Systems

Fencing for grass-based dairies can be a significant cost and should be designed for ease of use and flexibility of paddock size, as paddock size will likely change as the growing season progresses.

More and more grass-based dairy producers are utilizing electric fencing for permanent perimeter

fencing and for inner paddock sections. The permanent perimeter fence is usually constructed with wooden or steel posts and high-tensile wire and carries a current that is distributed to the fences that subdivide the individual paddocks. The paddocks can be divided either with permanent fencing or with temporary posts and poly wire or tape. The advantage of temporary paddock fencing is that the paddock sizes can be changed according to animal numbers or forage production throughout the season.

Some of the necessary equipment for designing and constructing electric fences include:

- A charger (energizer) and grounding rods
- High-tensile wire, 10-, 12.5-, or 14-gauge
- Tensioners and insulators
- Poly tape and poly wire for sectioning off paddocks
- Tools, including volt meters, crimping devices, lightning arrestors, and surge protectors
- Posts, such as wood and steel (for permanent and corner braces) and fiberglass or plastic step-in posts (temporary)

There are many manufacturers and distributors of electric fencing equipment. Your local feed store or farm co-op might be the first place to look. Online dealers are also a good place to obtain fencing materials.

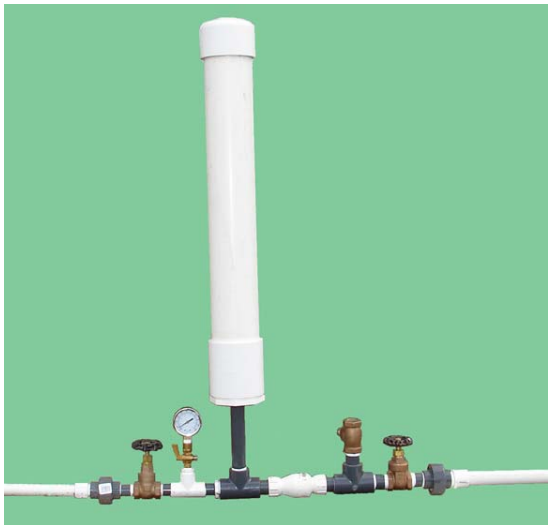
Water is the most important nutrient for dairy cattle (NRC, 2001). An adequate water supply is necessary to renew the cows' body water content that is lost daily through milk production, urine and feces, sweating, and exhalation. A 1,500-pound lactating cow producing 60 pounds of milk per day requires 21.8 gallons in cool weather, about 40 degrees Fahrenheit, and 28.9 gallons in hot weather (about 80 degrees) (Waldner and Looper, 2002). Water should be clean and fresh, as dirty water decreases water intake. Nutrient metabolism in the body depends on water, and if a cow stops drinking, nutrient metabolism (growth and lactation) will decrease.

Water should be delivered to cattle in the most efficient manner possible. Tanks can be placed in each paddock, or can be made portable and moved to individual paddocks as the cattle move. Water can come from municipal sources, wells, springs, ponds, or streams. Solar pumping systems are effective for delivery from wells or ponds,

Electric poly wire is a cost-effective tool for maximizing pasture utilization. Photo: Courtesy of USDA NRCS

A single source provides water to multiple paddocks. Photo: Courtesy of USDA NRCS

and low-input technologies such as ram pumps can supply minimum water flow to tanks from running streams and can even pump water uphill if sufficient head is achieved. Detailed information on solar water pumping, including further resources, can be found in the ATTRA online publication *Solar-Powered Livestock Watering Systems* or by calling ATTRA at 800-346-9140. Ram pumps utilize stream flow to pump water and can lift water from a stream to a tank without electricity. Clemson University has plans and specifications for building a ram pump, available at http://virtual.clemson.edu/groups/irrig/Equip/ram.htm.



Homemade hydraulic ram pump. Ram pumps are simple and inexpensive to build. All the materials can be purchased at your local hardware store. Photo: Courtesy of Clemson University

Seasonal systems match the reproductive cycle of the cows to availability of forage.

The USDA booklets *Electric Fencing for Serious Graziers* and *Watering Systems for Serious Graziers* from Missouri Natural Resources Conservation Service contain detailed suggestions, plans, and troubleshooting ideas and should prove valuable to producers designing and constructing fencing and watering systems. See the Further Resources section for information on how to download or order these guides.

Seasonal Dairying

Dairying in the United States has traditionally produced milk on a year-round basis with a feeding system of silage, hay, and grain. However, seasonal dairying is becoming more popular. It was first practiced in New Zealand, where little grain is grown and government subsidies disappeared years ago. Seasonal systems match the reproductive cycle of the cows to availability of forage. The periods of highest nutrient requirements of the cow—during calving and lactation—are timed to occur in the season of highest grazing quality and quantity. This usually is in the spring.

In seasonal dairying, since all the cows dry off at once, it is not necessary to milk for a couple of months during the year. The idea is to avoid the period when milk production is most expensive. In very hot, humid climates, summer might be the time to dry off the cows. Many dairy producers appreciate this rare opportunity for time off from milking, but all must adjust to a period of no income from milk. As more dairies have become seasonal, milk processors have begun indicating that producers may be penalized, especially in certain parts of the country where there is already an oversupply of milk in the spring.

Managing for a short-season calving period is critical for the seasonal dairy farmer. The goal is for all cows to calve within a six- to eight-week period. For organic dairy producers, this can be done without hormonal injections and achieve a fairly high degree of success. Success depends on body condition, adequate nutrition, and good all-around reproductive management; however, getting cows bred in a short time period may be the biggest challenge in a seasonal dairy program. Producers are finding that getting cows off concrete and onto pasture aids in detecting estrus in cows.

Keys to success for transitioning to seasonal production include:

- Synchronizing estrus
- Detecting heat
- Breeding cows within a narrow window of time (approximately six weeks)
- Maintaining cows on a high plane of nutrition and maintaining body condition with high-quality pasture and forages
- Providing adequate facilities for calving, calf raising, and breeding in one season
- Culling late breeders, or letting them go through a complete breeding season and trying to get them bred next season

Benefits of Seasonal Calving

With spring calving, a producer has the ability to match peak lactation with forage production. The cows are also dry when forage is scarce in the winter months. For fall calving, the cows are dry during the hot summer months. In the fall, milk prices are generally higher, and breeding is accomplished during the cooler months. In addition, seasonal calving allows the farmer to concentrate on the actual process of calving for an intense period of time, and to be available for help if needed.

Natural and Homeopathic Aids for Estrus Synchronization

Dr. Hubert Karreman, a Pennsylvania veterinarian who has seen and treated his fair share of organic dairy cattle on farms throughout the mid-Atlantic region, suggests that observation of even the slightest change in behavior is critical to successful heat detection. He has noted that good dairy farmers can "just see" that a cow is in estrus by the way she looks and behaves, including such characteristics as milk letdown and feed intake (Karreman, 2007). His book *Treating Dairy Cows Naturally*, which includes a section about reproduction and heat cycles, provides firsthand knowledge from an experienced veterinary practitioner. The section describes basic anatomy and physiology, nutritional effects on fertility, heat detection methods and suggestions, reproductive disorders, and botanical and homeopathic treatments. See Further Resources for information on obtaining a copy of the book.

Seasonal Economics

In seasonal dairying, high milk production is not an overriding objective. Instead, emphasis is placed on lowering feed costs by relying on pasture. Lower capital requirements and lower feed costs can potentially lead to a profitable system (Miller and Schnitkey, 1994).

Maintaining a high level of management is crucial to realizing potential profits in a seasonal system. Tom Kriegl of the University of Wisconsin-Madison Center for Dairy Profitability has suggested that a moderate financial return should be expected even by experienced and highly capable managers committed to the seasonal system. Kriegl has studied the economics of grazing, nongrazing, and organic dairying systems from 1999 through 2014, which provide insight into the factors that influence net farm income from operations (NFIFO) per cow and per hundredweight equivalent (CWT EQ) in comparing grazing, seasonal, and conventional dairies. See the Further Resources section for contact information for the University of Wisconsin-Madison Center for Dairy Profitability, which maintains links to Kriegl's studies online.

According to Gordon Groover, an Extension economist and associate professor at Virginia Tech, "selling most of the milk produced during the lowest price period has little impact on total gross sales." Therefore, sound financial analysis and time-management considerations should also factor into making decisions about seasonal dairying (Groover, 2000). Groover's book, *The Income Side of Seasonal vs. Year-Round Pasture-based Milk Production,* explains the implications of the seasonal price index and milk sales in comparing seasonal versus year-long production. See Further Resources for information on obtaining a copy of the book.

Dry Cow Management

Develop a working relationship with a large-animal veterinarian who is qualified and comfortable working with grass-based systems. If you are considering organic production, you might also consider a qualified holistic veterinary practitioner. The main point is that any health program, including a dry-cow program, should be developed with the input of a veterinarian who understands and respects the systems approach to production that is exemplified by grass-based and organic dairies.

Maintaining a high level of management is crucial to realizing potential profits in a seasonal system.

A dry-cow program is a year-long systematic plan that involves preventative health, nutrition, observation, proper milking procedure, a commitment to animal welfare, and treatment when conditions warrant. The following points should be kept in mind when developing a dry-cow program:

- The cow should be in good condition at dry off. Dry-off time is too late for rebuilding nutritional reserves.
- The cow requires minerals, vitamins, amino acids, and enzymes to rebuild her body stores and get ready for the next production cycle.
- Dry-cow management begins three months before calving, which is usually a month before dry off.
- Salt, kelp, calcium, and phosphorus must be made available free choice.
- Feed bulk dry-cow rations such as grass, hay, and no more than about five pounds of grain. Too much energy will fatten her and can cause parturition difficulty. Corn silage is also a very good dry cow feed; just be sure not to feed too much.
- Prepare the cow for a natural immune system drop after dry off. This generally occurs

about seven days after dry off, and again two to three weeks before and after calving. These are stressful times of hormonal change and imbalance. Do not carry out any treatments, vaccinations, or other procedures during this time. Leave her udder alone during this time, as well. Plenty of free-choice mineral and vitamin supplementation beginning three months before dry off will help the immune system cope with these natural changes.

- Animal handling should be exercised with extreme care. Yelling, pulling, hitting, and banging of gates causes stress and lowers natural immunity. Sunshine and pasture are important for animal well-being and maintenance of natural immunity.

As the cow progresses through her lactation period, the amount of high-quality forage required will increase.

Observe somatic cell counts prior to dry-off period. Think of treating only those cows with high counts. Probiotics and whey products have been successful treatments. Causes of a high somatic cell count include acidosis, lack of barn and equipment sanitation, poor milking procedure, and negligent cow handling, which can cause stress.

Observe the cow after calving. Calving difficulty and health problems associated with calving are indicators of low immunity at calving.

Sample Dry-Cow Management System

- Feed an adequate amount of dry hay for rumen function.
- Provide calcium, phosphorus, and trace minerals, including salt, available for free choice at all times.
- Provide vitamin A and E and selenium supplementation if needed, especially in the winter when green forage isn't available.
- Natural treatments help boost immune system and include kelp with or in addition to aloe vera pellets at two weeks prior to calving.
- Use whey products and probiotics for cows with high somatic cell count at one week after dry up.
- Consider pre-milking for cows with past udder trouble. Pre-milking is stimulating the udder by hand massaging to encourage milk let-down.

Grazing Nutrition

Ruminants are adapted to use forage because of a symbiotic relationship with rumen microorganisms. Therefore, feeding the rumen microorganisms will in turn feed the animal and maintain ruminant health and productivity. Some basic principles of grazing nutrition include:

- Ruminant nutritional needs change depending on age, stage of production, and weather.
- Adequate quantities of high-quality green pasture can supply most—if not all—of the energy and protein a ruminant needs.
- Forage nutritional composition changes depending on plant maturity, species, season, moisture, and grazing system.
- Supplementation may be necessary when grass is short, too mature, dormant, or when high-producing animals require it.
- Excessive supplementation may reduce the ability of the rumen microorganisms to digest forage.
- Supplementation with a high-protein forage or feeds when the herd is grazing grass-legume pastures may cause animals to refuse pasture and produce less milk. If protein overfeeding continues for too long, cows may lose condition, not breed back, and develop hoof problems.

Grazing cattle require green, growing, leafy grass and legumes to meet the protein and energy requirements needed to maintain lactation. Maintaining a high plane of nutrition is critical for good grazing management, as covered in the Forages and Grazing section. Appropriate supplementation is necessary when forage is inadequate, which is the subject of the next section.

Supplementing Dairy Cows

The energy requirements of lactating cattle can be met with fresh pasture or with high-quality grass-legume hay or silage in the winter. However, energy supplementation on pasture is often effective in maintaining high gains and higher milk production. Dry cows can subsist on lower-quality feedstuffs but will need to be maintained at an acceptable body condition score to successfully breed and deliver a healthy calf.

When to Supplement

Supplementing energy is helpful on vegetative, well-managed pastures for more efficient utilization of forage protein for high-producing animals.

Supplementing with protein is necessary on low-quality pasture and rangeland or when continuously grazing temperate warm-season pastures.

Energy is important for cattle on high-protein pasture because the microorganisms that occupy the rumen need energy to digest all the protein the animal ingests. If the microorganisms do not get enough energy, the protein is converted to urea and is passed through in the urine, resulting in inefficient protein use. For very high-producing dairy cattle, an energy supplement such as grain or corn silage can result in better protein digestion, and therefore higher milk production and greater weight gains for growing cattle. Most dairy graziers who supplement their cattle provide from 8 to 18 pounds of corn or another high-energy grain per head per day, depending on the quality of the pasture, in addition to forage or pasture.

Digestible fiber feeds are good energy sources for dairy cattle on high-quality forage because digestible fiber feeds do not reduce intake and provide energy for protein metabolism. Examples of digestible fiber feeds include corn gluten feed, made with corn gluten meal and bran; wheat midds, made from screenings from wheat flour processing; and whole cottonseed.

For more in-depth information on cattle nutrition, refer to the ATTRA publication *Ruminant Nutrition for Graziers.*

Cow Nutrition and the Art of Grazing

Cliff and Maggie Hawbaker own Hamilton Heights Farm and Emerald Valley Farm, organic grass-based, no-grain dairy operations in south central Pennsylvania. They milk a total of 425 cows on 869 acres, and on their farm, grass is their number-one concern.

"Energy, fiber, and protein are what the cows are after," says Cliff. "Energy comes from the sun and, through photosynthesis in the plants, becomes carbohydrates, which feed the cows. The cows get the best balance of energy with fiber and protein by grazing the top half of a pasture stand that has just a little maturity on it." The rest is tramped into the soil to feed the soil microorganisms. By keeping his recovery periods to 40 days or less, he maintains adequate protein in his pasture and provides a good balance of protein to energy.

"We capitalize on energy as much as we can," says Cliff. Protein isn't the limiting factor in a dairy herd.

It's energy and especially fiber that are often overlooked. The little bit of maturity in the forages provide that balance he's looking for.

Photo: Northeast Organic Dairy Producers Association

Health Management

The natural living conditions of pastures decrease animal stress and remove unnecessary burdens on the immune system. Other practices such as sanitation, quarantine of new animals, and the use of probiotics in young animals can also foster a healthy environment for livestock. Disease prevention is the best health plan you can have for your cow herd, and a well-planned pasture-based system will effectively eliminate many vectors for disease and alleviate many nutritional disorders.

Cattle health management is a disease-prevention strategy that includes:

- Fostering natural immunity in animals by increasing animal and plant biodiversity on the farm
- Balancing nutrition through pasture grazing management and mineral supplementation
- Development of a proactive dry-cow management program
- Proper milking procedures
- Reducing animal stress through appropriate facility design, outdoor access, and providing high-quality forage in the dormant season

Recordkeeping is a critical component of a livestock health plan and is of vital importance to a dairy farmer. ATTRA has a set of organic livestock recordkeeping forms that help producers document pasture use, livestock inventory, individual cow health, and breeding. To access these forms, visit ATTRA's website or call 800-346-9140.

To learn more about animal health and disease prevention, contact the author at 800-346-9140.

Organic Dairy Production

There is an increasing demand for organic and pasture-based dairy products. Many conventional dairy farms transitioning to pasture-based production are also becoming certified organic. This section will discuss how to get started in transitioning a dairy to certified organic production.

Several challenges are typical in the transition period of changing from conventional to organic production. In addition to feeding only certified organic feeds, a producer should develop an ecological approach to production as opposed to an input approach. In practical terms, this means developing soil fertility through grazing management, careful use of winter manure, controlling pests and disease through sanitation and plant and animal diversity, and stress reduction. These are just a few concerns during the transition period.

The first step in transitioning to organic production is to select a certifier in your area. Many states have one or more certifying agencies that are authorized agents by the USDA National Organic Program (NOP). Certifying agencies are listed on the NOP website at http://ams.usda.gov/nop. Once you select a certifier, you will complete an application packet, which will become your organic system plan. Remember that it takes three years from the date of the last application or use of a prohibited substance, such as synthetic herbicides and fertilizers, until a product from the land can be sold as organic. It also takes one year to transition a dairy herd to organic. Alternatively, a certified organic herd can be purchased once the farm is certified organic.

Transitioning to Organic Dairy

The transition period for organic dairy cows is 12 months on certified organic land or third-year transitional land. Before cows are brought onto the farm, the land must be inspected and certified. The farmer should request certification first for the land and then for the cows. If the farmer can prove through a prior land-use affidavit or a field and pasture record that no prohibited substances have been applied to the land during the past three years, the land can be certified right away. The cows would not be included on the certificate until the 12-month cow-transition period has been completed.

Livestock are usually transitioned during the land's third year of transition. Most farmers start their land transition and then during the beginning of the third year will start their dairy transition. During the third year, farmers can feed third-year transitional crops ONLY from their own land (or they can feed purchased certified organic feedstuffs). Bedding must be organic, but transitioning farmers can use third-year transition bedding from their own farm, as well. A farm can't sell or buy third-year transitional crops for transitional dairy feed or bedding.

The Organic System Plan (OSP)

According to NOP regulations, every certified organic farm, ranch, and handling operation must submit an organic system plan (OSP) when applying for certification. The OSP must be updated annually or more frequently if operational changes are made.

An OSP includes the name and contact information of the producer, the type of operation seeking certification, and a livestock inventory. In addition, the following elements should be documented to maintain an audit trail in order to establish organic system integrity:

- Livestock origin – Livestock products that are to be sold, labeled, or represented as organic must be from livestock under continuous organic management for one year prior to certification.
- Feed – The total feed ration must be composed of agricultural products, including pasture and forages that are organically produced and, if applicable, organically processed.
- Health care – The producer must establish and maintain preventative healthcare practices, including selection of appropriate livestock species, adequate nutrition, appropriate housing and sanitation, freedom of movement and reduction of stress, administration of vaccines, and proper treatment of sick animals, even if organic status could be affected.
- Livestock living conditions – The producer must establish and maintain living conditions that accommodate health and natural animal behavior, including pasture for ruminants.
- Recordkeeping – The producer must maintain records concerning production, harvesting, and handling of agricultural products. The records must fully disclose all activities and transactions, be readily understood and audited, and be maintained for five years.

Detailed information on these criteria can be obtained from the ATTRA/NOP Sound & Sensible Tipsheet *Organic Cattle, Sheep, and Goats for Dairy* (https://attra.ncat.org/tipsheets.html). Contact ATTRA at 800-346-9140 to obtain a copy.

The Northeast Organic Dairy Producers Alliance (NODPA) has many useful documents on its website for farmers thinking about transitioning. Visit www.nodpa.com/resources.shtml for detailed information on transitioning to organic, grazing, and more.

The National Organic Program Pasture Standard

The Access to Pasture Rule, a provision of the NOP regulations, took effect in June 2010 and all organic operations were in compliance by June 2011. The regulations set forth the requirements that organic ruminant livestock producers must document to be compliant with organic standards. To be certified organic, all animals must obtain a minimum of 30 percent of their dry-matter intake from grazing pasture during a grazing season of no less than 120 days. In addition, producers must document pasture dry-matter intake, have a pasture management plan, and manage pasture as a crop to meet the nutritional requirements for the animals as well as to protect soil and water quality. Finally, the rule states that all bedding used on organic livestock farms must be organic.

To be certified organic, all animals must obtain a minimum of 30 percent of their dry-matter intake from grazing pasture during a grazing season of no less than 120 days.

The organic pasture rule also states that all ruminants should be managed on pasture year-round by providing grazing throughout the growing season and access to the outdoors throughout the year, including during the non-growing season.

The ATTRA/USDA publication *Pasture for Organic Ruminant Livestock: Understanding and Implementing the National Organic Program (NOP) Pasture Rule* offers a summary of several key provisions within the NOP regulations as they pertain to pasture management, access to pasture, feed, and grazing intake by ruminant livestock—collectively, referred to as the "Pasture Rule." It also assists producers in implementing the provisions of the rule. Tools for calculating dry matter intake and conducting grazing management are included.

Grass-Fed Standards and Process Verification

Three grassfed certification organizations are the American Grassfed Association, Animal Welfare Approved, and PCO's Grassfed Certification Program. A summary of these programs follows.

American Grassfed Association

Forage: An AGA-Certified Grassfed animal is born, raised, and finished on open grass pastures where perennial and annual grasses, forbs, legumes, brassicas, browse, and post-harvest crop residue without grain are the sole energy sources, with the exception of mother's milk, from birth to harvest. Hay, haylage, silage, and ensilage from any of the above sources may be fed to animals while on pasture during periods of inclement weather or low forage quality.

Confinement: AGA-Certified Grassfed ruminants must graze pasture where they will receive most, if not all, of their nutrition, and be allowed to fulfill their natural behaviors and basic instincts of grazing at all times. The only exceptions to this standard are emergencies that may threaten the safety and well-being of the animals or soil, and management practices such as roundups, sorting, shipping, and weaning.

Animal health and welfare: Mineral and vitamin supplements may be provided free choice to adjust the animals' nutrient intake and to correct deficiencies in the total diet energy source. The feeding of animal by-products is prohibited, and no antibiotics, ionophores, or hormones of any type may be administered. Any animal in need of medical attention must be treated to relieve its symptoms. If prohibited medication or antibiotics are required for treatment, the animal must be tagged, identified, and removed from the certified grassfed program. Producers will develop and maintain a written record of all vaccines, medications, and/or other substances used in their animal health care program.

Origin and identification: Animals eligible for acceptance in the AGA-Certified Grassfed program must be born and raised in the United States. Animals must be identified at the earliest opportunity following birth by a producer-determined animal identification system. Each animal's record must include breed, ear tag or unique identification number, date of birth, and owner. Producer records that trace an animal from birth to harvest must accompany animals when delivered to processor. Genetically engineered and or cloned animals are prohibited.

For information on becoming certified through AGA, call 877-774-7277 or visit the website at www.americangrassfed.org.

Animal Welfare Approved Optional Grassfed Certification

The Animal Welfare Approved (AWA) Certified Grassfed standards are an optional addition to the AWA beef, meat and dairy sheep, meat and dairy goat, and bison standards. These standards do not stand alone and cannot be applied in isolation. In order for animals to be approved as AWA Certified Grassfed, they must also be approved under the AWA species-specific standards.

To gain AWA-Certified Grassfed certification, you must feed your animals only grass and other forages from weaning onwards. As with non-grassfed AWA certification, you must also raise your animals outside on range or pasture for their entire lives. No growth hormones or sub-therapeutic antibiotics are permitted and all Certified AWA animals must be slaughtered at an AWA-recommended slaughter plant.

For more information on AWA certification, call 202-546-5292 or visit the website at http://animalwelfareapproved.org.

The PCO Grassfed Certification Program

PCO, a USDA accredited certifier in Pennsylvania, has established a certification program for 100% grassfed operations. Operators certified to this standard must first be certified organic under the USDA NOP regulations.

Under the PCO standard, livestock may be fed forage that consists of grass, legumes, browse, cereal grain crops in the vegetative (pre-grain/pre-boot) state, hay, haylage, baleage, silage, crop residue without grain, or other roughage. Forage may include seeds naturally attached to forage, provided that crops normally harvested for grain (including but not limited to corn, soybean, rice, wheat, and oats) are foraged or harvested in the vegetative state (pre-grain/pre-boot). Grain crops that have matured to boot stage or later, and corn that has matured past the V10 stage or into tassel stage, are prohibited. Forage must not be fed in concentrated (i.e., pelletized) form.

For information on the PCO 100% Grass-fed Certification Program, contact PCO at 814-422-0251, email pco@paorganic.org, or visit the website at www.paorganic.org.

Animal Welfare

Animal agriculture has become significantly focused on production efficiency, as evidenced by confinement systems, total mixed ration delivery of concentrated feedstuffs, genetic selection for high-producing cows, and the use of hormones and antibiotics to sustain high production levels. These practices have increased the production of milk and milk products dramatically, but often at the expense of animal welfare. From an economic perspective, grass-based dairies place more attention on net income than on high productivity, and some dairy farmers with less extensive production systems achieve a higher net income by lowering their production costs. From an ecological perspective, grass-based dairy farms measure success in increased soil and animal health and a better quality of life for the farm family.

Grass-based dairies foster an environment that is conducive to animal health and longevity. Some of the factors that positively affect animal welfare on grass-based farms are:

- Outside access and reduced confinement, which decreases respiratory problems from dust and ammonia
- Forage-based ration instead of grain-based, which reduces incidence of acidosis
- Low-stress weaning for calves and cows, which reduces sickness
- Natural grazing rhythms, which keep animals stress-free, since cows graze when they are physiologically ready, not when they have to
- Pasture, which improves the cows' comfort

Marketing Pasture-Based Livestock Products

Grass-based and seasonal dairy products likely need marketing schemes that differ from traditional marketing channels. Many grass-based and seasonal dairy producers have a niche product and try to receive premium prices. This is because seasonal producers have a hard time finding a traditional milk buyer who can accommodate seasonal milk production. Most buyers want to know they have milk coming all year, especially given the seasonal milk fluctuations that already affect them.

Niche Markets and Product Differentiation

If feasible, grass-based and seasonal milk producers should consider marketing private-label milk and dairy products. Selling milk locally is another good option to get premium prices, but requires a commitment of equipment, expertise, and time. Local and artisan cheese makers can also be a market for grass-based and seasonal producers. Producers can seek cheese makers who want to make a grass-fed cheese and are willing to pay a premium for the milk. The ATTRA publication *Adding Value to Farm Products: An Overview* discusses the concept of adding value to farm products, the differences between creating and capturing value, and the implications for value-added enterprises. It describes some different approaches to adding value, including starting a food-processing business, with a brief look at non-food products.

Of course, grass-based producers can still sell milk through traditional channels. Keeping costs low through grazing has been a very effective means of staying profitable.

Marketing Basics

Enterprise evaluation – Ascertain the feasibility of new enterprises and clarify goals. Identify financial resources and potential customers.

Market research – Identify and define your product. Consider production, processing, and packaging needs, and estimate sales volume. Look for an unfilled niche market. Seek out information on consumer habits and competitors.

Marketing plan – Identify advertising strategies for reaching customers. Clarify objectives, appropriate actions, projected income, pricing structures, costs, and potential profitability.

For more detailed information and marketing resources, including feasibility studies and business planning guides, see ATTRA's *Direct Marketing* publication.

Conclusion

Grass-based and seasonal dairying is a viable choice for many farmers looking to increase profitability and maintain a farming lifestyle for generations to come. The importance of exceptional forage management cannot be overemphasized. Supplementation on pasture is provided to cattle based on energy needs, and an ecological approach to health care is crucial to developing a low-input farming strategy that reduces production costs and increases profitability.

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Further Resources

Equipment resources

Watering Systems for Serious Graziers. 2006. USDA Natural Resources Conservation Service, Columbia, MO. https://prod.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1144213.pdf

Topics include livestock water needs, water sources, delivery systems, tanks, protecting watering areas, tank location, installing pipes, and spring water development.

Electric Fencing for Serious Graziers. 2005. USDA Natural Resources Conservation Service, Columbia, MO. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_010636.pdf

Topics include selecting an energizer, grounding, selecting wire, temporary fencing, gates and braces, tools, safety, and troubleshooting.

Gallagher Fence
www.gallagherfence.net
Electric fencing systems and related components.

Premier Supplies
www.premier1supplies.com/c/fencing
Electric fencing and electric netting, sheep and goat supplies, clippers and shearers, ear tags, poultry product, and expert advice.

Building and equipping a parabone swingline parlor, in *Dairy Grazing Manual*. University of Missouri Extension. http://dairy.missouri.edu/buildings/facilitiesdesign.pdf
Details a milking facility for graziers that is inexpensive, very efficient, and can be updated or improved as cash flow permits, and large enough to allow producers to complete each milking in 1 to 1 1/2 hours.

Remodeled Parlors. 2001. By David W. Kammel. Biological Systems Engineering Department, University of Wisconsin-Madison, Madison, WI. http://cdp.wisc.edu/pdf/Remodeled%20Parlors.pdf
Step-by-step planning process and guidance for designing a new facility.

Milking Facilities for the Expanding Dairy. 1995. By Douglas J. Reinemann. Department of Agricultural Engineering, Milking Research and Instruction Lab, University of Wisconsin-Madison. Madison, WI. www.uwex.edu/uwmril/pdf/MilkingParlors/95_WVMA_Parlors.pdf
Guidance for planning parlor expansion, including considerations for New Zealand-style parlors.

Transforming a Dairy Parlor at Low Cost – Developing Dairy in Iowa. Animal Industry Report. 2008. By Larry Tranel. Iowa State University, Ames, IA. http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1353&context=ans_air
Low-cost remodeling and retrofitting of old stall barns and parlors into cost-effective, modern milking parlors.

Grass-based and seasonal dairy management resources

Center for Dairy Profitability, University of Wisconsin-Madison
http://cdp.wisc.edu/Great%20Lakes.htm
Comprehensive research project reports comparing conventional, organic, seasonal, and pasture-based dairy farms in the Midwest. An excellent resource for dairy farmers considering a transition to organic and pasture-based production.

The Small Dairy Resource Book. 2000. By Vicki H. Dunaway. Sustainable Agriculture Network (SAN), Beltsville, MD. http://naldc.nal.usda.gov/download/36631/PDF
Hard-to-find resources for on-farm processing and small-scale dairy production. Includes rare and out-of-date books, as well as resources available online.

Dairy Farming Without Grain. By Sarah Flack. On Pasture. http://onpasture.com/2014/11/17/dairy-farming-without-grain
Article summarizes the most important management issues for farms considering a zero-grain dairy ration.

The Income Side of Seasonal vs. Year-Round Pasture-based Milk Production. 2009. By Gordon Groover. Virginia Cooperative Extension, Virginia Tech, Blacksburg, VA. http://pubs.ext.vt.edu/404/404-113/404-113.html
Discusses the issues related to seasonal price patterns affecting milk sales for dairy producers considering the choice between seasonal or year-round production.

Milk Production from Pasture: Principles and Practices. 2007. By C. W. Holmes, I.M. Brookes, D. J Garrick, D.D.S. Mackenzie, T.J. Parkinson, and G.F. Wilson. NZ: Massey University, Palmerston North, New Zealand. http://lunz-shop.myshopify.com/products/milk-production-from-pasture
This book focuses on the principles and practices of intensive milk production from grazed pastures. In New Zealand, these pastoral dairy systems are able to produce highest quality milk at the lowest costs in the world. Therefore, they are of increasing interest in many other places in the world, including parts of Australia, South Africa, North and South America, and Europe.

Milk Production Costs: How Much Does It Cost You to Produce 100 lbs./Milk. 2002. By Dale Johnson. University of Maryland, College Park, Maryland. www.arec.umd.edu/sites/default/files/_docs/Milk%20Production%20Costs.pdf
Worksheets for calculating costs per hundredweight for milk production.

Increasing Dairy Base with Millionaire Model Dairy Farms. Animal Industry Report. 2006. By Larry Tranel. Iowa State University, Ames, IA. http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1162&context=ans_air
10-step process toward a low-cost, labor-efficient dairy with modified seasonal calving, cross-bred dairy cattle, and management intensive grazing designed for long-term financial security and sustainability.

Profitable Grazing-Based Dairy Systems. Range and Pasture Technical Note. 2007. Natural Resources Conservation Service. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044245.pdf
This technical note defines grazing-based dairies and describes their ecological, social, and economic benefits and the considerations involved in developing or making the transition to a grazing-based dairy. It also contains a series of case studies from different parts of the country.

Grazing and pasture resources

Understanding forage quality. 2001. By Dr. Don Ball, Dr. Mike Collins, Dr. Garry Lacefield, Dr. Neal Martin, Dr. David Mertens, Dr. Ken Olson, Dr. Dan Putnam, Dr. Dan Undersander, and Mr. Mike Wolf. American Farm Bureau Federation, Park Ridge, IL. www.uky.edu/Ag/Forage/ForageQuality.pdf

Information about forage quality and forage testing that can be used to increase animal performance and producer profits.

Extending Grazing and Reducing Stored Feed Needs. 2008. By Don Ball, Ed Ballard, Mark Kennedy, Garry Lacefield, and Dan Undersander. Grazing Lands Conservation Initiative, Bryan,TX. www.agry.purdue.edu/Ext/forages/pdf/ExtendingGrazing-Auburn.pdf

Outlines strategies that can be used in some or many areas to extend grazing and reduce stored feed needs, thus increasing profit.

Pasture Rule and Calculator: Grazing and the Pasture Rule. By Beth Unger and Dr. Guy Jodarski. CROPP Cooperative. www.farmers.coop/producer-pools/dairy-pool/pasture-rule-and-calculator

Includes downloads for pasture dry matter intake calculators, useful for organic dairy producers and graziers alike.

Grazing and Feeding Management for Lactating Dairy Cows. 2000. By Karen Hoffman Sullivan, Robert DeClue, and Darrell L. Emmick. New York State Grazing Lands Conservation Initiative in Cooperation with USDA Natural Resources Conservation Service, Syracuse, NY. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044250.pdf

Guidebook for understanding grazing animal nutrition and grazing management for ensuring high-quality forages for lactating cattle.

Pastures for profit: A guide to rotational grazing. 2002. By Dan Undersander, Beth Albert, Dennis Cosgrove, Dennis Johnson, and Paul Peterson. University of Wisconsin Extension, Madison, WI. www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1097378.pdf

Guide for setting up a multi-paddock rotational grazing system, including assessing resources, determining grazing and recovery periods, and paddock layout and size.

USDA Natural Resources Conservation Service, Local NRCS service centers http://offices.sc.egov.usda.gov/locator/app

NRCS grazing specialists and conservationists can assist producers with technical assistance and in accessing cost-share programs to offset costs to transition to grass-based dairying. Some of the practices that are cost-shared might include planning a grazing system, installing fence, developing water systems and installing laneways.

Health and reproduction resources

Alternative Treatments for Ruminant Animals, Revised, Expanded Edition. 2009. By Paul Detloff. Acres USA, Austin, TX. www.acresusa.com/alternative-treatments-for-ruminant-animals

Presents safe, natural veterinary care for cattle, sheep, and goats.

The fundamentals of dry cow management. By Dr. Paul Dettloff. The New Farm, Rodale Institute. www.newfarm.org/columns/dettloff/1105/index.shtml

Practical advice on managing a cow's natural immune system decline during the dry period.

Treating Dairy Cows Naturally. 2006. By Hubert Karreman. Acres USA, Austin TX. www.hubertkarreman.com

This book addresses many aspects of maintaining healthy animals and treating them naturally. It includes organic treatments and covers aspects of biologics, botanical medicines, homeopathic remedies, acupuncture, and conventional medicine.

Organic resources

Organic Dairy Production. 2011. By Sarah Flack. Chelsea Green Publishing, White River Junction, VT. www.nofa.org/publications.php

Guidebook for understanding soils, crop production, grazing management, livestock, marketing, recordkeeping, and making the transition to organic.

The Organic Dairy Handbook: A Comprehensive Guide for the Transition and Beyond. 2009. Katherine Mendenhall, editor. Northeast Organic Farming Association of New York, Inc. Cobleskill, NY. www.nofanj.org/_literature_57178/organic_dairy_handbook

Comprehensive guidebook on making the transition to organic, including chapters on crop, soil, and pasture management, dairy nutrition, herd health, case studies on organic dairy producers, and numerous helpful appendices.

USDA National Organic Regulations. Agricultural Marketing Service. www.ams.usda.gov/about-ams/programs-offices/national-organic-program

Includes links to a number of useful resources, including NOP organic regulations, national list of allowed and prohibited substances, publications, and list of certifying agencies.

Notes

Dairy Production on Pasture: An Introduction to Grass-Based and Seasonal Dairying

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