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

A Publication of ATTRA—National Sustainable Agriculture Information Service • 1-800-346-9140 • www.attra.ncat.org

By Lee Rinehart
NCAT Agriculture Specialist

In an era of high feed costs and uncertain milk prices, many dairy producers are looking to pasture to provide most of the 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, reproduction and health, organic production and seasonal economics. Included are extensive resources for further reading.

Contents

Jerseys grazing highly productive cool-season perennial pasture in Vermont. Photo courtesy USDA NRCS.

Basic concepts

Pasture management is the basis of a sustainable grass farm. Pasture can provide the main source of nutrition for the milking herd, dry cows and developing heifers during the grazing season. In order for pasture to provide the main source of nutrition for lactating dairy cows you should first establish a baseline of information by conducting a systematic assessment of the grazing resource. The grazing plan can then be implemented and periodically assessed with a pasture monitoring program.

Grazing management is the systematic methodology of allotting pasture and ensuring delivery of high-quality forage feedstuffs. This includes pasture system design such as fencing and water delivery systems; appropriate rotations with variable recovery periods; and haying 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.

Stress management is the monitoring of animal stress that 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 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.

ATTRA—National Sustainable Agriculture Information Service *(www.ncat.attra.org)* is managed by the National Center for Appropriate Technology (NCAT) and is funded under a grant from the United States Department of Agriculture's Rural Business-Cooperative Service. Visit the NCAT Web site (*www.ncat.org/sarc_current.php*) for more information on our sustainable agriculture projects.

Introduction

Grass-based dairying is best described as a method of marketing forage through milk products. Success with grass-based dairy farming requires high-quality pasture and livestock adapted to a high-forage diet. Grass-based producers ensure that forages provide the bulk of the energy and protein needed to produce milk by providing high-quality pasture during the grazing season and stored forages in the dormant season. Supplementation is provided to cattle based primarily on mineral and energy, 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; maintains the system in ecological balance as much as possible to reduce pest and disease pressure; 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. 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

Cattle Production: Considerations for Pasture-Based Beef and Dairy Producers

Dairy Farm Sustainability Checksheet

Dairy Beef

The Economics of Grass-based Dairying

Dairy Resource List: Organic and Pasture-Based

Raising Dairy Heifers on Pasture

Value-added Dairy Options

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

NCAT's Organic Livestock Workbook

Organic Livestock Documentation Forms

Adaptive management

Grass-based dairy farming requires a level of acumen and observational sophistication not approached in most conventional farms. It is critically important that farm 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

Providing high-quality pasture as the principle 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.

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. Feeding grains and concentrates in New Zealand is 6 to 12 times as costly as grazing. This situation has forced New Zealand producers to be extremely proactive in developing low-cost production technologies, and pasture has become the main factor in decreasing farm costs.

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

- Maximum 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)

Switching to grass-based dairy production provides other benefits as well, 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 persons, producers have realized an increase in net income, even with reduced milk production (GLCI, 2005). However, 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 should be closely observed if transitioning to grass-only feeding to ensure the cows maintain body condition, breed back on time and continue to produce milk sustainably.

Making a decision to switch to a grass-based system includes 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).

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 American Livestock Breeds 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 Ayrshire and Jersey breeds 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.

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)

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

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

For more information on livestock breeds, see the Oklahoma State University Department of Animal Science Web site at *www.ansi.okstate.edu/breeds*. Information on rare breeds can be found at the American Livestock Breeds Conservancy Web site at *www.albc-usa.org*.

Taking an inventory of resources for grass-based dairying

Taking 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 at *www.attra.org/attra-pub/PDF/dairychecksheet.pdf* or by calling ATTRA at 1-800-346-9140.

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

Darrell Emmick, a grazing specialist with New York National Resources Conservation Service, has suggested some steps to evaluate resources when considering a new grazing operation. First, identify your goals. What it is 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 adapting to new changes. For detailed information on resource inventory, see chapter three in *Managing and Marketing for Pasture-Based Livestock Production*, published by the National Resource, Agriculture and Engineering Service in 2006 (NRAES, 2006a).

Forages and grazing

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 from 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 (2007). For pastures under high density grazing systems, from 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.

Grazing systems and plant recovery time

If given a choice, livestock will eat the highest quality, most palatable plants in a pasture. In order to ensure that plant biodiversity is maintained in the pasture, it is necessary to set up a grazing management system to better control livestock grazing. The elements of grazing that should be controlled are 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 again. Rotational grazing systems take 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.

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 accompanying information box for details on how 49 acres of pasture can provide fresh forage during the growing season as well as ensiled forages for the winter.

For more information, see the ATTRA publications *Rotational Grazing* and *Pasture, Rangeland and Grazing Management* or review ATTRA's grass farming publications at *www.attra.org/livestock.html#Grass*.

Managing spring-to-fall pasture recovery periods though rotational grazing

Bill Murphy, a grazing expert in Vermont, relates a story about a successful grazing dairy farm in Vermont in his chapter on 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).

Forage management during the summer slump

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 and beef cattle. But when the summer slump arrives, we

Forage legumes like red clover provide nitrogen fertility to the soil and high protein for grazing cows. Photo by Mary Rinehart.

need to be able to extend the recovery periods to give these pastures time to regrow. We also need to keep our animals on a high plane of nutrition and maintain them without expensive feed inputs.

Here is a list of several things you 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 2-inch stubble. Be careful to rotate at the right time so animals do not have the time to graze the regrowing shoots before the plant recovers or you will begin to deplete the root reserves. Close grazing in the spring makes cool-season grasses 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 3 to 4 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 and several varieties of brassicas such as turnips are available and can be spring planted and grazed during the 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.

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 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. Others to consider are reed canarygrass, tall fescue 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. 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 bale and feed hay by eliminating the baling process altogether. Swath grazing works best in dryer regions where weathering is less likely to reduce the nutritional quality and palatability of the hay.

Corn and grass-legume silage

Corn silage should be fed to ruminants 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, planting or fertilization. However, the ratio of energy output per unit input is slightly lower than corn silage.

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 Grassfarmer,* the grass is cut and blown 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 has also done some research with this system and many farmers in New England have successful used this technology (Markesich, 2002).

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

Dairy housing

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 (Anon)

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 nutrient loss is much less 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. 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:

Dairy cattle graze paddocks divided with a single strand of electric poly wire. Photo by Linda Coffey.

- 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 (2008).

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.

To assist you in determining energy efficient practices, you can access the online NRCS *Energy Estimator for Animal Housing* at *http://ahat.sc.egov.usda.gov*. This interactive tool will allow you to input your farm data and energy costs. The tool will then recommend practices to conserve energy and estimate savings based on your location.

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. The perimeter fence carries a current that is distributed to the fences that subdivide the individual paddocks. The paddocks can be divided with either 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

A simple electric fence provides protected access to a stream for livestock watering. PVC pipe is used as a flotation device for the bottom strand. Photo courtesy Alice Beetz.

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

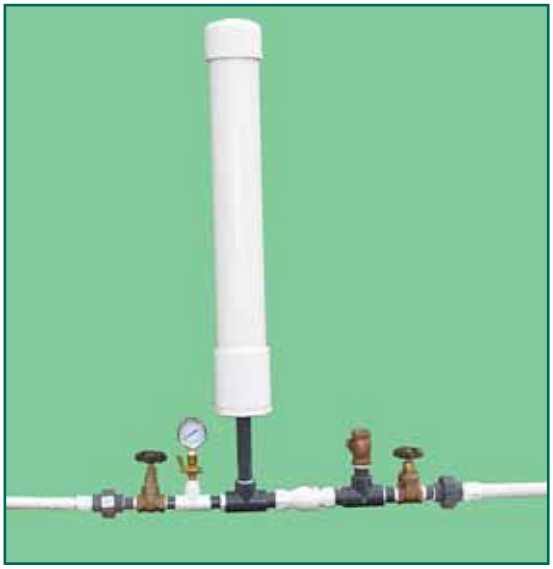
- Tools, including volt meters, crimping devices, lightning arrestors and surge protectors
- Posts, such as wood and steel (for permanent and corner braces) and step in (temporary)

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 such as Gallagher are also a good place to obtain materials. Visit the Web site at *www.gallagherusa.com*.

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). 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.

A single source provides water to multiple paddocks. Photo courtesy USDA NRCS.

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, 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 publication *Solar-Powered Livestock Watering Systems* online *at www.attra.org/attra-pub/PDF/solarlswater.pdf* or by calling ATTRA at 1-800-346-9140. 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 at *www.clemson.edu/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 Clemson University Cooperative Extension Service. **www.clemson.edu/irrig/Equip/ram.htm**

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 below for information on how to order these guides.

Seasonal dairying and considerations on reproduction

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 of the year.

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. 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. 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 into pasture aids in detecting estrus in cows. Unfortunately, producers are also learning that vegetative forages are very high in rumen degradable protein and low in energy. Poor body condition and low energy intake have a negative impact on reproduction; therefore some grain feeding should be done to counter the tendency for cows to lose condition because of decreased available energy.

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
- 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. 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.

The estrous cycle

The reproductive cycle for cattle is known as the estrous cycle, after estrus, or heat. Cows cycle every 21 days beginning with the onset of puberty, which begins when cows are about eight months old. Managing the estrous cycle is a challenging task, especially for organic dairy farmers. Synthetic hormones commonly used in conventional dairies are not allowed in organic production. This section will describe the characteristics of estrus and some considerations for managing reproduction for organic and seasonal dairying.

Characteristics of estrus and breeding in cattle

Estrus – the period of time when a cow shows behavioral signs of heat

Estrous – of, relating to or characteristic of estrus; being in heat

Age at puberty:
From 12 to 18 months, usually first bred at 15 months depending on breed and size

Cycle type:
Polyestrous, or all year

Cycle length:
21 days, with a range of from 18 to 24 days

Duration of estrus (heat):
18 hours with a range of from 10 to 24

Length of lactation:
Approximately 280 days (Merck, 2006)

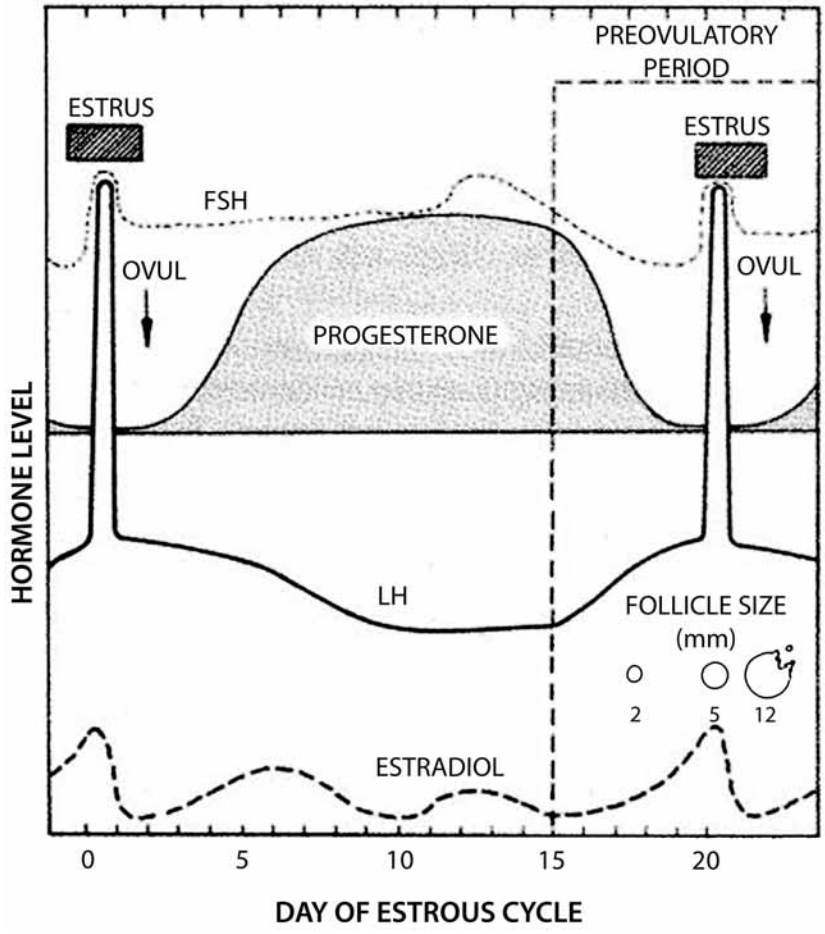
Best time to breed:
At the first sign of heat. As the egg ages conception rates may decrease. The younger the egg, the better the conception rate (Karreman, 2007)

First estrus after parturition:
Varies, best to breed at 60-90 days post partum (Merck, 2006)

Ovulation:
Occurs from 10 to12 hours after the end of estrus.
Uterine bleeding occurs about 24 hours after ovulation in most cows, but may require vaginal examination for detection. Bleed-off usually indicates heat occurred from 2 to 3 days prior (Karreman, personal communication)

Length of Gestation:
283 days

Figure 1. The estrous cycle



FSH: *follicle-stimulating hormone, responsible for development of follicles*
Follicle: *releases ovum (egg)*
LH: *luteinizing hormone, stimulates ovulation and forms corpus luteum*
CL: *corpus luteum, mature follicle after ovulation, produces progesterone*
Progesterone: *hormone that maintains pregnancy*

Graph courtesy of University of Missouri Extension.

The cow's estrous cycle lasts for 21 days. The cycle is split into four periods: metestrus, diestrus, proestrus and estrus.

Days one through three are in metestrus. This occurs immediately following ovulation and is indicated by a rise in progesterone, which maintains pregnancy.

Days three through 19 are diestrus, wich is marked by high progesterone and low estrogen in system. If pregnant, the animal will remain in this phase throughout her pregnancy.

Days 19 and 20 are in proestrus. This is marked by a decrease in progesterone and a rise in estrogen if the cow is not pregnant, and signs of heat begin.

Day 21 is estrus. Standing heat occurs. Ovulation occurs from 25 to 32 hours after onset of estrus.

Signs of heat

The primary sign that indicates a cow is in heat is a cow standing to be mounted, termed standing heat. Some secondary signs that occur before, during or after standing heat and are not necessarily related to ovulation include:

- Mounting other cows
- Discharging mucus
- Swelling and reddening of vulva
- Bellowing, restlessness and trailing
- Rubbed tailhead or dirty flanks
- Chin resting or back rubbing
- Sniffing genitalia
- Not letting milk down as usual

These secondary heat signs indicate that breeding time is getting close. Another sign to look for is metestrus bleeding, which is a bloody mucus discharge that occurs one to three days after estrus and is caused by high estrogen levels. Metestrus bleeding is variable from cow to cow. It signals that an animal was in heat, and is either bred or open. If the cow is open she will be in estrus in another 18 or 19 days.

Detecting estrus

Most mounting activity occurs in the evening and early morning. It is important to time observations accordingly. Provide ample room for cattle to behave naturally and minimize muddy, slippery conditions. Employees should be trained in heat detection and assigned to duties accordingly, observing cows for 30 minutes in the morning, again in mid to late afternoon and again at midnight. At the very least, observe cows in the early morning and early evening. Maintain records of activity, record all heats and develop a heat expectancy chart for each cow. Consider using heat detection aids, such as those listed in the box on the top of the next page:

Heat detection aids

- Use heat detection records and expectancy charts to estimate heat periods.
- Perform cow-side milk progesterone assays for problem cows.
- Use tailhead markings such as paint or Kamar pressure-sensitive devices. These are effective but conception rates are usually lower if not accompanied with direct visual observation of standing heat. Tailhead markings can give false positives due to any number of situations that would result in markings being smudged or rubbed off.
- Consider heat detector animals. Gomer bulls are surgically altered but still mount to breed. Cows will also mount cows in estrus.
- Understand that cows are generally more active during estrus.

Timing of breeding or insemination

Cattle sperm is viable in the cow's vagina and uterus for from 18 to 24 hours. Ovulated eggs remain viable for from 10 to 20 hours. The older the egg is when fertilized, the greater are the chances for embryonic death. For optimum fertilization, inseminate cows as soon as possible because during estrous observation you may have only seen the cow's very last standing mount.

Photoperiod extension

According to a 1994 study in Ohio, it is thought that spring breeding is favored by photoperiod extension, which improves endocrine gland activity related to ovulation (Zartman, 1994). Photoperiod extension is nothing more than extending day length with artificial light. Some producers may be able to take advantage of photoperiod extension for seasonal dairying, especially in mild regions where cattle are less likely to experience breeding problems associated with hot climates. Photoperiods can also be manipulated to increase lactation efficiency. For detailed information on photoperiod manipulation, see the articles by Geoffrey Dahl referenced below in the **Further resources** section.

Conception rates

A 60-percent conception rate for the first service is average for most dairy herds, and about 2 percent of the cows in an average herd need more than five services to conceive. A high number of repeat breeders can indicate a problem. Consider culling for severe repeat breeders.

Synthetic hormones and organic production

Synthetic hormones are not allowed in organic production. Therefore, the routine manipulation of reproduction such as heat synchronization with hormones and the administration of gonadotropin-releasing hormone (GnRH) to improve conceptions rates are not allowed in organic dairy farming. Organic dairy farmers rely on cultural practices such as heat detection, photoperiod manipulation, culling and homeopathic or botanical aids to synchronize estrus.

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 first-hand 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 the **Further resources** section 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 dairies.

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:

If you are considering organic production, you might also consider a qualified holistic veterinary practitioner.

- 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 with free choice.
- Feed bulk dry cow rations such as grass, hay and no more than 5-or-so 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. Feed 20 pounds or less per day for cows on grass.
- 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.
- 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 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 high somatic cell count cows 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 microbes. Therefore, feeding the rumen microbes 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 green forage can supply most —if not all — 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 microbes to use forage.
- Supplementation with a high-protein forage or grain when the herd is grazing grass-legume pastures may cause animals to refuse more 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. As the cow progresses through her lactation period, the amount of forage required will increase. Maintaining a high plane of nutrition is critical for good grazing management, as covered in the Forage and Grazing section above. Appropriate supplementation is necessary when forage is inadequate, which is the subject of the next section.

High-quality legume pasture. Photo courtesy USDA NRCS.

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.

Energy is important for cattle on high-protein pasture because the microbes that occupy the rumen need energy to digest all the protein the animal ingests. If the microbes 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.

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.

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*.

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 healthier environment for livestock. Disease prevention is the best health plan you can develop 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 and pasture exposure 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 the producer document pasture use, livestock inventory, individual cow health and breeding records. To access these forms, visit *http://attra.ncat.org/organic.html#livestock* or call 1-800-346-9140.

To learn more about animal health and disease prevention, see the ATTRA publication *Cattle Production: Considerations for Pasture-Based Beef and Dairy Producers*.

Organic dairy production

There is an increasing demand for organic and pasture-based dairy products. Many conventional dairy farms are transitioning to pasture-based production and 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. The primary concern is to 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, plant and animal diversity; and stress reduction. These are just a few concerns during the transition period.

In transitioning to organic production, you will be confronted with new and often rigorous recordkeeping and management requirements. Yearly inspections will be required to verify compliance to the organic regulations. In addition, there can be a substantial cost to the certification process.

The first step in transitioning to organic production is to select a certifier in your area. Many states have one or more

USDA accredited certifying agents

The USDA maintains a list of accredited certifiers, listed by state, on the National Organic Program Web site at *www.ams.usda.gov/nop*. If you would like a printed list of the certifiers in your area, contact ATTRA at 1-800-346-9140.

certifying agencies that are authorized agents by the National Organic Program. 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 restricted substance such as synthetic herbicides and fertilizers until a product can be sold as organic. It also takes one year to transition a herd to organic. Alternatively, an organic herd can be purchased once the farm is certified organic.

The organic system plan (OSP)

According to the National Organic Program Regulations, every certified organic farm, ranch and handling operation must submit an organic system plan 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, except as is provided for in the National Organic Program regulations.
- *Feed* – The total feed ration must be composed of agricultural products, including pasture and forage, that are organically produced and, if applicable, organically processed.
- *Health care* – The producer must establish and maintain preventative health care 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 National Organic Program's Web site at *www.ams.usda.gov/nop* or by contacting ATTRA at 1-800-346-9140.

The Northeast Organic Dairy Producers Alliance (NODPA) has many useful documents on their Web site for farmers thinking about transitioning. Access the information at *www.nodpa.com*.

Proposed organic dairy grazing standards

As of this writing, the National Organic Program is considering a new section of the rule that covers grazing and housing of organic livestock. The final rule should be published in 2009.

The National Organic Program regulations currently include grazing as a portion of the total feed requirements of ruminant livestock. According to NOP § 205.237, the producer of an organic livestock operation must provide livestock with a total feed ration composed of agricultural products,

It takes three years from the date of the last application or use of a restricted substance such as synthetic herbicides and fertilizers until a product can be sold as organic.

including pasture and forage. In addition, livestock living conditions are addressed to accommodate the health and natural behavior of livestock. A proposed change to the rule states that producers shall ensure that, during a pasture growing season of at least 121 days, at least 30 percent of the cow's dry matter intake shall come from green, growing pasture.

The proposed organic pasture rule 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 nongrowing season. Dry lots and feedlots will no longer be permitted in organic production under this proposed rule. Instead, the pasture system must include a sacrificial pasture for grazing and to protect the other pastures from excessive damage during periods when saturated soil conditions render the pastures too wet for animals to graze (USDA AMS, 2000).

This publication will be amended in the future to reflect changes to the rule by the National Organic Program. For more information on the proposed rule, see the USDA National Organic Program Web site at *www.ams.usda.gov/nop*.

Grass-fed standards and process verification

The USDA initiated a voluntary grass-fed claim standard in 2007 that allows producers to use the *Process Verified* term and shield in their marketing and label their products as grass-fed. The producer will document all verification points, or those substantive and verifiable production claims that add value to the product, and have them verified by a third party. Two organizations approved for third-party verification from the USDA are AgInfoLink, *www.aginfolink.com*, and IMI Global, *www.imiglobal.com/index.aspx*. See the **Further resources** section below for detailed contact information.

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 and organic dairies place more attention on income than on high productivity. It has been mentioned that some dairy farmers with less extensive production systems achieve a higher income by lowering their production costs. From an ecological perspective, grass-based and organic dairy farms measure success in increased animal health and a more appropriate quality of life for the farm family.

The grass-fed claim for ruminant animals and products

The USDA Agricultural Marketing Service's Standards for Livestock and Meat Marketing Claims, Grass (Forage) Fed claim gives authority to label grass-fed livestock products according to the following language: Grass and forage shall be the feed source consumed for the lifetime of the ruminant animal, with the exception of milk consumed prior to weaning. The diet shall be derived solely from forage consisting of grass (annual and perennial), forbs (e.g., legumes, Brassica), browse, or cereal grain crops in the vegetative (pre-grain) state. Animals cannot be fed grain or grain byproducts and must have continuous access to pasture during the growing season. Hay, haylage, baleage, silage, crop residue without grain, and other roughage sources may also be included as acceptable feed sources. Routine mineral and vitamin supplementation may also be included in the feeding regimen. If incidental supplementation occurs due to inadvertent exposure to non-forage feedstuffs or to ensure the animal's well being at all times during adverse environmental or physical conditions, the producer must fully document (e.g., receipts, ingredients, and tear tags) supplementation that occurs including the amount, the frequency, and the supplements provided (USDA AMS, 2007).

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
- 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

Seasonal economics

Seasonal production is known to lower feed costs and capital requirements, ultimately leading to higher farm profitability. However, 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 expectation of financial return should be expected even by experienced and highly capable managers committed to the seasonal system (Kriegl, 2005). The studies, which ran from 1995 to 2005, provide insight to the factors that influence net farm income from operations (NFIFO) per cow and per hundredweight equivalent (CWT EQ) in comparing seasonal and conventional dairies. See the **Further resources** sectopm 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). His publication *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 yearlong production. See the **Further resources** section for information on obtaining a copy of the book.

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 nonfood products.

From an ecological perspective, grass-based and organic dairy farms measure success in increased animal health and a more appropriate quality of life for the farm family.

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, available at *www.attra.ncat.org/attra-pub/PDF/directmkt.pdf* or by calling 1-800-346-9140

The publication is available at *http://attra.ncat.org/attra-pub/PDF/valueovr.pdf* or by calling 1-800-346-9140.

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.

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 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.

Acknowledgements

Special thanks to Hubert Karreman, doctor of veterinary medicine, and Sarah Flack, grazing consultant, for providing technical review to this publication. Thanks also to Margo Hale and Jeff Schahczenski of NCAT for providing input for the equipment, marketing, and economics sections of this publication.

References

Endres, Marcia I and Kevin A. Janni. 2008. Compost Bedded Pack Barns for Dairy Cows. University of Minnesota, St. Paul. Accessed March 13, 2009. *www.extension.org/pages/Compost_Bedded_Pack_Barns_for_Dairy_Cows*

Fraser, Clarence M. (ed). 2006. The Merck Veterinary Manual. 7th ed. Rahway, NJ: Merck & Co. 1832 p.

Gerrish, J. 2007. Can legume nitrogen do it alone? BEEF Magazine, April 2007. Accessed March 13, 2009. *http://beefmagazine.com/pasture-range/jim-gerrish/legume_nitrogen*

GLCI. 2005. Converting to a Grass Based Dairy (DVD, 18 minutes). Pennsylvania Grazing Lands Conservation Initiative.

Groover, Gordon. 2000. The Income Side of Seasonal vs. Year-Round Pasture-based Milk Production. Virginia Tech. Accessed March 13, 2009. *www.ext.vt.edu/pubs/dairy/404-113/404-113.html*

Holmes, C.W., I.M. Brookes, D.J. Garrick, D.D.S. MacKenzie, T.J. Parkinson, and G.F. Wilson. 2007. Milk Production from Pasture: Principles and Practices. NZ: Massey University. 602 p.

Karreman, H. 2007. Treating Dairy Cows Naturally. Austin, TX: Acres USA. 412 p.

Kriegl, Tom. 2005. Production Costs on Selected Wisconsin Grazing Farms, 1995-2005. University of Wisconsin, Center for Dairy Profitability. Accessed March 13, 2009. *http://cdp.wisc.edu/Great%20Lakes.htm*

Markesich, Kim Colavito. 2002. Direct-cut vacuum silage, in Farmer research groups tackle real world issues. Journal, Vol. 9, No. 2. University of Connecticut College of Agriculture and Natural Resources. *www.canr.uconn.edu/CANR/journal%20pdf%20files/apr_may_june02.pdf*

Murphy, Bill. 1995. Pasture Management to Sustain Agriculture, in Agroecology: The Science of Sustainable Agriculture, 2nd Edition. M. Altieri, Editor. Boulder, CO: Westview Press. p. 321 – 347.

Nation, Allan. 2005. Tips on how to make direct-cut vacuum silage. The Stockman Grassfarmer, November 2005. Accessed March 13, 2009. *www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=417*

NRAES. 2006a. Managing and Marketing for Pasture-Based Livestock Production. Edward B. Rayburn, Editor. Natural Resource, Agriculture, and Engineering Service.

NRC. 2001. Nutrient Requirements of Dairy Cattle, 7th Revised Edition. Washington DC: National Research Council.

Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA). Options to Reduce Energy use on the Farm. Accessed March 13, 2009. *www.omafra.gov.on.ca/english/engineer/facts/reduce.htm*.

USDA AMS. 2000. National Organic Program. Code of Federal Regulations, Title 7, Part 205. National Archives and Records Administration's Office of the Federal Register.

USDA-AMS. 2007. Federal Register, Docket No. AMS–LS–07–0113; LS–05–09; Grass-Fed Livestock Claim.

Waldner, Dan N. and Michael L. Looper. No date. Water for Dairy Cattle. Oklahoma Cooperative Extension. *http://osuextra.okstate.edu/pdfs/F-4275web.pdf*

Zartman, D.L. 1994. Intensive Grazing/Seasonal Dairying: The Mahoning County Dairy Program, 1987-1991. OARDC Research Bulletin 1190. The Ohio State University, OARDC, Department of Dairy Science.

Further resources

Housing and equipment resources

Dairymaster USA Inc.
2120 Tuley Road
Indian Springs, OH 45015
www.dairymaster.com

Milking equipment suitable for small-scale grass dairies

Gay, Susan Wood and Rick D. Heidel. 2003. Fencing Materials for Livestock Systems. Virginia Tech. *www.ext.vt.edu/pubs/bse/442-131/442-131.html*

Fencing types, materials, and costs

Gay, Susan W. 2004. Site Selection for Dairy Housing Systems. Biological Systems Engineering, Virginia Tech. *www.ext.vt.edu/pubs/bse/442-096/442-096.html*

Iowa State University Extension. Estimating costs for livestock fencing, FM 1855. *www.extension.iastate.edu/Publications/FM1855.pdf*

Compares the costs of building a quarter-mile (1,320 feet) straight perimeter fence with woven wire, barbed wire, high-tensile non-electric and high-tensile electrified and temporary interior fencing.

Kammel, D.W. 2001. Remodeled Parlors. Biological Systems Engineering Department, CALS, University of Wisconsin-Madison. *http://cdp.wisc.edu/pdf/Remodeled%20Parlors.pdf*

Reinemann, D.J. 1995. Milking Facilities for the Expanding Dairy. University of Wisconsin-Madison, Department of Agricultural Engineering, Milking Research and Instruction Lab. *www.uwex.edu/uwmril/pdf/MilkingParlors/95_WVMA_Parlors.pdf*

Tranel, Larry. 2007. Transforming a Dairy Parlor at Low Cost. Iowa State University Extension. *www.extension.iastate.edu/NR/rdonlyres/B090C051-8602-4456-B3D6-1ED769C2D495/61848/pm2033transiowaparlor12Mg.pdf*

University of Kentucky. Online interactive fencing cost calculator. *www.bae.uky.edu/ext/Livestock/Calculators/LivestockCalculator_FenceWovenBarbed.htm*.

This site will allow you to enter various materials and configurations to compare fencing options.

University of Wisconsin Cooperative Extension Dairy Modernization Web site. *www.uwex.edu/ces/dairymod/index.cfm*

Detailed information on parlor design, dairy housing, feed storage systems and manure handling

University of Wisconsin. Low Cost Parlor Options CD. 2001. Dairy Modernization-Retrofit Team of the University of Wisconsin Cooperative Extension in cooperation with the UW Center for Dairy Profitability and the Biological Systems Engineering Department of the University of Wisconsin.

Single copies of the CD may be purchased from the Center for Dairy Profitability for $25. This price includes shipping and handling. Send orders to:
Arlin Brannstrom,
285 Animal Science Building
1675 Observatory Drive
Madison, WI 53706, 608-265-3030
or Brannstrom@aae.wisc.edu

Tessa I.E.C, Group Limited
www.iec-il.com/dairy.html

Dairy production mini-plants

USDA. 2005. Electric Fencing for Serious Graziers. Columbia, MO: Missouri Natural Resources Conservation Service. *www.mo.nrcs.usda.gov/news/news/MO%20NRCS%20Electric%20Fencing_low.pdf*

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

USDA. 2006. Watering Systems for Serious Graziers. Columbia, MO: Missouri Natural Resources Conservation Service. *www.mo.nrcs.usda.gov/news/images/Watering%20Systemslow.pdf*

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

The preceding two USDA NRCS publications can be downloaded in PDF or ordered from:
USDA NRCS
601 Business Loop 70 West, Suite 250
Columbia, MO 65203

Grass-based and seasonal dairy management resources

Center for Dairy Profitability
University of Wisconsin-Madison
1675 Observatory Drive
266 Animal Science Building
Madison, WI 53706
(608) 263-5665
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.

Dunaway, V. 2000. The Small Dairy Resource Book. Beltsville, MD: Sustainable Agriculture Research and Education. *www.sare.org/publications/dairyresource/dairyresource.pdf*

Gildersleeve, Rhonda R. 2008. Useful Grazing Resources & Reference Materials. University of Wisconsin Cooperative Extension. *www.uwex.edu/ces/cty/iowa/ag/documents/UsefulGrazingResourcesrev508.pdf*

Resource listing for grazing, forage, fencing, and livestock water.

GLCI. 2005. Converting to a Grass Based Dairy (DVD, 18 minutes). Pennsylvania Grazing Lands Conservation Initiative.
Jana Malot
State Grazing Specialist
One Credit Union Place, Suite 340
Harrisburg, PA 17110-2912
(717) 237-2247
(717) 237-2238 FAX
jana.malot@pa.usda.gov

Groover, Gordon. 2000. The Income Side of Seasonal vs. Year-Round Pasture-based Milk Production. Virginia Tech. *www.ext.vt.edu/pubs/dairy/404-113/404-113.html*

Holmes, C.W., I.M. Brookes, D.J. Garrick, D.D.S. MacKenzie, T.J. Parkinson, and G.F. Wilson. 2007. Milk Production from Pasture: Principles and Practices. NZ: Massey University.
Centre for Professional Development & Conferences Private Bag 11 222
Palmerston North, New Zealand
d.p.crow@massey.ac.nz

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.

Johnson, D. and D. Schwartz, Jr. 2002. Milk Production Costs: How Much Does It Cost You to produce 100 Pounds of Milk? University of Maryland. *http://extension.umd.edu/publications/PDFs/FS790.pdf*

Worksheets for calculating costs per hundredweight.

Minnesota Department of Agriculture. 2006. Dairy Your Way: A Guide to Management Options for the Upper Midwest. Meg Moynihan, Editor. *www.misa.umn.edu/Dairy_Your_Way.html*

Nation, Allan. 2003. Farm Fresh: Direct Marketing Meats & Milk. Green Park Press. *www.stockmangrassfarmer.net/cgi-bin/page.cgi?id=361.html*

Schlabach, Matthew. 2008. My Reasons for Seasonal Grass Dairying, in Farming Magazine, Spring 2008. Mt. Hope, OH. *www.farmingmagazine.net/Articles/My%20Reasons%20for%20Seasonal%20Dairying.pdf*

Thicke, Francis. 2004. Organic Grass Based Dairy Products for Local Markets. Presented at Animals in the Food System: A Conference to Consider Pasture-Based Alternatives and Challenges for Research, Outreach and Development. Kellogg Biological Station, Michigan State University. *www.foodandsocietyfellows.org/library/uploadedFiles/Organic_Grass_Based_Dairy_Products_for_Local_M.htm*

Tranel, Larry F. 1994. Dollars and Sense: A Handbook for Seasonal Grass Based Dairying. Green Park Press.

Out of print. Try libraries or online book sellers to obtain a copy.

Tranel, Larry. 2006. Increasing Dairy Base with Millionaire Model Dairy Farms, A.S. Leaflet R2098. Iowa State University Animal Industry Report 2006. *www.ans.iastate.edu/report/air/2006pdf/R2098.pdf*

University of Missouri-Columbia. 2001. SW Center Dairy — Is Seasonal For You? in Southwest Center Ruminations, April - June, Vol. 7, No. 2. The Missouri Agricultural Experiment Station. *http://aes.missouri.edu/swcenter/news/archive/v7n2/swrc5.stm*

USDA. 2007. Profitable Grazing-Based Dairy Systems. Edited by Stefanie Aschmann and James B. Cropper. Natural Resources Conservation Service. *ftp://ftp-fc.sc.egov.usda.gov/GLTI/technical/publications/tn_rp_1_a.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.

Wahlberg, Mark. 2008. Beef End Product: Livestock Update, VA Tech. Voluntary Standards for a Forage-Fed Livestock Marketing Claim. Agricultural Marketing Service. Docket No. AMS–LS–07–0113; LS–05–09. United States Standards for Livestock and Meat Marketing Claims, Grass (Forage) Fed Claim for Ruminant Livestock and the Meat Products Derived From Such Livestock.) *www.ext.vt.edu/news/periodicals/livestock/aps-08_06/aps-0604.html*

Grazing and pasture resources

Cooper, D. and D. Cosgrove. Pasture Forage Intake Calculator for Dairy Cows. University of Wisconsin Extension. *www.uwrf.edu/grazing/DMI.xls*

Cosgrove, Dennis and Dennis Cooper. Estimating Dry Matter Intake of Grazing Dairy Cattle, in Grazier's Notebook, Vol. 2 No. 2. University of Wisconsin Extension. *www.uwex.edu/ces/crops/uwforage/GN-EstimatingDMintake.pdf*

Emmick, Darrell L. and Danny G. Fox. 1993. Prescribed Grazing Management to Improve Pasture Productivity in New York. Cornell University. *www.css.cornell.edu/forage/pasture/index.html*

McCrory, Lisa. 2007. Measuring 30% DM from Pasture, in Northeast Organic Dairy Producers Alliance News, Vol. 7 Issue 2. *www.nodpa.com/IndustryNews/Measuring_30_Percent_may2007.pdf*

NRAES. 2006b. Forage Production for Pasture-Based Livestock Production. Edward B. Rayburn, Editor. Natural Resource, Agriculture, and Engineering Service.

NRAES. 2007. Forage Utilization for Pasture-Based Livestock Production. Edward B. Rayburn, Editor. Natural Resource, Agriculture, and Engineering Service.

All NRAES publications can be ordered from:
NRAES Cooperative Extension
PO Box 4557
Ithaca, NY 14852-4557
(607) 255-7654
www.nraes.org/nra_index.taf

Sullivan, Karen, Robert DeClue, and Darrell Emmick. 2000. Prescribed Grazing and Feeding Management for Lactating Dairy Cows. New York State Grazing Lands Conservation Initiative.
Free. Order from:
Darrell Emmick
(607) 756-0581, ext. 117
Darrell.emmick@ny.usda.gov

University of Maine Cooperative Extension. Pasture Management Online Home Study Course *www.umaine.edu/umext/pasture*

University of Maine Cooperative Extension. Northeast Grazing Guide. *www.umaine.edu/grazingguide*

Undersander, Dan, Beth Albert, Dennis Cosgrove, Dennis Johnson, and Paul Peterson. 2002. Pastures for profit: A guide to rotational grazing. University of Wisconsin Extension. *http://learningstore.uwex.edu/pdf/A3529.PDF*

USDA Natural Resources Conservation Service
Financial Assistance Programs Division
14th and Independence Ave., SW
Room 5239-S
Washington, DC 20250
(202) 720-1845

Local NRCS service centers
http://offices.sc.egov.usda.gov/locator/app?agency=nrcs
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

Cassell, Bennet. 2001. Using Heritability for Genetic Improvement. Virginia Cooperative Extension. *www.ext.vt.edu/pubs/dairy/404-084/404-084.html*

Crystal Creek
N9466 Lakeside Road
Trego, WI 54888
1-888-376-6777
www.crystalcreeknatural.com

Dahl, Geoffrey. 2001. Photoperiod Management of Dairy Cattle. Ontario Ministry of Agriculture, Food and Rural Affairs. *www.omafra.gov.on.ca/english/livestock/dairy/facts/info_photoperiod.htm*

Dahl, Geoffrey. Photoperiodic Manipulation of Lactation in Dairy Cattle. University of Illinois at Urbana-Champaign. *www.livestocktrail.uiuc.edu/photoperiod*
This site contains background on the long-day photoperiod method to increase milk production. It also has studies that summarize and confirm the stimulatory effect of long days on milk production in cattle in North America and Europe. Example barns, recommendations and calculation to determine the number of light fixtures required for your barn style are available.

Dettloff, Paul. 2004. Alternative Treatments for Ruminant Animals. Austin, TX: Acres USA.
Safe, natural veterinary care for cattle, sheep, and goats.
Acres USA
PO Box 91299
Austin, TX 78709
(512) 892-4400
www.acresusa.com

Dettloff, P. 2005. The fundamentals of dry cow management. The New Farm, Nov. 10. *www.newfarm.org/columns/dettloff/1105/index.shtml.*

Karreman, H. 2007. Treating Dairy Cows Naturally. Austin, TX: Acres USA.
Penn Dutch Cow Care
1272 Mt Pleasant Rd,
Quarryville, PA 17566
(717) 529-0155
www.penndutchcowcare.org
This book addresses many aspects of maintaining healthy animals and treating them naturally. The book includes organic treatments and covers aspects of biologics, botanical medicines, homeopathic remedies, acupuncture and conventional medicine.

Mellenberger, Roger. 2001. California Mastitis Test (CMT): An Invaluable Tool for Managing Mastitis. Department of Animal Sciences, Michigan State University. *www.uwex.edu/milkquality/pdf/046acaliforniamastititest.pdf*

Merck. 2006. The Merck Veterinary Manual. Rahway, NJ: Merck & Co. *www.merckvetmanual.com/mvm/index.jsp.*

Morris, Tom and Michael Keilty. Alternative and Herbal Livestock Health Sourcebook. Northeast Regional Sustainable Agriculture Research and Education program, Burlington, VT and the College of Agriculture and Natural Resources, University of Connecticut. *www.cag.uconn.edu/plsc/plsc/ahlh%20sb-web.pdf*

National Dairy Herd Information Association
PO Box 930399
Verona, WI 53593-0399
(608) 848-6455
www.dhia.org

NRC. 2001. Nutrient Requirements of Dairy Cattle, 7th edition. Washington DC: National Research Council. *www.nap.edu/openbook.php?record_id=9825&page=R1*

MOFGA. 2006. Raising Organic Livestock in Maine: MOFGA Accepted Health Practices, Products and Ingredients *www.nofamass.org/programs/organicdairy/pdfs/tech_livestocklist.pdf*

A list consistent with information provided by the National Organic Program, the National Organic Standards Board's recommendations, Organic Materials Review Institute and communication with Northeast Interstate Organic Certifiers Committee.

O'Conner, M.L. 1993. Heat Detection and Timing of Insemination for Cattle. State College, PA: Penn State University Cooperative Extension. *www.pubs.cas.psu.edu/FreePubs/pdfs/ec402.pdf*

Rhodes, R.C. The Use of Milk Progesterone Assays for Reproductive Management. University of Rhode Island. *www.wvu.edu/~exten/infores/pubs/livepoul/dirm9.pdf*

The Virtual Dairy Cattle Encyclopedia of Reproduction. 2008. G.W. Smith, Y. Kobayashi, N.M. Bello, editors. Michigan State University. *www.angel.msu.edu/section/default.asp?id=GROUP-050706-182227-DAK*

A Web-based teaching tool designed to provide information on the fundamentals of dairy cattle reproduction, new technologies and the importance of reproduction to dairy farm profitability.

Whittier, Jack C. 1993. Reproductive Anatomy and Physiology of the Cow. University of Missouri Extension. *http://extension.missouri.edu/xplor/agguides/ansci/g02015.htm*

Organic resources

Flack, S. 2005. Organic Dairy Production. Northeast Organic Farming Association. *http://nofany.org/publications.html*

MOSES. 2006. Organic Dairy Farming: A Resource for Farmers. Jody Padgham, editor. Gay Mills, WI: Orang-utan Press.

USDA. National Organic Program, 7 CFR Part 205. Agricultural Marketing Service. *www.ams.usda.gov/nop*

Process verified programs and resources

AgInfoLink
1860 Lefthand Circle
Suite G
Longmont, CO 80501
www.aginfolink.com

Dutton. Jennifer. 2007. Q & A: Grass-fed Claim and Process Verification for Meat Products. Center for Profitable Agriculture, University of Tennessee Extension. *http://cpa.utk.edu/pdffiles/cpa145.pdf*

IMI Global
221 Wilcox St. Ste. A
Castle Rock, CO 80104
(303) 895-3002
www.imiglobal.com

USDA Process Verified Program
USDA, AMS, LS, ARC Branch
100 Riverside Parkway, Suite 135
Fredericksburg, VA 22406
(202) 690-1038 FAX
http://ProcessVerified.usda.gov

The USDA Process Verified Program provides suppliers of agricultural products or services the opportunity to assure customers of their ability to provide consistent quality products or services.

Notes

Notes

Dairy Production on Pasture: An Introduction to Grass-Based and Seasonal Dairying
By Lee Rinehart
NCAT Agriculture Specialist

Holly Michels, Editor
Amy Smith, Production

This publication is available on the Web at:
www.attra.ncat.org/attra-pub/grassbaseddairy.html
or
www.attra.ncat.org/attra-pub/PDF/grassbaseddairy.pdf

IP340
Slot 338
Version 063009