

Proceedings of the Mid Atlantic Dairy Grazing Conference and Organic Field Day

October 8 & 9, 2008
Shenandoah Valley, Virginia



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Mid Atlantic Dairy Grazing Conference and Organic Field Day Agenda

October 8, 2008	Shenandoah Valley Produce Auction, Dayton, VA
1:00PM	Registration
1:30PM	Welcome and Introductions
2:00PM	Tour Lamar Rhodes Certified Organic Grazing Dairy Farm -Overview of Farm Operations / Facility -Walk Paddocks -Soils and Soil Pit -Discussion – ‘forage choices and seed sources for grass dairies’
4:00PM	Tour Philip Witmer Grazeland Dairy operated on rented farm -Overview of Farm Operations / Facility – ‘where we are in the organic transition’ -Walk Paddocks -Discussion – ‘What we have done and what we would do differently’
6:00PM	Dinner at Shenandoah Valley Produce Auction Producer Panel follows Dinner -Lamar Rhodes, Certified Organic, VA -Phil Witmer, Grass Dairy on a Rented Farm -Cheyenne Christianson, No-Grain Organic Holsteins
October 9, 2008	Campus of Blue Ridge Community College, Weyers Cave, VA
7:45 – 8:45AM	Registration
8:00 – 9:00AM	Virtual Tour of Cheyenne Christianson Dairy, No-grain organic Holsteins
9:00 – 9:45AM	Break-Out 1 CLA’s, Omega 3’s, and our strategy to market grass-derived organic dairy products, Ned MacArthur, Natural by Nature, Inc. Not All Soils Are Created Equal: Understanding the Potential and Limitations of Soils on Your Farm, Jason Teets, West VA NRCS
9:45 – 10:00AM	Questions / Discussion of Break-Out 1
10:00 - 10:15AM	Break
10:15 -11:00AM	Break Out 2 Serious Considerations of Unpasteurized Milk -Bill Chirdon, PA Department of Agriculture -John Beers, VA Department of Agriculture and Consumer Services Building and Maintaining Soil Fertility in Organic Grazing Systems - Bill Bryan, West Virginia University
11:00 – 11:15AM	Questions / Discussion of Break-Out 2
11:15 – 11:30AM	Break
11:30 – 12:15PM	Break Out 3 Good approaches to cow shares and herd shares, Pete Kennedy, Attorney at Law Pasture Ecology: Managing Things That We Can Not See, Ed Rayburn, West Virginia University
12:15 – 12:30PM	Questions / Discussion of Break-Out 3
12:30 PM Lunch	
1:15PM –	Conference Capstone Address – Joel McNair, editor of 'Graze' Followed by Questions and Comments for all the conference speakers

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Dairy Outlook

October 2008

US Dairy Industry Outlook Depends on Global Demand

US milk supply growth has slowed in response to high production costs

Scott Brown

Food and Agricultural Policy Research Institute, University of Missouri

The outlook for milk prices will continue to depend in large part on the global demand for dairy products. Oceania cheese prices had averaged \$5,000 per metric ton (about \$2.25 per pound) for much of 2008, but recently they have slid to \$4,500 per metric ton. Even after the recent decline, global cheese prices remain well above historical averages. This has provided the US an opportunity to commercially export cheese in 2008, which has in turn helped increase domestic cheese prices. American cheese exports totaled 33 million pounds in the first six months of 2008 compared to 22 million pounds over the same period in 2007. As a result of the strong world cheese price, US cheese prices have remained in the \$1.80 to \$2.00 per pound range for much of 2008. US cheese prices fell to an average of \$1.74 for the month of August but have recovered back to near \$2.00 per pound by the end of September.

Global skim milk powder and butter prices have also remained above historical averages. However, these global prices have seen larger declines relative to the record levels seen in 2007 than has been the case for cheese. For example, European skim milk powder prices are \$1,500 to \$2,000 per metric ton lower in 2008 than the same period a year ago. Similar to cheese, US exports of these products have also been larger than those experienced in the past.

The strong international demand has kept minimum class prices higher than many expected for most of 2008. The minimum class III price for August is \$17.32 per cwt. It appears with the recent strengthening in cheese prices, the class III price will climb even higher in September. Class IV prices have strengthened since March 2008, driven by butter prices that moved from \$1.21 per pound in February 2008 to \$1.63 per pound in August 2008.

These federal order class prices have translated into US all milk prices above \$18.00 per cwt thus far in 2008. Unless world dairy product prices experience further large declines relative to today's levels, it appears that prices will remain above this level for the remainder of 2008.

Current FAPRI estimates suggest that the outlook for 2009 milk prices will be for levels that are near those seen in 2008, with the all milk price averaging \$18.90 per cwt.

Milk supply growth slows

Near record dairy industry returns in 2004 and 2007, as well as solid returns in 2005 have allowed dairy cow inventories to exceed year ago levels for 42 consecutive months. This has been unprecedented growth in dairy cows!

The traditional balance that suggested a decline of roughly one percent was needed in dairy cows to offset the two percent increase in milk yields so that the net increase in milk supplies would not drastically erode profitability has not held true recently. In fact, the industry will have experienced four straight years where milk supply growth has exceeded 2 percent annually with the close of 2008. However, recently monthly data suggests that milk production growth is beginning to slow. After averaging about 3.0 percent from July 2007 through June 2008, with only one month registering less than 2.0 percent, data from the August milk production report showed growth of only 1.1 percent, following a 1.4 percent growth rate in July.

Rapidly rising production costs are to blame. Despite milk prices that have been at or near record levels, returns to dairy producers have been far from record levels as a result of the large increase in feed cost the industry has experienced the past couple of years. The cost of producing a hundredweight of milk has grown by nearly \$4.00 since feed costs began their strong ascent. While feed costs have recently moved a bit lower, they still remain at high levels. It is not likely that milk prices will soon fall to the lows seen as recently as two years ago given this new level of feed costs (remember that class III prices averaged \$11.00 per cwt in August 2006).

2008 Farm Bill

The 2008 farm bill has made modifications to the Milk Income Loss Contract (MILC) program. The Milk Income Loss Contract Program (MILC) has been extended, with incremental increases beginning in October 2008 for the maximum amount of milk per fiscal year eligible on an operation (2.985 billion pounds instead of 2.4 billion pounds), as well as the percentage of the difference between the MILC trigger price and the Boston Class 1 milk price that will be used to calculate payments (45% instead of 34%).

The interesting aspect of the new MILC program deals with the dairy feed ration cost adjustment provision. This actually allows the trigger price for payments to increase when feed costs reach high enough levels, making MILC the only livestock industry program currently in place to help counter high feed costs. So how high do feed prices have to get before the trigger adjusts upwards? The feed price ration is calculated based on nationally reported prices for corn, soybeans, and hay. The ration is assumed to be comprised of 51% corn, 8% soybeans, and 41% hay. When the value of feed needed to produce 100 pounds of milk exceeds \$7.35, the base trigger price of \$16.94 per cwt (for a Boston Class 1 milk price) adjusts upward by 45% of the difference between the dairy ration cost and \$7.35. December 2007 was the first time the \$7.35 threshold was exceeded, but every month since then would have resulted in an increase in the MILC trigger, with the ration cost of \$10.63 for July feed prices increasing the trigger by \$3.40 $[16.94 * \text{MAX}(0, ((\$10.63 - \$7.35) / \$7.35 * 45\%))] = \$3.40$.

Lamar Rhodes Family Farm
 October 8, 2008; Mid Atlantic Dairy Grazing Conference and Organic Field Day
 Farm Tour and Producer Panel



50 cows milking currently

65% calve in spring
 35% calve in fall

Herd is a JerseyXHolstein base
 and are being bred A.I. to
 Swedish Red with a Milking
 Shorthorn bull used as clean-up.

69 acres, of which 50 are tillable

30 additional tillable acres are
 rented, used for growing corn,
 sorghum X sudan, and hay.

29C2, Frederick Lodi Soil, 7 – 15% slopes, eroded. Surface layer will be 7 – 9 inches thick of brown or gray silt loam, subsoil depth is 60 inches or more with brown clay loam changing to yellowish red or red clay or silty clay with increasing depth.

Permeability and available water capacity is moderate. Surface runoff is rapid. The soils are low in natural fertility and organic matter content. The shrink swell potential of the subsoil is moderate to high. The root zone extends to bedrock. These soils are strongly acid or very strongly acid. These soils are considered well suited to cultivated crops and pasture but care must be taken to prevent erosion.

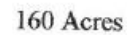
31D2, Frederick Lodi Soil, cherty silt loam, 15 – 25% slopes, similar to 29C2 but with chert through out the soil profile. Slope makes these soil unsuited for cultivated crops.

Productivity classifications for different crops.

Soil Series	Corn	Wheat	Soybean	Alfalfa	Tall Grass / Clover Hay and Pasture
Frederick-Lodi	IIb	I	II	I	II
	150 bu / 22.5 tons	64 bu standard mgt 80 bu intensive mgt	40 bu full season 32 bu dbl crop	> 6 tons / ac	> 4 tons / ac

Lamar's favorite paddock contains a mix of tetraploid ryegrass, alfalfa, red & white clover, endophyte-free fescue, chicory, and prairie brome. Lamar likes diversity in paddocks. He feels this is the best way to achieve swards with high durability and high productivity.

Farm Tour and Producer Panel



185 cows milking currently, conventional milk, will be sold late fall

15% calve in fall

80 open heifers, 7–10 months old

29C2, Frederick Lodi Soil, 7 – 15% slopes, eroded. (29D2 is the same but has 15 – 25% slopes). Surface layer will be 7 – 9 inches thick of brown or gray silt loam, subsoil depth is 60 inches or more with brown clay loam changing to yellowish red / red / or silty clay with increasing depth.

Permeability and available water capacity is moderate. Surface runoff is rapid. The soils are low in natural fertility and organic matter content. The shrink swell potential of the subsoil is moderate to high. The root zone extends to bedrock. These soils are strongly acid or very strongly acid. These soils are considered well suited to cultivated crops and pasture but care must be taken to prevent erosion.

Productivity classifications for different crops.

Phil and two full-time employees run the farm. The farm shipped 3.6 million lbs of milk in 2007. Phil's favorite paddock currently is composed of alfalfa and matua (prairie brome). It was seeded two years ago with 10 lbs of Matua and 18 lbs of Alfalfa in August.

Doug Martin Family Farm, Chambersburg, PA

Producer Panel, Mid Atlantic Dairy Grazing Conference and Organic Field Day, October 8, 2008

110 acres at the dairy, almost entirely devoted to grazing, extremely rocky

600 acres off of the dairy platform which are farmed

300 acres off of the dairy platform which are grazed (heifers and dry cows)

Milking herd is 300 registered Jerseys.

65% of herd calves in the spring, 35% of herd calves in the fall

6 'full-time equivalent' workers, 3 are hired employees and the rest is family labor

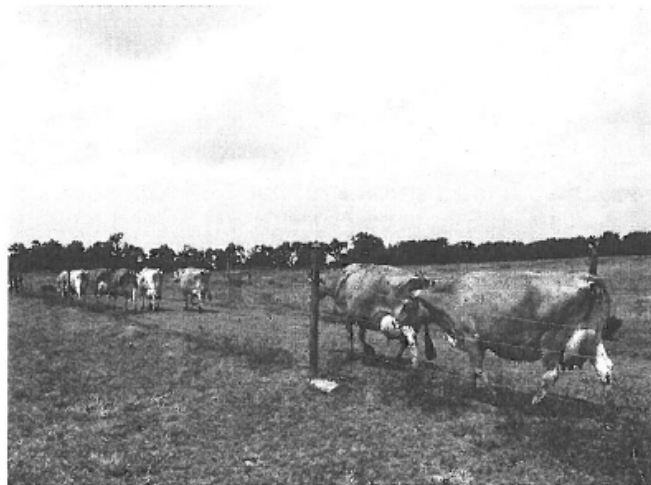
Breeding Program:

- On the milking herd, A.I. is used for 3 weeks and then clean-up bulls are turned-in.
- All Heifers are bred by natural service

Feeding Program:

- Grazing Season:
 - In May and early June, $\frac{3}{4}$ of dry matter intake is from pasture, $\frac{1}{4}$ is from a TMR.
 - On average for the grazing season, $\frac{1}{4}$ of dry matter intake is from pasture, $\frac{3}{4}$ is from TMR
- Winter
 - 100% of dry matter intake is from TMR
 - Milking Herd's TMR is $\frac{1}{2}$ corn silage, $\frac{1}{2}$ grass silage, + grain supplement
- At no time is forage less than 60% of dry matter intake and they strive for forage quality that allows forage to be 70% of dry matter intake or higher.
- Heifers older than 1-year and Dry Cows have pasture, grass silage, and / or hay ONLY
- Heifers younger than 1-year receive some grain.

Favorite paddocks have orchardgrass as a base with ryegrass and bluegrass mixed in. Intense invasive pressure by thistles and the subsequent control program limits the presence of clover



Some of Doug Martin's Jerseys. The cow in the rear of the line is 9-years-old and the cow just in from to her is 11 years-old

Cheyenne Christianson, Certified Organic Dairy, Chetek, Wisconsin

Producer Panel, Mid Atlantic Dairy Grazing Conference and Organic Field Day, October 8, 2008

Milking herd is 70 Holstein cows and growing on 280 acres.

Oats are an important annual in the grazing program

- Spring oats fit in well in June when the grass started to slow down or the first cutting grass hay had not re-grown sufficiently to graze. The oats gave a couple weeks so pasture could re-grow or second cut could be grazed.
- Fall oats could carry us into late fall when grass once again slowed way down. This was a great help in keeping quality food going into the cows right up to winter.
- Purple top turnips are grown with the fall oats. The turnips are very cold hardy so grow well after frost and stay green even when the ground is frozen.
- Has have found tilling up some acres for annuals has helped immensely in growing feed under dry conditions



Cheyenne Christianson's Holsteins grazing spring oats.

Grazing taller forage has been good for cows.

- In Cheyenne's opinion, there is far too much protein and little fiber in short pasture which puts a huge load on the energy reserves of the cow as she excretes the excess as MUN and BUN.
- Generally, cows graze paddocks that are 12 inches and higher but NOT fully mature.

Grass hay is offered when pastures are short (early spring) to slow passage rate from the rumen.

Soil fertility is another key

- farm still has some low fertility fields but has addressed trace elements and uses things like Ocean Grown and liquid kelp to cover the micros nutrient needs.
- Winter bedding pack is the best way to bring a field back to life.
- Has been feeding free choice kelp for 10 years or so which he feels has helped the cows by providing many of the traces that may still be missing from the forages.

Hay quality is very important, it is vital for keeping flesh on the cows. This doesn't mean high protein "rocket fuel", just really nice hay with good mineral levels. Seed-heads are usually showing at baling but not overly mature. High moisture baleage allows timely harvesting and first cutting is generally 12% to 15% protein. Our Second cutting is generally 15% to 18%. A mix of first and second cutting during winter feeding makes a nice balance. Our favorite paddocks contain Red clover, timothy, and/or brome.

Cheyenne Christianson Dairy - Chetek, Wisconsin



My wife Katy and I and our 7 children (ages 2 to 15) have a 280 acre certified organic dairy in northwest WI. We are currently at 70 cows and growing as new heifers join the herd.

We moved on our farm in July 1993 and rented for a little over a year. We purchased it in the fall of 1994 and spring of 1995. We started grazing right away in 1994. Our farm had very run down soils so fertility has always been an issue. I have taken a fairly slow approach to bringing in fertility inputs, as we focused on paying debt down.

I started the no grain path in about 1994 or 1995 when we had a lot of acidosis in the herd when on pasture. Looking back I feel it was from lack of fiber from too short of pasture, not necessarily from the grain, which was cob corn. This was the beginning of our future. We grew the last corn in 1997 and then fed some oats in 1999.

Most of what we learned was by "accident" and observation, like planting oats for grain but ended up grazing them off and it worked great. For many years we did very little tillage (10 to 20 acres spring and fall), but that changed when it got dry, as we have found that tilling up some acres for annuals has helped immensely in growing feed under dry conditions. For years we grew some oats in the spring and again in the fall. The spring oats fit in well in June when the grass started to slow down or the first cut wasn't off in time for new growth. The oats gave us a couple weeks so pasture could regrow or second cut could be grazed. We found the fall oats could carry us into late fall when grass once again slowed way down. I feel this was a great help in keeping quality food going into the cows right up to winter. We added purple top turnips to the fall plan about four or five years ago. The turnips are very cold hardy so grow well after frost and stay green even when the ground is frozen. As soil fertility improves so pasture grows better, tillage may be less important, but I feel it helped us a lot to till a field that would grow very little fall grass, but would still grow nice fall oats.

Somewhere through the years we started grazing taller and taller pasture. I feel this is one of the keys to low/no grain. There is far too much protein and little fiber in short pasture which puts a huge load on the energy reserves of the cow as she excretes the excess as MUN and BUN. Obviously, the cow will get thin if energy is lacking or being used to excrete excess protein. I tend to graze at 12 inches and up. I've even grazed at 3 to 4 feet tall with decent results. This is short term and very dependant on grass varieties. Orchard grass doesn't work. Red clover, timothy and brome work well. By grazing tall I don't mean fully mature as energy declines again. I am doing high stocking to some degree as we give the cows only what they need and often move them twice during the day and again at night. If I don't have the height I want because of drought or in early spring I will feed a grassy hay to balance things out, slow them down, and let the pasture grow. I use manure consistency as my guide. I want to avoid loose manure always. In the spring we keep cows on the pack at night so they are full of hay when we let them go pick on early grass. Over two to three weeks we transition cows onto full grass. I think it helps the rumen

adjust to new lush feed. We only graze on a few acres so the rest can grow before we graze it.

I think soil fertility is another key so the plants have the minerals needed to raise the Brix and provide the nutrition the animal needs. My farm still has some low fertility fields but I have addressed traces and use things like Ocean Grown and liquid kelp to cover the micros. The winter bedding pack is the best way to bring a field back to life. With all the dry years we've had it is amazing how the higher fertility fields will produce compared to low fertility ones. We've been feeding free choice kelp for 10 years or so and I think that has helped by providing many of the traces that may still be missing.

Hay quality is very important, especially if you milk through the winter. It is vital for keeping flesh on the cows to have top quality hay or baleage. This doesn't mean high protein "rocket fuel", just really nice hay with good mineral levels. I usually have heads showing when I bale, but I don't let it get too mature, and baleage allows baling when it needs to be. My first cut would fall in the 12% to 15% protein range and second from 15% to 18% generally. When I mix the two in winter it makes a nice balance. We had a lot of poor quality feed from 2007 as it was very dry. Much of the hay we bought wasn't that great or possibly low mineral density. By spring 2008 we had a few cows that lost condition which reaffirms the need for quality hay. Also, much of what we bought was alfalfa and it doesn't have enough energy to keep cows fat. Alfalfa also has a lot of soluble protein which must be excreted.

- Cheyenne Christianson

The following is a article written by Joel McNair, editor of *Graze* magazine about Cheyenne's dairy grazing operation: It appeared in the February 2006 issue of *Graze*

Well-fed, no grain organic Holsteins

Chetek, Wisconsin — Cheyenne Christianson has a simple answer for grazing-based, organic dairy producers besieged by escalating costs for purchased grain.

Don't feed any.

While he doesn't recommend that everyone follow his route, Cheyenne hasn't fed a kernel of grain for nearly six years. And he is making no-grain work under what would seem to be less than ideal circumstances.

For one thing, the northwestern Wisconsin combination of brutally cold winters and late, chilly springs boosts energy requirements in the 55-cow dairy herd well beyond those for cattle in friendlier climes.

The milking cows are overwintered on covered and uncovered bedding packs, while dry cows and heifers are outwintered on pasture with natural shelter. The other thing that would seem to make no-grain tougher here is that Cheyenne is working almost entirely with Holstein genetics. They aren't the sort of Holsteins that win shows, and they don't have the latest hot milking genetics. But mature weights average close to 1,500 lbs.

Seeing is believing: In October the Christianson Holsteins were in very fine flesh. Granted, they were milking 40/lbs./day en route to shipping 11,000 lbs./cow for the year (not counting at least 1,000 lbs. fed to calves).

On the flip side, these Holsteins produced a 4.1% average fat test in 2005, never dropping under 3.91%, and hitting a high of 4.34% on winter rations (calving is April through November). Cell counts usually run at 200,000-300,000. Over the past three years, Cheyenne culled 26 cows, for a 15-20% annual culling rate. And with a \$21.76/cwt. milk price (simple monthly average) for 2005, he is making money at this.

By later this year Cheyenne, 34, and his wife, Katy, intend to be debt free - 12 years after purchasing a worn-out, 280-acre farm (250 tillable/grazeable) from the Farm Credit System. Though Cheyenne had grown up on a 25-cow dairy farm, his lack of assets caused some trouble in finding a lender. His father co-signed the initial cattle loan and shared some machinery during the early going.

Since then, the Christiansons' net worth has grown from \$17,000 to more than \$1,000,000 with appreciation, or \$600,000 without it. After starting with nearly \$200,000 in debt - most of it at 10% interest - Cheyenne says the family has paid at least \$1,000 per cow in loan principal each year. All debt would be gone by now if the Christiansons had not purchased \$230,000 in new equipment over the past three years. And the farm has paid for every dollar of family living for seven children from a gross income that averaged \$120,000 in recent years. "But we do live modestly," Cheyenne notes.

Scoff if you like. Cheyenne and Katy paid only \$500/acre for their farm. In hindsight, Cheyenne says that perhaps they could have spent more money on improving the fertility of a farm where some fields had phosphorus readings below 7 ppm, and less on rapid debt reduction.

While Cheyenne thinks that no-grain can work for others, he doesn't guarantee success for someone with a greater debt load, a non-organic milk market, or management problems that might prevent satisfactory performance. And living this cheaply "does require some sacrifice," Cheyenne notes.

But the fact of this matter is that no-grain can work with well-managed pastures and organic milk prices.

Like most farmers in their 20s, Cheyenne worked hard during the early years here. But he suffers from narcolepsy, and soon burned out. "For a couple of years, all I wanted to do was sleep," he relates. "I had to simplify things. I had to learn to pace myself." In his case, this meant eliminating many tasks that dairy farmers and dairy consultants hold near and dear.

Cheyenne's great streamlining effort coincided with his transition to organic certification in the late 1990s. (He got on the CROPP/Organic Valley truck in December 1999.) He stopped filling silos, and eventually went to both dry and high-moisture round bales. 1998 was the last year for growing corn, and the cattle ate their last grain (oats) in 2000.

Milk testing went out the door. So did artificial breeding: For the past six years he has been selecting bulls from his own herd. Onnet income held steady through most of the past six years, and increased sharply last year despite the lower herd average. "And it's so much simpler not to feed grain," Cheyenne says.

There are other reasons for this choice. One is Cheyenne's view that the Bible tells us not to do too much tinkering with natural systems. He is also convinced that someday markets for "grass-fed" milk will be more lucrative than conventional organic. Cheyenne would like CROPP to get more serious about marketing grass-fed products. "Our operation is gearing up for pasture-fed milk, either through CROPP, or by ourselves," he explains.

Without the grain crutch, Cheyenne has had to focus greater effort on grass management. He has tightened his paddock subdivisions, and now prefers to turn milking cows in on 12- to 15-inch forage. "In the early years I had them grazing short pastures without enough feed, and ended up with acidosis problems," Cheyenne explains. He feels the taller stands offer more dry matter, energy and fiber. Cow body condition has improved since the shift.

The grazing herd is not required to graze down to proper re-growth levels - Cheyenne is willing to clip where required. He'll also allow occasional grazing of shorter stands, and judge the quality of the ration more by body condition and manure consistency, and less by the bulk tank stick.

Annual grazing crops such as oats and turnips play the quadruple roles of boosting forage quality, extending grazing seasons, renovating substandard paddocks, and aiding fertility by providing ground on which to apply bedding pack material.

Many of his older stands are dominated by an early maturing orchardgrass variety that the cows don't like. Cheyenne is in the process of renovating about 15 acres each year to timothy, brome grass and red clover, along with some alfalfa and perennial ryegrass.

His only tillage tool is a Howard Rotavator. In spring, Cheyenne will tear up sod to plant oats for mid-summer grazing. Cows get 12-hour breaks, and the oats amount to half of their ration over a two- to three-week summer period, with permanent pasture and just a little dry hay making up the rest.

In mid-summer Cheyenne plants other acres to oats and oats/turnips for fall grazing. Oats is grazed in October, providing up to 50% of the total ration through strip grazing. The oats/turnips mix is targeted to November. Usually he'll plant about 1 to 1.5 bushels of oats and close to 2 lbs. of turnip seed per acre. Turnips survive late into fall, while providing additional protein to complement late-season forages.

Cheyenne has also improved his winter forage program, with much of that improvement tied to the recent major investment in haymaking equipment. "In the end, we make more money by making our own feed with our own machinery, rather than buying," he asserts.

Lately, Cheyenne has shifted more emphasis to dry bales. "The cows like the baleage, but I like the dry hay because there's less risk. I noticed some cows limping when I was feeding more baleage, and I was worried about acidosis," he explains.

Compared to five years ago, Cheyenne feels he is now much closer to having the no-grain system figured out. "Forage quality is more even. Milk production doesn't bounce around as much as it used to, and the cows are in good flesh," he explains. "We're not too worried about milk production, because we're profitable."

After several years, he feels the herd is largely acclimated to going without grain. Culling is now mainly a product of cell counts, breeding performance and attitude, as even 11,000-lb. producers are profitable in this system.

With the debt gone this year, and with an eye toward getting his children into the business, Cheyenne wants to improve and enlarge on what he has developed. The Christiansons are saving all their heifers. This year, they have tentative plans for installing a New Zealand-style swing parlor in the tie-stall barn. Cheyenne wouldn't be surprised if he is milking more than 70 cows in the fairly near future.

"We used to think 30 to 40 cows was as big as we wanted to be," Cheyenne notes. But with an easy system in place, and his children getting older, he says it seems like the time to head into a moderate expansion.

Cheyenne says he may go back to doing some artificial breeding, probably with New Zealand genetics. Another goal is to tighten the calving window to avoid having to harvest as much dairy quality hay. He also wants to concentrate more on soil fertility, perhaps through buying more bedding straw for compost, tilling down crops, or buying additional lime and/or rock phosphate.

"I think we can double our (crop) production," Cheyenne asserts.

And he thinks he can continue to be profitable while not feeding any grain. Could he make more money if he fed some? "Probably a little, if I grew my own," Cheyenne responds. If he maintained the 15,000-lb. average he had when feeding cob corn, the organic milk check would likely produce more income. He has the land base to make this work.



Cheyenne Christianson's Holsteins grazing spring oats.

"I never tell people to quit feeding grain," Cheyenne emphasizes. "That has to be an individual decision."

But growing grain requires labor that Cheyenne doesn't want to provide. He certainly doesn't see any profit in buying expensive, organic-certified grain. With their debt gone, and their Holsteins acclimated to the system, the Christiansons feel they are in position to take advantage of future

markets for milk made without grain. Says Cheyenne, "I see the future in grass-fed, and I feel I have to move that way."

Not All Soils Are Created Equal: Understanding the Potential and Limitations of Soils on Your Farm

By Jason Teets Resource Soil Scientist USDA NRCS West Virginia

The starting point for understanding the potential and limitations of your grazing land soils is a conservation plan that starts with a base map derived from a soil survey. A conservation plan is a tool designed to help you better manage the natural resources on your farm. An NRCS Soil Conservationist will meet with you to evaluate the soil, water, air, plant and animal resources on your property and offer several alternatives to address the resource conditions. Conservation planning is a service provided free by the U.S. Department of Agriculture Natural Resources Conservation Service in cooperation with your local Soil Conservation District.

Soil survey data are a product of the National Cooperative Soil Survey, a joint effort of the USDA Natural Resources Conservation Service and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants. Soil survey data includes both spatial (maps) and tabular (tables) information. The majority of the eastern United States have digital soil maps available. These maps can be accessed through the web soil survey at: <http://websoilsurvey.nrcs.usda.gov/app/>. The conservation planner assisting you will be able to create the soil maps for you. The tabular data includes commonly used soil properties as reports, examples include: Restrictive layer depth, cation exchange capacity (CEC), soil reaction (pH), organic matter content, available water capacity, and other reports. This information can be accessed here: <http://soildatamart.nrcs.usda.gov/Default.aspx> or the conservation planner can generate the reports.

Soil maps provide with the conservation plan are used to identify different soil types across the landscape of your farm. Soil type information will help determine the potential forage growth for a particular grazing unit or farm field. Actual forage growth is influenced by the soil fertility, type of plants growing on the soil, management of the forage, weather condition effecting forage growth, disease, and pest pressure. Primary soil conditions effecting the potential forage growth are rooting depth and the soil available water holding capacity. Soil type factors that limit rooting depth include the presence of a seasonal high water table, and a root restricting layer. A soil's water holding capacity is influenced by soil texture, organic matter, and bulk density.

The Conservation Plan will provide you with the fundamental information that will help you understand the potentials and limitations of soils on your farm. This information will provide the basis for making important decisions on how to manage your grazing land. This information will also assist you in making decisions on where to best place inputs to maximize forage yield. With the high price of inputs including energy, equipment, organic fertilizers, etc. information that helps understand the soil's potential forage yield may prove to be a very important risk management tool now and for the foreseeable future.

Serious Considerations of Unpasteurized Milk

By John A. Beers, Virginia Department of Agriculture and Consumer Services

“Unpasteurized milk should not be consumed by anyone, at any time, for any reason”

The sale of unpasteurized milk is prohibited in Virginia by the Regulations Governing Grade “A” Milk, 2 VAC 5-490.

The prohibition is justified by the fact that unpasteurized milk has long been associated with human illness.

The greatest risk of illness is caused by unavoidable environmental contamination of the milk. During the milking process almost anything on the udder, flanks or tail of an animal can be incorporated into the milk. This foreign material can consist of particles of soil, feces, silage, hay, drops of water or animal hair that is normally strained out of the milk before cooling and storage. Numerous bacteria are carried with this foreign material into the milk and can not be strained out. Some of these bacteria may be pathogenic. There is no way to know if a pathogen has gotten into the milk; however, pasteurizing the milk will eliminate any potential pathogens that may be present rendering the milk safe to drink.

Some environmental pathogens found in unpasteurized milk include *Listeria monocytogenes*, *Campylobacter jejuni*, *Salmonella* and *Escherichia coli*. Each of these organisms has caused multiple incidents of human illness in the past.

Of less concern are animal diseases capable of infecting humans that are shed in the milk. *Mycobacterium tuberculosis*, *Mycobacterium bovis* and *Brucella abortus* are examples. The risks of infection from these bacteria are generally controlled by animal health programs in this country.

Individuals consuming unpasteurized milk are at different levels of risk based on their resistance to a particular infection. People raising dairy animals, milking them and consuming the unpasteurized milk have an acquired immunity because they have been exposed to the pathogens in their environment over time. People living in the city or trying unpasteurized milk for the first time are at higher risk of infection. The very young (Children), the aged and infirm (Elderly), pregnant women and the immunocompromised (cancer patients, transplant recipients) have the highest risks of infection.

Mid Atlantic Dairy Grazing Conference

Plecker Workforce Center

Weyers Cave, VA

October 9, 2008

***Serious* Considerations of Unpasteurized Milk**

John A. Beers

Office of Dairy and Foods

Virginia Department of Agriculture and Consumer Services

Mid Atlantic Dairy Grazing Conference

***Serious* Considerations of Unpasteurized Milk**

Federal Regulation 21CFR1240.61

No person shall cause to be delivered into interstate commerce or shall sell, otherwise distribute, or hold for sale or other distribution after shipment in interstate commerce any milk or milk product in final package form for direct human consumption unless the product has been pasteurized or is made for dairy ingredients that have all been pasteurized, except where alternative procedures to pasteurization are provided for by regulation, such as in part 133 of this chapter for curing of certain cheese varieties.

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***Serious* Considerations of Unpasteurized Milk**

Virginia Regulation 2 VAC 5-490-70

.... a person may sell, offer for sale, or expose for sale in the Commonwealth only grade A pasteurized, ultra-pasteurized, or aseptically processed milk or milk products to the final consumer, or to restaurants, soda fountains, and grocery stores.

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Serious Considerations of Unpasteurized Milk

Virginia Regulation 2 VAC 5-490-73

No person shall cause to be delivered into intrastate commerce or shall sell, otherwise distribute, or hold for sale or other distribution after shipment in intrastate commerce any milk, milk product,.....or dry milk product in final package form for direct human consumption unless the product has been pasteurized or is made from milk, milk product,or dry milk product that has all been pasteurized, except where alternative procedures to pasteurization are provided for under 21 CFR Par 133 for curing of certain cheeses varieties.

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Serious Considerations of Unpasteurized Milk

Virginia regulations 2 VAC 5-490-75

No person may offer to sell or sell, barter, trade, or accept any goods or services in exchange for unpasteurized milk if the unpasteurized milk is intended for human consumption.

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Serious Considerations of Unpasteurized Milk

Regulations only apply to “sales” of unpasteurized milk.

Regulations **do not apply** to unpasteurized milk that is **given away free**

Regulations **do not apply** to unpasteurized milk or milk products from one’s own animals that are consumed by the owners or guest in their homes

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Serious Considerations of Unpasteurized Milk

Why do the regulations prohibit the sale of unpasteurized milk?

Because the consumption of unpasteurized milk has been associated with human illness.

The scientific evidence supporting this association is overwhelming.

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Serious Considerations of Unpasteurized Milk

Why is unpasteurized milk associated with human illness?

Milk is produced by animals that may harbor pathogens capable of infecting humans. Examples are: *Mycobacterium tuberculosis*; *Mycobacterium bovis*; and *Brucella abortus*.

These organisms are shed in the milk of infected animals.

The risk of contracting one of these diseases is largely controlled by animal health programs operated in this country today.

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Serious Considerations of Unpasteurized Milk

Why is unpasteurized milk associated with human illness?

The “REAL” risk comes from **environmental pathogens**. Organisms that are resident in or on the grass, soil, water, straw, and many other niches around the farm that can contaminate unpasteurized milk during milking, handling and storage.

Examples of these organisms include: *Campylobacter jejuni*, *Salmonella*, and *Escherichia coli*.

Large numbers of these organisms are excreted in the feces of infected animals.

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Serious Considerations of Unpasteurized Milk

Why is unpasteurized milk associated with human illness?

All milking animals have a certain amount of environmental contamination on them from contact with other animals, laying down or simply walking around. Some of this contamination will get into the milk, especially during milking. *Why do you think people strain milk before it is cooled or consumed?* **To remove trash and debris for the milk.**

There is no way to know if pathogens are present in the milk; however, because it is impossible to completely exclude them from the milk we make the assumption that the milk may be contaminated and require it to be pasteurized.

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Serious Considerations of Unpasteurized Milk

Why don't I get sick from drinking unpasteurized milk?

Acquired Immunity! People living on the farm have some immunity because they are exposed to low numbers of the environmental pathogens that may be present in the milk all the time. Newborns receive some protection from their mother's milk, but it is exposure to low numbers of pathogens in the immediate environment that builds up the immune system over time. Because of this exposure people on the farm are more resistant to pathogens found on the farm than someone who does not live in the farm's environment.

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Serious Considerations of Unpasteurized Milk

Why don't I get sick from drinking unpasteurized milk?

Acquired Immunity is why people living off the farm or trying unpasteurized milk for the first time are much more likely to become ill. Examples:

School children tour a dairy farm and are served unpasteurized milk – later more than half of the children become ill.

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Serious Considerations of Unpasteurized Milk

Why don't I get sick from drinking unpasteurized milk?

Relatives visit from the Midwest and consume unpasteurized milk on the family dairy farm– after returning home they fall ill with *Campylobacter jejuni* infections.

Retired person living in Charlottesville purchases unpasteurized milk for herself. Her two sisters come for a visit and consume unpasteurized milk before returning to their homes in North Carolina. Both sisters fall ill with *Campylobacter jejuni* infections after returning home.

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Serious Considerations of Unpasteurized Milk

Why don't I get sick from drinking unpasteurized milk?

The highest risk groups for contracting an illness from unpasteurized milk are:

Children – the very young

Elderly – the aged and infirm

Pregnant Women – risk to the fetus

Immunocompromised – cancer patients, transplant recipients

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Serious Considerations of Unpasteurized Milk

Why don't I get sick from drinking unpasteurized milk?

No one is completely immune. Even healthy adults can become ill.

There is always a risk of illness when consuming unpasteurized milk. If the extent of the risk was at its worst a case of diarrhea then regulation may not be warranted; however, there are many more devastating and permanent consequences that can occur including hemolytic uremic syndrome that can cause kidney failure and death.

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Serious Considerations of Unpasteurized Milk

Because of the health risk associated with consumption of unpasteurized milk Virginia regulations prohibit its sale.

The Virginia General Assembly has declined to overturn the regulations and allow unpasteurized milk sales on numerous occasions.

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Serious Considerations of Unpasteurized Milk

Unpasteurized milk should not be consumed by anyone, at any time, for any reason.

This statement is supported by FDA and American Medical Association

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Serious Considerations of Unpasteurized Milk
Animal Shares

Virginia does not regulate or approve animal shares.
When uncovered, animal share operations are evaluated individually to determine if we object to the business model being employed.

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Serious Considerations of Unpasteurized Milk
Animal Shares

The purpose of the evaluation is to determine:
If the animal share operation represents “owners” receiving unpasteurized milk from animals they own; or
If the animal share operation is a scheme designed to circumvent the prohibition on the sale of unpasteurized milk for human consumption.

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Animal Shares

We rely on two Virginia Supreme Court decisions for guidance in making a determination.
Carbaugh v. Solem, 302 S.E.2d 33, 34-35 (VA. 1983)
Kenley, M.D. v. Solem, 375 S.E.2d 532, 533 (VA 1989)

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Animal Shares

After conducting an evaluation the operator will receive a letter from our office informing them of our decision, explaining any objections we have and asking for corrections. We also offer to review and comment on any changes the owners may want to make, if requested.

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Animal Shares

You will be hearing a presentation on “Good approaches to cow shares and herd shares” by Mr. Pete Kennedy.

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Serious Considerations of Unpasteurized Milk
Thank you.

Contact Information:

John A. Beers
804-786-1452

Good Approaches to Cow Shares & Herd Shares

by Pete Kennedy, Esq.

A. What's the Law?

1. Legal status – the consumption of raw milk is legal in every state; the sale of raw milk is legal in only about half the states
2. Legality of share agreements – livestock lien laws
3. State laws – states where share programs are prohibited

B. Share Agreements

1. Cow/Goat share – complete or partial undivided ownership interest in a dairy animal
2. Herd share – undivided ownership interest in a dairy herd
3. Herd lease – undivided leasehold interest in a dairy herd

C. Variations of share arrangements

1. Forming an association – one shareholder to provide flexibility of distribution to members
2. Farm share – investment in entity owning the dairy herd

D. Contractual features

1. Liability – waiver of liability & indemnity clauses
2. Special services – distribution of processed raw dairy products

E. Final Points

1. Interstate commerce – federal ban on interstate shipments of raw milk for human consumption
2. Surprise inspections – rights of the farmer
3. Consumer role – the importance of shareholders being politically active

F. Resources for those interested in starting up share programs

1. Farm-to-Consumer Legal Defense Fund (FTCLDF) – www.farmtoconsumer.org or 1-703-208-3276; *Raw Milk Production Handbook* by Tim Wightman, \$6.00
2. Virginia Dairy Agisters Coalition and Shareholders Association (VDACS) – www.vdacs.org or info@vdacs-assoc.org
3. Virginia Independent Consumer and Farmer Association (VICFA) – www.vicfa.net or info@vicfa.net

TERMS & DEFINITIONS:

Cow shares - the term “cow shares” actually refers to share agreements for any lactating animal whether it be a cow or a goat etc.

Agistment - “a kind of bailment under which a person (the agister), for consideration, takes animals for care and pasturing on his land, and the person who cares for the animals has an ‘agister’s lien’ on the animals for care.”

Agister’s lien - if the shareholder fails to pay the fees, the lien allows the farmer to sell those animals as collateral for the debt without needing to go through the courts.

Lease - the *Uniform Commercial Code* defines “lease” as “a transfer of the right to possession and use of goods for a period in return for consideration.”

LLC - limited liability company (known as an LLC).

VIRGINIA LAWS:

Prohibition on sale of raw milk - The Virginia Administrative Code [5 VAC 5-490-75] provides that:

“No person may offer to sell or sell, barter, trade, or accept any goods or services in exchange for unpasteurized milk if the unpasteurized milk is intended for human consumption.”

Virginia Bill of Rights - Article I, Section 1 of the Virginia Constitution states:

“That all men are by nature equally free and independent and have certain inherent rights, of which, when they enter into a state of society, they cannot, by any compact, deprive or divest their posterity; namely, the enjoyment of life and liberty, with the means of **acquiring and possessing property**, and pursuing and obtaining happiness and safety.”

Livestock Lien Law - Title 43 of the Virginia statutory code [Va. Code 43-32A] includes a provision that

“every person pasturing or keeping any horses or other animals . . . shall have a lien upon such horses and other animals, . . . for the amount which may be due him for the keeping, supporting, and care thereof, until such amount is paid.”

LISTS:	NOTES:
<p>Types of share agreements</p> <p>In addition to the traditional agistment agreement, there are several types of share agreements that are commonly used to distribute raw milk:</p> <ol style="list-style-type: none"> 1. The cow or goat share agreement 2. The herd share agreement 3. The cow or goat lease agreement 4. The herd lease agreement 5. The farm share 	
<p>Duties of farmer (herd manager)</p> <p>The duties of the farmer under the boarding contract are generally the following:</p> <ol style="list-style-type: none"> 1. To provide boarding for the animals 2. To maintain and care for the herd in accordance with generally accepted standards 3. To acquire and dispose of the dairy animals as is necessary to maintain the health and productive capacity of the herd 4. To schedule distribution of raw milk 5. To provide reports to the owners as shall be appropriate to apprise the owners of the condition of the herd 	
<p>Liability</p> <p>Three basic ways to limit a farmer's liability:</p> <ol style="list-style-type: none"> 1. Waiver of liability clauses in the agreement 2. Indemnity clauses in the agreement 3. The farmer forming a corporation 	
<p>Changing laws</p> <p>Four ways a law can be changed:</p> <ol style="list-style-type: none"> 1. A favorable court decision, such as the <i>Schmitmeyer</i> ruling 2. Passage of a bill such as the Colorado cow share law 3. An administrative regulation, such as Wisconsin's farm share rule 4. An agency changing its interpretation of the law 	
<p>CONTACT INFO:</p> <p>Farm-to-Consumer Legal Defense Fund Attn: Pete Kennedy, Esq. 8116 Arlington Blvd., #263 Falls Church, VA 22042 phone 703-208-FARM (3276) fax 703-208-3278 pete@ftcldf.org</p>	

Pasture Ecology: Managing Things That We Cannot See

By Ed Rayburn¹

As pasture-based livestock producers we are in the business of harvesting solar energy and converting it to food and fiber products for people. We manage plants to optimize harvesting solar energy, animals to transfer that energy into livestock products, and cycling of mineral nutrients in the landscape to make our businesses socially, economically, and environmentally sustainable. We are pasture ecosystem managers.

Most of our day-to-day efforts are spent with the livestock, managing the above ground portion of the pasture community to ensure that the livestock are properly fed. However, there is more biomass and biological activity below ground than above (Table 1).

Let's visit an old pasture and look at what is going on down below. We will see how this subterranean activity helps us achieve our goals and how proper above ground management can benefit the soil community.

Citizens of the soil community

Each plant, animal, bacteria, protozoa, and fungus has its niche or place in the pasture ecosystem. Each has an optimum physical and chemical environment and habitat. The habitat provides adequate food and cover, allowing the species

Table 1. Biomass of organisms above ground in the pasture and below ground within the pasture soil.

Organisms	Standing crop biomass lbs/a
Above ground	
1200 Dairy cow ¹ or	587
1200 Beef cow ²	450
Pasture ³	2500
Below ground	
Pasture roots ⁴	2500
Bacteria	2052
Actinomycetes	2052
Fungi	6244
Algae	219
Protozoa	80
Nematodes	62
Mites	65
Collembola	65
Earthworms	624
Other fauna	40

Adapted in part from Brady and Weil 2002.

1. Cow producing 40 lbs milk/day 180 days/acre, 50% of forage standing crop consumed, 5 rotations/year.
2. Cow weaning 600 lb calf 3 acres/year.
3. Cool-season grass-clover pasture, 10 inches tall at grazing.
4. Roots equal top growth at grazing.

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to reproduce and maintain itself. The environment is based on the climate, soil texture, position in the landscape, and management.

The food chain (trophic levels or food web) is composed of primary producers who fix energy from the sun and all the other organisms that eat each other to get their part of this fixed solar energy. These are the primary consumers, higher level consumers or predators, omnivores, and parasites, and detritus feeders or decomposers. Here is a short introduction to the citizens of the pasture soil community (Figure 1).

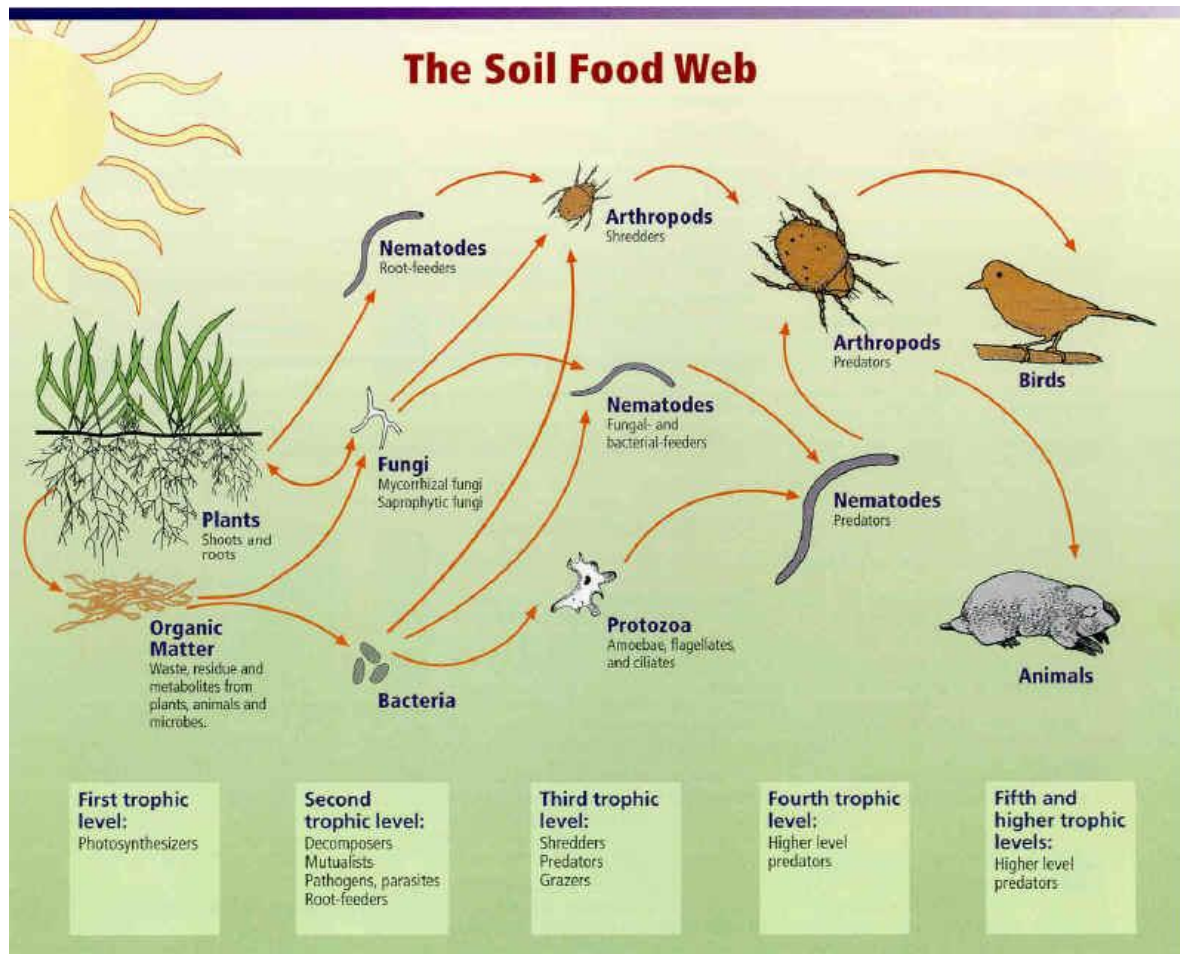


Figure 1. The Soil Food Web.

(NRCS http://soils.usda.gov/sqi/concepts/soil_biology/soil_food_web.html)

This chart has not included earthworms, snails, slugs, and other soil dwelling organisms.

Plant roots are an essential portion of the above ground producers. Roots gather water and nutrients for the plant and provide a major source of live and dead organic matter for food to soil organisms. Legumes within this group, with their symbiotic rhizobia bacteria, fix nitrogen from the air and provide it to the rest of the pasture community. Algae and moss are other primary producers that provide organic matter to the community.

Earthworms eat dead plant material (detritus). They are opportunistic predators when they consumer soil containing bacteria, protozoa, nematodes, fungus. They provide the ecological

functions of shredding large pieces of organic matter making it more accessible to bacteria and fungus. They aerate and invert the soil, improving soil drainage, and aggregation of soil particles. They become food for birds, moles, skunks, and carnivorous slugs and nematodes.

Slugs and snails are consumers of live plant material with some carnivorous species being predators of earthworms and other slugs. They provide the service of shredding large pieces of organic matter into smaller pieces. They are food for birds, mice, daddy longlegs, beetles, and firefly larvae (glow worms).

Nematodes are consumers of plant roots and algae; predators of bacteria, protozoa, fungus, and nematodes, and parasites of insect larva, slugs, and earthworms. They provide an important function in the nitrogen cycle by eating bacteria and releasing nitrogen back into the soil for plants and other organisms. They are food for other nematodes, fungus, and mites.

Woodlice feed on dead plant material. They are shredders of coarse organic matter. They are food for birds and spiders.

Spiders are predators. **Mites** are consumers of algae and predators of nematodes, springtails, fungi, insect larva and eggs, and nematodes. Some species are detritus feeders while others are insect parasites.

Centipeds are predators of insects, slugs, and worms. **Millipeds** predominately eat detritus and fungus but some times are consumers of live plants and their seeds.

There are a number of insects that act as consumers and predators in the soil community.

Spring tails consume dead organic matter and fungus. Some consume plant seedlings, small nematodes, and dung of other soil animals. They are food for ants.

Beetles, such as the clover root curculio, are consumers of live plants. Some beetles are predators consuming other insects, earthworms, and snails. Other beetles, such as carrion and dung beetles, are detritus feeders. These beetles provide the ecological function of soil aeration, soil inversion and nutrient cycling in the community.

Ants are consumers of live plants and “farm” aphids for their honey dew. They also consume fungus and are predators of other soil organisms. They provide the function of soil inversion, providing improved soil aeration and water infiltration.

Termites consume dead plant material and are shredders of coarse organic matter. They digest cellulose using gut bacteria similar to a cow and provide the functions of soil aeration and soil inversion.

Bacteria are central participants in the nitrogen cycle. As symbiotic consumers in root nodules they use sugar provided by the plant as energy to fix nitrogen from the air into ammonia. This is passed on to the plant for making protein. Other bacteria are detritus feeders and break proteins down into ammonia while other bacterial convert ammonia to nitrate. Bacteria are food for protozoa and nematodes.

Actinomycetes look like fungus but are closely related to bacteria. Some species live on dead organic matter and are able to decompose the more resistant cellulose and phospholipids. Some species form symbiotic relations with plants and fix nitrogen while others are plant parasites.

Protozoa come in three forms; ciliates, amoeba, flagellates. Their main food source is bacteria. They are food for nematodes.

Fungus come as molds, mushrooms, and **mycorrhizae**. Fungi are decomposers of dead organic matter. Some fungi are predators of nematodes. The mycorrhizae fungi are a very important group of fungus. In their symbiotic relation with higher plants they provide mineral nutrients to the plant in exchange for energy and protein. Mycorrhizal fungi may cover the surface of plant roots (ectomycorrhizal) or enter inside the plant root cells (endomycorrhizal). Fungi produce glomalin, a glue-like material that is essential in the formation of soil aggregates. Fungi can decompose the more resistant organic matter such as cellulose and lignin.

Energy flow and nutrient cycles

So how do all of these citizens work together to help us manage our pastures? Their help revolves around solar energy flow in the ecosystem and nutrient cycling.

The green leaves of plants capture solar radiation through photosynthesis. They take carbon from the air and water from the soil and lock the energy in sugar while releasing oxygen to the atmosphere. The plants take the sugar and add nitrogen supplied from the soil or rhizobia bacteria if a legume (actinomycetes in some plants) to make proteins. The plants use these sugars and proteins to grow new leaves, stems, and roots. This metabolism requires the use of all the macro (N, P, K, S, Ca, Mg) and micro (Cu, Zn, Mn, Mo, Fe, B) nutrient minerals that are part of the enzyme systems in the plant. Plants are the primary producers in the pasture food web.

We often talk of ecological cycles with the various mineral cycles being separate from the carbon cycle. Carbon in the organic form is participating in the flow of energy. Other minerals are cycled in unison with organic carbon in plants and animals, at different rates and following different paths (Figure 2).

When a cow grazes the pasture, plants slough some roots while they are in the process of growing new leaves. Along with the roots clover plants drop some of their nodules. Earthworms eat these dead roots as they burrow through the soil while bacteria decompose dead roots and nodules that the earthworms do not eat. Later earthworms may end up consuming these bacteria as they go back through the soil.

Some bacteria prefer the highly digestible sugars and proteins while other bacteria prefer the readily digestible fiber; similar to bacteria in the cow's rumen. After the really digestible parts are digested, fungus and actinomycetes go to work digesting the less digestible fiber and lignin. All of this activity is necessary for the decomposition of dead plant material to return the mineral nutrients to the soil to be used again by plants. This is the process of nutrient cycling.

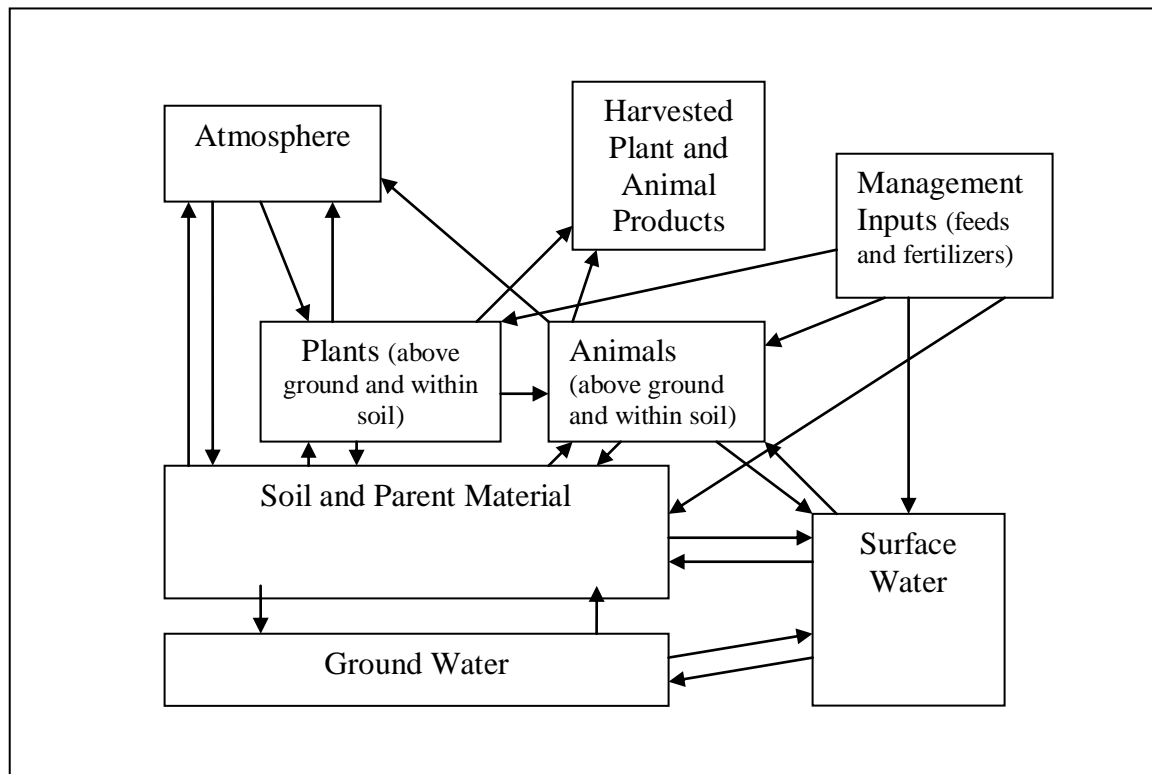


Figure 2. Generalized nutrient cycle for all mineral nutrients, carbon, and water; flow rates and concentrations differ for each nutrient.

During grazing cows also treaded down part of the pasture sward. This material likewise is consumed by earthworms and detritus feeding insects, mites, bacteria, and fungus releasing C back to the air as they use the carbohydrates for energy and the protein nitrogen and minerals to sustain themselves. When organic matter energy is in good supply bacteria hold onto the nitrogen, divide, and make a whole lot more of themselves. Then when predatory nematodes and protozoa come along they eat the bacteria and release a large part of the nitrogen (what that they don't need) back into the soil where it is available for plants to use.

Environments and niches

As we walk across the upper pasture we notice that different grasses, forbs, and legumes grow best in different parts of the landscape. On the well drained uplands orchardgrass is abundant while in a wet area we find a stand of reed canarygrass. These different sites present different soil environments. The plants that do well on a part of the pasture are those adapted to the soil chemical and physical environment in that area. They are also tolerant of the timing and intensity of grazing placed on them by the animals as controlled by the farmer. These plants have found their niche or place in the pasture community.

Some plants are more abundant during one part of the year and appear to be replaced by other plants during another part of the year. For example in warm areas white clover does well in the spring and summer while annual lespedeza is more prevalent during the heat of the summer. This

is a case of two species using the same niche but separated temporally (niches in the same physical space but separated in time) due to environmental temperature.

The same principles apply below ground. There are many species of bacteria, protozoa and other microorganisms that have the same ecological function in the soil. Some do better where the soil is high pH others do better where the soil is lower in pH. Some do best when the soil is cool others do best when the soil is warm. Having high species diversity is good since it ensures good microbiological activity across a range of environmental conditions.

Cows also drop dung and urine back on the soil surface. Dung is the residue of the forage that the rumen bacteria and protozoa and acid stomach did not digest. Urine contains the nitrogen that was excess to the cows ability to convert rumen nitrogen to bacterial protein and protein that was excess to the cow's need for growth and/or milk production.

Dung is quickly inhabited by dung beetles, fly larva, rove beetles that eat fly larva, earthworms, and bacteria. One group of dung beetles lays its eggs in the cow pie while another takes the dung and move it into burrows in the soil under the cow pie to lay eggs. A third group of dung beetles take small balls of dung and role them away for burial in the soil as food for their larva. These dung beetles are demonstrating different physical niches or niches separated in space. Different species of dung beetles within these groups use the dung at different times of the year demonstrating different temporal niches. After a while fungus and actinomycetes invade the cow pie and help decompose the more resistant forms of carbon.

Soil Moisture a controlling factor

All of this biological activity affects plant productivity by cycling nutrients. It also has major effects the soil portion of the water cycle. Earthworms and dung beetles assist by making passageways from the surface into the lower soil. Earthworms, bacteria and fungus assist by making glues that hold soil particles together making them stable when wet so that the soil has more, small, stable passages for water infiltration. All of this improves water infiltration during rain storms resulting in more water going into the soil and less running off the surface. The organic mater and soil micro pores increase the amount of plant available water the soil can hold after a rainfall event. This allows plants to grow well longer between rains.

Nitrogen fixation and cycling

Pasture growth is highly dependent on available nitrogen. Nitrogen fixing legumes and their symbiotic bacteria are a critical component in the pasture ecosystem. Healthy and active nodules are identified by their red interior. This color is caused be the iron containing red leghemoglobin used as part of the nitrogen fixing system and is similar to the hemoglobin in blood. Different strains of rhizobium form symbiotic relations with different legume species. Legumes that form symbiotic relations with the same strain of rhizobia or actinomycetes are grouped together as cross-inoculation groups (Table 2). When planting legumes it is important to inoculate the seed with the bacterial strain that will become a symbiont with the legume being planted.

In pastures both leguminous forbs and trees and their associated bacteria provide nitrogen to the system (Table 3). Nitrogen fixed by the legume and bacteria is first supplied to the legume.

Therefore, in a new seeding the grass at first does not get much nitrogen from the legume. The legumes take off nicely and sometimes outcompete the grasses. Legume nitrogen enters the soil through nitrogen rich root exudates, root and nodule death, livestock trampling, and dung and urine deposition. This nitrogen is made available to grasses and legumes as the organic matter is broken apart by the shredders and decomposed by the detritus feeders, bacteria, and fungus.

Table 2. Cross inoculation groupings for different species of legumes.

Cross inoculation groups
Alfalfa, black medic, bur clover, red clover, sweet clover
Birdsfoot trefoil
Cowpeas, kudzu, lespedeza, partridge pea, peanut
Crotalaria
Crown vetch
Garden beans
Garden pea, hairy vetch, Canadian field pea, Austrian winter pea
Red clover, Ladino and other white clovers, alsike clover, crimson clover
Soybeans

Table 3. Annual rate of nitrogen fixation by different legume and non legume species and their associated symbiotic bacteria.

Host plant	Symbiotic bacteria	Nitrogen fixed/acre/year
Alfalfa	Rhizobium	150-300
Clover, white and red	Rhizobium	100-200
Locust tree	Rhizobium	75-200
Vetch and annual legumes	Rhizobium	75-150
Alders	Actinomycetes	50-185
Kudzu	Actinomycetes	100-140

With time the legume roots meet with mycorrhizal fungus which attaches to the root. The mycorrhizal fungus also attach to grass roots. Then the fungus offers the clover extra phosphate in exchange for carbohydrate and nitrogen. The fungus provides part of the nitrogen to the grass from which it obtained the phosphate in exchange for carbohydrates. The fungus also obtains phosphate and trace minerals from the soil that it uses in this bartering system.

Accumulation of ammonia in the plant or high nitrate in the soil limits N fixation. Legumes preferentially use available soil N since there is a high energy cost to fixing N. Grasses are more competitive than legumes in taking up soil N due to their fibrous root systems. In soils that are high in nitrate grasses will have increased N uptake and be more competitive with the legume. This occurs in established grass-legume pastures as the organic matter builds up and a healthy

microorganism community breaks the organic matter down releasing the nitrogen and converting it to nitrate. In these pastures grasses have a competitive advantage and the legumes may disappear. After a period of time the soil organic matter decreases and the available soil nitrate decreases causing the grasses to be less vigorous and the clovers come back in to the system. This is one of the causes of clover cycles in pastures.

Management needed to help the system

So what are the management practices needed to help the pasture ecosystem function at its best. I will define “best” as pasture ecosystems that captures solar energy, transfer that energy to ruminant animals that produces food for people in a socially, economically, and environmentally sustainable manner. These management practices are the ones that we have talked about again and again over the years.

1. Lime the soil to provide the pH that is optimum for plant, rhizobia, and other microbes the soil, a pH from 6.0-7.0 depending on the primary legume and its symbiont in the system.
2. Apply adequate but not excessive amounts of mineral or organic P and K fertilizers to the system. Organic fertilizers such as compost, biosolids, poultry litter, and other livestock manures provide trace minerals (Mo, Mn, Cu, Zn, B) as well as other macro minerals (N, S, Ca, Mg). Organic fertilizers also provide digestible carbon which is an energy source for decomposers. This will stimulate microbial growth and activity. Soil bacteria and fungus make nutrient more available to high plants but they have energy and other nutrients to work with.
3. When seeding legumes make sure to inoculate the seed with the bacteria that will become a symbiont with the legume species being planted.
4. Manage the nutrients already on the farm. Grazing recycles nutrients in pastures. Manure management should recycle nutrients to the hay fields that the hay removed. Manure stimulates earthworm populations and activity as well as microbial populations and activity. Organic on-farm sources of nutrients include hay, other feed wastes, manure, and bedding. Where hay is fed back on meadows forage yields can be increased 2-fold during late spring droughts. This is due to higher soil organic matter holding additional plant available water. In wet years, yields are about 1.5 fold greater than where no hay was fed.
5. Graze pastures at the timing and intensity suitable for the forage species present. Grazing pastures to a 1- to 2-inch residual height during cool, moist weather benefits legumes and their rhizobia which fix nitrogen for all the organisms in the pasture system. Grazing too close during hot droughts can be detrimental to cool-season grasses and legume.
6. Close, rotational grazing of pastures in the fall helps develop tillers in the cool-season grasses and stolons on white clovers. It also reduces adult clover root curculio activity in pastures whose larvae are detrimental to legumes.
7. Rest pastures to get good cover before grazing to provide cover for night crawler earthworm. Night crawlers need adequate food and cover for reproduction especially in the cool moist

weather of the spring and fall. Earthworms are like most animals they prefer legumes over grasses for forage.

8. When choosing fly control options consider their effect on dung beetles and other dung feeding insects and organisms. There are chemical and organic methods that do no harm to these beneficial organisms.

9. When choosing weed control options consider their effect on other plants and soil micro organisms. Co-grazing livestock such as sheep and goat that convert “weeds” to marketable animal products and manure has a positive effect on the pasture ecosystem.

Above ground we manage grasses, legumes, and forbs with animals to capture solar energy, convert solar energy into marketable livestock products, and to cycle nutrients so that our pasture-livestock system can be sustainable. The result of our management influences the soil environment and the organic matter available to feed macro- and microorganisms in the soil. This affects the soil’s physical condition, availability of macro- and micronutrients to grasses, legumes and forbs, and plant available soil moisture. Understanding how our management affects the soil community can assist us in our management of the entire pasture ecosystem.

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Grazing: From Sideshow to Main Show

By Joel McNair Editor/Publisher Graze

Terrorism threats, the housing meltdown, overall private and public financial sector financial turmoil — all are serious problems. However, the overriding challenge facing Americans and the entire world today and over the next few decades stems from the reality that we have reached the end of an era that featured plentiful supplies of basic natural resources along with low commodity prices. Energy, feedstuffs, food, metals, water — all face supply-demand pressures today and in coming years. This is a global phenomenon.

Short-term availability and prices will rise and fall due to fluctuations in economic cycles, weather, production and other factors. An example of the “fall” part of the cycle is happening today with oil markets that are softening due to conservation efforts and weakening economies around the world. However, the great majority of analysts agree that the long-term outlook for these basic building blocks of modern human life is much tighter, costlier and more uncertain compared to the situation that ruled during the final two decades of the 20th Century.

We can no longer take the basics for granted while concentrating on adding value. Extreme price volatility, actual shortages, and conflicts over limited supplies are very real possibilities in the coming years. These views are held by mainstream analysts, not just kooks and doomsayers. The reasons for this rapid change from comfortable surpluses to potentially devastating shortages are numerous and complex, but can be boiled down to some basic supply and demand realities.

On the demand side, western nations (primarily the U.S.) succeeded in convincing the rest of the world that capitalism is the best economic system. In the final two decades of the 20th Century, China’s move toward quasi-capitalism, the collapse of the Soviet communist bloc, and reduced international trade barriers opened varying forms of free enterprise to perhaps a third of the globe’s population. Basically, at least two billion of the world’s people were given some form of additional opportunity to live like Americans and western Europeans. While this shift has had some negative effects on U.S. farmers, in general the global economic boom has played a major role in keeping our economy afloat over the past 10 years in particular.

However, capitalism requires growth, and growth still requires natural resources despite all of our technological improvements. The average person in China is now consuming far more resources than was the case just a few years ago. Multiply that out by hundreds of millions of people in the region from China through Southeast Asia to India, and you have a staggering new demand for natural resources. Add more than two billion to the globe’s population over the next 40 years as is forecast, and the pressure becomes even more intense.

If we have made a mistake, it is that we decided to fuel 21st Century growth with 20th Century resources and methods of consuming them. This is not surprising, since these resources and methods were readily available and economically practical for developing nations to implement. While it is possible and even probable that growth in Southeast Asia and elsewhere will slow somewhat in coming years, the capitalist horse is out of the barn. To try to return the horse to its stall could lead to problems that we Americans would not welcome — problems such as warfare and economic meltdown. The world is now interconnected.

Just in the past two or three years we have started to learn that these natural resources are finite. Shortages of food and water may ultimately represent our most serious global challenges. While Americans are unlikely to starve or go thirsty in any major numbers, such calamities are very possible through much of the developing world, thus posing very serious security problems for the U.S.

Energy may well be the most immediate problem area, and indeed energy costs are a major factor driving sharply higher food prices. The U.S. Department of Energy forecasts that world energy output must increase 57% over the next quarter-century just to meet new demand. As creative and motivated beings, humans will come up with many advances in attempting to meet this energy challenge.

However, these efforts are likely to occur at a time of declining production of the world's most versatile and important energy resource, crude oil. Many analysts — again many mainstream authorities and not just kooks — see global oil production peaking no later than 2015. While the Earth probably holds enough oil to last another century or more, it has become obvious that we have already skimmed the great majority of the “cream” — high quality crude that is relatively cheap and easy to extract. It is also obvious that a high percentage of readily available future supplies lie with the spheres of OPEC and Russia — both of which cannot be entirely trusted to bend to U.S. wishes. A very high percentage of the rest of the world's oil reserves will be expensive to find and deliver.

As a result, we will likely be dealing from an energy price base the equivalent of somewhere near \$100 per barrel of crude oil, with political events, natural disasters and other potential disruptions causing price spikes far above those seen this past summer.

What this means for a U.S. agriculture that was built on \$20 per barrel oil is certainly an interesting question. I forecast that energy production will continue to be a priority on U.S. crop acres despite the obvious weaknesses of corn ethanol, and thus feedgrain prices will continue high. University of Illinois economists said this summer that the breakeven price of a bushel of corn in their state was nearing \$4 per bushel at \$150/barrel crude oil. With big hikes in land rents and seed charges in the works for next year, it is hard to see that breakeven declining even if oil prices are somewhat lower.

Confined, grain-fed livestock agriculture thus faces some real problems. It takes two pounds of grain to produce a pound of chicken, close to four pounds per pound of pork, and there are relatively few substitutes for such non-ruminants. Cattle obviously have more options, but under the current dominant feedlot system a pound of gain requires close to eight pounds of grain.

Fools and con men make predictions with confidence. However, it is obvious that a new game is confronting grain-fed livestock agriculture, with much higher costs relative to overall inflation compared to what has been the norm over the past few decades.

It would seem that this situation opens some marvelous new opportunities for grazing-based farms that are managed well enough to keep input costs under control while maintaining at least a moderate level of productivity. However, my view of the field is that we have not learned to fully utilize our free sunlight and rainfall to make the most meat and milk at the lowest costs. If

grass farmers are going to move from sideshow to main show, they are going to have to do better.

How to accomplish this task will vary from region to region and even farm to farm. It is always wise to view with suspicion those experts who bring simple solutions — especially solutions that require purchase of their products and expertise. However, a competitive grass-based system for the future will contain most of these elements:

- Efficient on-farm nutrient cycling featuring minimal waste and labor.
- Near-total dependence upon on-farm and local input resources.
- Minimal purchase of dry grains and protein supplements.
- Minimal investment in capital infrastructure and equipment.
- Investments concentrated on low-cost, labor-saving equipment and practices.
- Strategic use of annual grazing crops, double cropping with small grains, improved plant varieties, irrigation — practices related to dealing with drought and limited growing seasons.
- Strategies to maintain legume populations at no less than 40% of sward populations as a nitrogen source and for drought tolerance.
- Smaller-framed animals.
- Less “religion” and more economic common sense in terms of decisions regarding input use and management. A few pounds of purchased nitrogen at the right time may be more important than maintaining organic status.

Doubtless there are other important strategies worth pursuing and improving upon. Major impediments to progress include land costs (which will dictate halfway decent per-acre productivity), relative lack of university and agribusiness support, and a shortage of skilled management and labor with an understanding of grazing systems.

However, these hurdles can be overcome with the right effort and thinking. Let’s work together to make it happen, because much will depend upon our success in doing so.