SARE Project LNC93-59

UDDER $ENSE

Low-Cost/Sustainable Strategies of Resourceful Dairy Farmers

by Larry Krcil & Shawn Gralla

Dedication

We dedicate this publication to those who have started this work before us. They include the many Nebraska farmers and farm families who have been involved in Center For Rural Affairs on-farm projects dating back to 1976 when the Small Farm Energy Project was started by CRA staff members Ron Krupicka, Dennis Demmel, Rob Aiken and Janet Hamilton. Many of the farmers involved in these projects have continued to share their ideas, provide farm tours and offer support to ongoing CRA efforts. Many former staff members have gone on to either farm themselves or to spearhead sustainable agriculture efforts in other parts of the country.

We also dedicate this publication to the beginning farmers and farm families struggling to create sustainable farming opportunities for themselves. We have met many of these people through the Center for Rural Affairs Beginning Farmer Support Network, and they have inspired us with their sincerity, creativity and determination.

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Acknowledgements

This publication has resulted from the collaboration, goodwill and contributions of many people. In it, we have collected vignettes and ideas sifted out from countless workshops, farm tours, conferences, farmer interviews, on-farm research/demonstration projects, sustainable agriculture literature and conversations over corral fences.

We first acknowledge the collaborating Nebraska farmers and farm families featured in the "Farm Focuses." These include Clark and Lynette Grueber, Martin and Linda Kleinschmit, Marvin and Evelyn Lange, Edgar and Theodora Wuebben, Terry and Don Wuebben, and Gary and Delores Young.

We also recognize the other collaborating Nebraska farmers and farm families involved with on-farm projects for the walk-through fly trap, but whose work is not featured in this publication. Their contributions were significant, but unfortunately limited time, space and resources prevented a written recounting of all projects. They include Marvin DeBlauw, David and Connie Hansen, Mike and Cecelia Heimes, and Paul and Wilma Phelps. We also thank Linus and June Lange, and Delmar and Randy Pfanstiel for providing untreated groups of dairy cattle as controls for the fly-trap experiments.

Others supporting the fly-trap construction and experiments include: Gary Pinkelman and Pinkelman Manufacturing of Hartington, Neb., who constructed two steel-framed versions of the walk-through fly trap and contributed half the cost; Dr. Robert Hall and Kathy Doisy of the University of Missouri-Columbia and Dr. Rick Meyer of North Dakota State University, who provided references and guidance for designing our fly trap experiments and counting flies; CRA summer intern Frank James, who diligently counted flies with binoculars, befriended the cows and tackled every task undauntedly; Doug Dittman, Sam Welsch and the Nebraska Sustainable Agriculture Society for helping build fly traps; and the children of Marvin and Evelyn Lange (Michael, Terry, Karen, Doug and Lisa) who shared their enthusiasm, curiosity and eager participation.

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We appreciate the Land Stewardship Project's Brian DeVore, our editor, for writing more concisely and clearly the text of this publication. However, we claim full responsibility for the final content, omissions and any inadvertent errors.

We express gratitude to: Ron Krupicka, former CRA project leader, for his early guidance with this project; Janet Hamilton, the Hartington office manager, for her logistical support and superb ability to respond to last-minute requests; Megan Miller, CRA summer intern, for tracking down references for this publication; Jan Stansberry, past CRA public information coordinator, for her creative ideas and patience; Marie Powell, CRA communications director, for logistical support; and Christine Mallory, Walthill artist, for drawing selected graphics.

Finally, we the authors, no longer CRA staff members, thank the Center for Rural Affairs and its many friends, contributors, supporters and funders for the opportunity to serve you during our tenure. Long live our shared vision for a sustainable agriculture, prosperous family farms and vibrant rural communities.

With such a large number of collaborators and contributors, someone probably has been forgotten. If we have forgotten you, we want you to know we appreciated your support too.

– Larry Krcil & Shawn Gralla

What's Happening to Dairy Farming?

It has become increasingly clear in recent years that we need farming options that create profitable opportunities for family farmers, maintain rural communities and sustain our environment for the long-term.

The United States lost 27.3% of its dairy farmers between 1982 and 1987. The agriculture sector as a whole lost 6.8% of its farms between 1982 and 1987, making dairy farming's almost 30% decline particularly alarming. During this same period, numbers of dairy cows declined only 7.1%, indicating there is a trend toward fewer and larger dairy farms (U.S. Department of Commerce, Bureau of the Census, 1989; *1987 Census of Agriculture*).

This trend is neither positive nor inevitable. It's not positive because it comes at the cost of the environmental, social and economic health of rural America. It's not inevitable because, as the farmers featured in this publication are proving, there are viable farming opportunities out there.

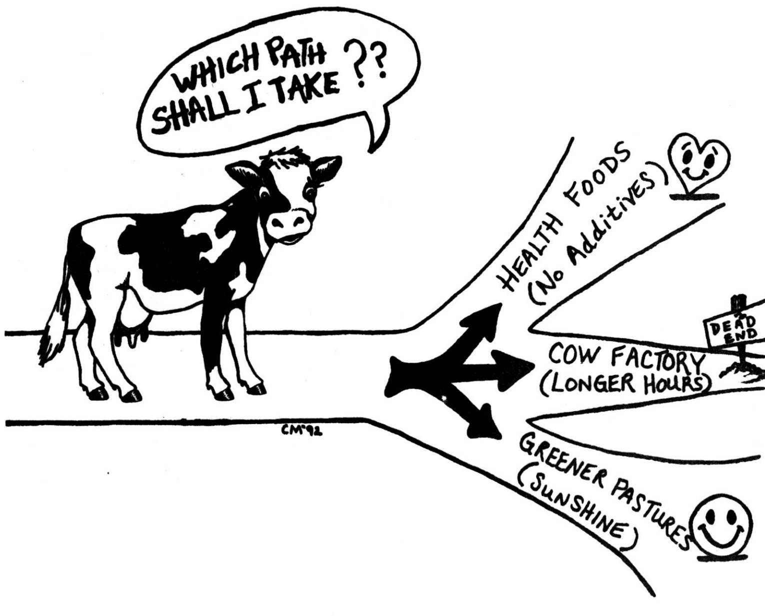
By no means is *Udder $ense* the final answer to our "farm problem." But we think it does show there is a reason to be optimistic about the future of the small-to medium-sized family dairy farm. The Center for Rural Affairs bases this optimism on real-life, on-the-farm-experience. For the past 18 years, we've been cooperating with farmers searching for farming alternatives that are sustainable financially, socially and environmentally. Certain goals have directed our work with these farmers. They include:

- Enhancing economic opportunity for small and mid-size farmers and creating entry opportunities for a new generation of beginning family farmers
- Encouraging the establishment of many small to moderate-sized family farms
- Enhancing the economic and biological relationships between crop and livestock enterprises, thus supporting sustainable farm practices and decreasing dependence on off-farm inputs

In this publication, we are providing a collection of farmer interviews and on-farm research results that begin to explore low-cost, sustainable dairy farming alternatives which can help achieve the above goals. As you will see, the farmers featured here are using a combination of hard work, good management, creativity and resourcefulness to make their farms viable. They are using technology from the past, present and future.

But this is not a recipe book or step-by-step operating manual. Ultimately, all we want to do with this publication is raise questions and share how some farmers are answering these questions for themselves. Each farm family must answer its own questions if it is to make dairying a profitable, sustainable and enjoyable lifestyle.

– Center for Rural Affairs, Spring, 1995



Alternatives by and for Farmers

☛ Grass-Based Dairying

At a time when many dairy farmers are discouraged with low milk prices and long hours, one group of dairy farmers is enthusiastic and optimistic about its future.

In February, 1992, some 500 dairy farmers met in Wisconsin Dells, Wis., for the first ever North American Dairy Grazing Conference. They are just a few of the farmers nationwide who are turning to "grass-based" dairying and controlled grazing. These dairymen are switching from year-around confinement feeding to managing their pastures intensively to grow abundant, low-cost, high-quality dairy cow feed.

Dr. William Leibhardt of the University of California Sustainable Agriculture Research and Education Program and researchers from various agricultural universities have developed case studies of 32 such farms (*The Great Dairy Debate*, W.C. Liebhardt, ed., 1993, UCD-SAREP, p. 133-134). Here are the results that these farmers reported:

- As much as a 66% increase in (milk) production
- Decreased feed cost per hundredweight (cwt) by as much as 36%
- Saved up to $18 per month per cow in grazing, $270 per year per cow in some cases
- Cut costs and allowed bigger profits in difficult years by trimming feed and machinery operating expenses
- Decreased energy costs by as much as 75%
- Increased days in milk production by as much as 15%
- Increased grazing season by as much as 30 to 100 days
- Increased milk protein percentage
- Reduced labor needs for putting up the same forage as hay by 43% and for green chop by 37%
- Increased value of pasture by as much as five times
- Increased herd health
- Reduced labor in spring and summer, allowing farm families more leisure time
- Improved lifestyle

By keeping their cows on the pasture through much of the year, grass dairy farmers: 1) reduce the need for supplemental grain and forage; 2) reduce or eliminate the investment and operations costs for expensive dairy buildings and equipment for confinement housing, manure handling and feed harvesting/storage. Plus, better milk quality, improved herd health and increased milk production all translate into more profits.

Maximizing milk production is not a goal of grass-based dairying, however. Bottom-line profits (income after expenses) and improved quality of life are.

Some farmers are choosing to milk their cows seasonally – freshening them right before new grass growth in the spring and drying them up in the early winter. This synchronizes peak grass growth with peak lactation, further reducing stored feed needs, and giving farmers a break from milking during part of the year.

With fewer cultivated crops, grass-based dairying also maintains a protective grass cover on erosive land and reduces use of fertilizers and pesticides. This diversifies the rural landscape and provides many environmental benefits.

As with other farming pursuits, the farmer must practice sound management to realize the most benefit from grass-based dairying. The grass dairy farmer does have more time for management, however, since the cows harvest their own forage and spread their own manure.

Those wishing to start or convert to a

grass-based dairy should learn the basics of controlled grazing and grass-based dairy nutrition before making any drastic changes or investments. Talking with an established grass-based dairy farmer would be a good place to begin.

What does controlled grazing involve?

"Controlled grazing" is a different approach than allowing cows to have run of the whole pasture at once. Under a controlled system, pastures are divided into many little pastures, called paddocks. Cows are moved to fresh pasture every 12 to 24 hours, depending upon the availability and growth rate of the forage. The benefits are high quality forage (up to 30% protein and high energy when pastures are grazed at the right time), greater harvest efficiency (cows waste less forage), greater pasture productivity (plants are given time to recover from grazing and therefore grow more) and improved pasture quality (more desirable forage species increase with better pasture management).

Under traditional management (or lack thereof), the grass matures quickly in the spring before the cows can graze it all. With controlled grazing, the farmer prevents this from happening by early grazing with the cows or by mowing (harvesting) the grass in some paddocks. This keeps the grass in a vegetative state (before it shoots seedheads) and can extend the grazing season into or through the summer. With traditional management, the grazing season would usually end after about six weeks because most cool-season grasses rapidly set seed and complete their life cycle when not grazed or mowed. Delaying this life cycle keeps the grass growing when favorable growing conditions exist.

Terms used for controlled grazing management, associated with grass dairying, include "management-intensive grazing", "time-controlled grazing", "intensive rotational grazing", "short-duration grazing", among others.

The key point, however, is that grazing management for grass-based dairying involves more than just rotating animals among paddocks or pasture subdivisions. It involves paying careful attention to the nutritional needs of the livestock AND the need for forage plants to recover from grazing.

Controlled grazing can involve some additional costs for electric fencing, watering systems (to prevent soil compaction and erosion from cows trailing to and from the barnyard) and/or pasture establishment. The Wisconsin Agricultural Stabilization and Conservation Service estimated it costs $40 to $70 per acre to establish pastures of diverse forage species (*Land Stewardship Letter*, Nov./Dec. '94, p. 7) The farmers featured in the grass dairying Farm Focuses in this publication used existing water systems and forages, and only spent a few hundred dollars a piece for single-wire electric fencing. Costs to implement controlled grazing vary greatly depending upon each farm situation and the resourcefulness of the farmer.

Grass-based dairying for Nebraska and other great plains states?

Some say that grass-based dairying won't work in drier regions of the country (e.g. Nebraska) because the grass doesn't grow during the hot, dry months of the summer. It is true that much of the activity with grass-based dairying is happening in higher-rainfall areas of the country. With higher rainfall and cooler temperatures (e.g. as in Wisconsin) cool-season grasses (e.g. brome and orchard grass) do grow later into the summer, thus providing more grazable forage.

However, grass-based dairying can work in Nebraska and other lower-rainfall Great Plains states. We just need to manage for our local area and conditions. For example, grass requires longer to recover from grazing with lower rainfall. In northeast Nebraska, grass generally takes from 25 to 65 days to recover from grazing depending upon forage species, moisture conditions and time of year. Generally, the shorter the time spent in any given paddock, the more consistent the nutritional value of the forage produced. We must adjust our management accordingly. As mentioned earlier, controlled grazing involves more than rotating pastures - one must consider the time needed for the grass to recover along with the dairy cow's nutritional needs.

Heat-tolerant forages also can provide high-quality dairy cow feed in areas where summer temperatures and lower rainfall limit the growth of cool-season grasses. For example, there are varieties of alfalfa that were developed for grazing. Some farmers graze their cows on alfalfa quite successfully with no problems. Other farmers experience some bloat problems with their cows. As with any farming endeavor, management is important. Allan Nation, editor of the *Stockman Grass Farmer* magazine, recently provided this advice to a reader concerned about grazing alfalfa: "A pasture salad mix of grass and legume is always best for animal performance and health. Bloat usually occurs when hungry cattle are turned onto pure legume stands that are wet with dew or rain. Most graziers have found they can graze pure stands of alfalfa if they gradually increase the animals' time on the alfalfa over several days and always provide free choice hay or straw during wet weather." (*Stockman Grass Farmer*, Apr. '92, p. 4).

Birdsfoot trefoil is another forage legume well-suited for summer grazing and is noted for having fewer bloat problems. Also, a few farmers are using annual forages like puna chicory and RANGI rape for summer grazing with success. RANGI rape has an energy level nearly equal to shelled corn on a dry matter basis.

These are just some of the forages graziers are experimenting with these days. In any event, much remains to be done to work out the management details for grass-based dairying in many regions of the country, particularly in the drier regions. In areas where grass-based dairying is proving to be quite profitable and successful, farmers spent a few years working out the details. But they are now reaping the benefits.

The *Stockman Grass Farmer* and back issues of the *New Farm* offer many practical ideas by farmers who operate successful grass-based dairies. These ideas, coupled with a little experimentation and sound dairy farm management, can help tailor profitable grass-based dairying alternatives to your farm.

Resources for Grass-Based Dairying

American Minor Breeds Conservancy, PO Box 477, Pittsboro, NC 27312; Phone: (919) 542-5704. Keeps track of sources of minor breeds of livestock, including dairy and dual-purpose cattle. Some of these breeds may be suitable for grass-based dairies. Some, such as the Ayrshire dairy breed, are increasingly being used as purebred stock or in cross-breeding programs. The advantage of many minor breeds of livestock is they still retain genetics adapted to high forage diets, hardiness and even insect resistance.

Appropriate Technology Transfer for Rural Areas (ATTRA), PO Box 3657, Fayetteville, AR 27702; Phone: 1-800-346-9140. ATTRA, a U.S. governmental information service, offers free packets on "Sustainable Dairy Production" and "Rotational Grazing." These packets include many of the best articles from the *New Farm* and *Stockman Grass Farmer* magazines.

Center for Rural Affairs, Beginning Farmer Sustainable Agriculture Project, PO Box 736, Hartington, NE 68739; Phone: (402) 254-6893. The CRA offers fact sheets on time-controlled grazing and alternative forages. These were developed with northeastern Nebraska farmers during the Small Farm Resources Project.

Department of Agronomy, c/o Bill Murphy, University of Vermont, Burlington, VT 05405. Dr. Murphy has done extensive work with Voisin Grazing Management and has authored the book, *Greener Pastures on Your Side of the Fence: Better Farming with Voisin Grazing Management* (1978, Arriba Publishing).

Department of Dairy Science, Ohio State University, Plumb Hall, Columbus, OH 43210-1094; Phone: (614) 292-6851. Dr. David Zartman at OSU has done pioneering work with seasonal, grass-based dairying.

Forage Systems Research Center, University of Missouri, Cornett Farm, Rt. 1, Box 80, Linneus, MO 64653; Phone: (816) 895-5121. This center conducts extensive research on rotational grazing and forages. It's not focused on dairy, but still provides excellent general information, including management intensive grazing seminars every summer.

Land Stewardship Project, 2200 4th St., White Bear Lake, MN 55110; Phone: (612) 653-0618. The Land Stewardship Project is one of the pioneers in farmer-led research and has worked extensively with Minnesota farm families. It offers practical publications and research summaries covering time-controlled grazing.

Stockman Grass Farmer, PO Box 9607, Jackson, MS 39286-9909. This is a practical monthly magazine for grass farmers. It also offers for purchase an extensive list of grass-based dairying/farming books and tapes through the SGF Bookshelf. The editor, Allan Nation, wrote an excellent editorial on grass-based dairying in the November, 1991 issue. Call 1-800-748-9808 for sample issue of magazine and publications list.

The Great Dairy Debate – Consequences of Bovine Growth Hormone and Rotational Grazing Technologies. Dr. William Liebhardt, editor. (1993, University of California Sustainable Agriculture Research and Education Program). Available through ANR Publications, University of California, 6701 San Pablo Ave., Oakland, CA 94608-1239. Phone: (510) 642-2431. Cost: $28 plus $3.50 shipping & handling. This volume provides a farm-level, community-level and industry-level look at the economic, social and environmental impacts of "rotational" grazing and bovine growth hormone technologies. It features case studies of 32 farms in the Upper Midwest and the northeastern U.S. Both academics and farmers would find this book useful.

***The New Farm*, Rodale Institute**, 222 Main St., Emmaus, PA 18098; Phone: (215) 967-5171. This now defunct magazine featured several articles on various aspects of grass-based farming over the years.

U.S. Department of Agriculture, National Agricultural Library, Public Services Division, Rm. 111, Beltsville, MD 20705. Offers a bibliography entitled *Rotational Grazing and Intensive Grazing Management.*

West Virginia University, c/o Ed Rayburn, PO. Box 6108, Morgantown, WV 26506-6108. Mr. Rayburn, formerly a grassland specialist with the Seneca Trail RC&D in New York, has done extensive work with grass-based dairying.

Wisconsin Pastures for Profit - A Hands-on Guide to Rotational Grazing, 1991. Available through the Agricultural Bulletin Room, Rm. 245, 30 N. Murray St., Madison, WI 53715; Phone: (608) 262-3346. Wisconsin-based, but provides much general information applicable to grass-based dairying in any area.

Wisconsin Rural Development Center, 125 Brookwood Drive, Mt. Horeb, WI 53572; Phone: (608) 437-5971. Recently published *The Grass IS Greener: Dairy Graziers Tell Their Story*, which features 16 grass farmers from Wisconsin and Minnesota. Cost: $7.50.

FARM FOCUS:

The *Gary & Delores Young* farm – Controlled grazing improved dairy pasture and milk production

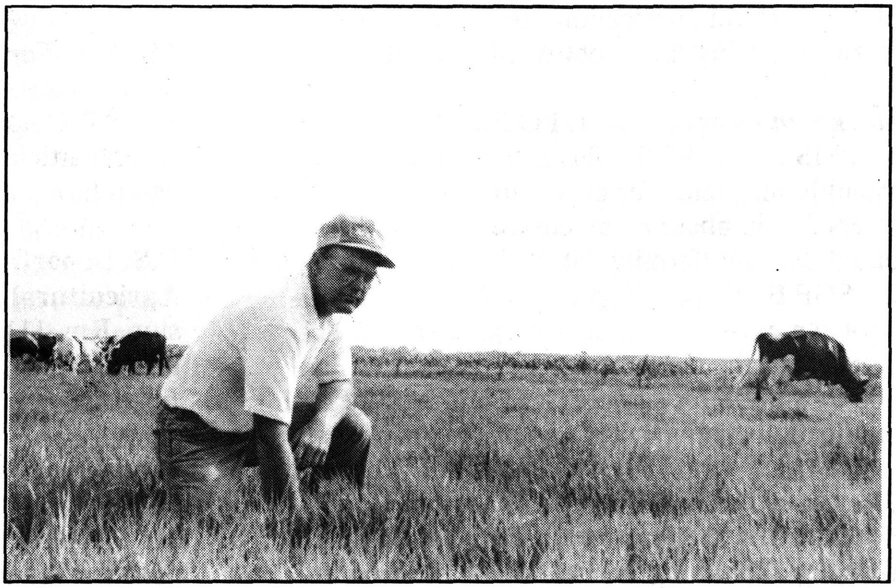
"I never dreamed of having a pasture like I've got now," said Gary Young, referring to his dairy pasture.

That pasture is 45 acres of bottom land near Magnet, in northeast Nebraska. It's made up of bluegrass, smooth brome grass, prairie cordgrass and reed canarygrass. Gary and his wife Delores grazed their 40 Holstein dairy cows on this pasture for their Grade A dairy. In 1984, the Youngs implemented a time-controlled grazing plan where they divided the pasture into first three and later six different paddocks.

"Now I've got a six-month pasture, not a six-week pasture. Before, the grass would mature rapidly, and the reed canarygrass would be above the cows' backs," said Gary. "They wouldn't eat it."

With a combination of controlled grazing and early cutting of parts of the pasture for hay, Gary was able to keep the grass in a vegetative (younger) state and increase pasture use and the cows' nutrition. In 1983, before the Youngs implemented the controlled grazing plan, the cows only milked a little over 30 pounds/head/day for the six-month grazing season between May and October. By 1988 and 1989, milk

The Youngs' cattle now graze young, lush, nutritious grass in its vegtative state where once it grew tall and coarse, making it unpalatable.



production had increased to more than 45 pounds/head/day for the grazing season. During this same period, Gary and Delores cut feeding of supplemental alfalfa hay nearly in half – from 18-20 pounds/head/day down to about 10 pounds/head/day. Supplemental grain remained the same (from 18-20 pounds/head/day) even though milk production increased by 50% during this time period.

The Youngs attribute their increased milk production and feed savings to their controlled grazing program.

"And it doesn't cost much either, but a little wire and a few posts. One wire is all you need (to keep the cows in). You don't need anything fancy," said Gary. "It doesn't take much time either, just a little time to fix fence in the spring and move the cows when you need to."

The quality of the pasture has also improved over time.

"I used to have over-grazed spots and under-grazed spots. There was a lot of foxtail barley that the cows wouldn't eat. Now the foxtail barley is mostly gone, and we're seeing a lot of white clover, alsike clover and even a little red clover. Some of the natives like big bluestem and switchgrass are also coming back. I haven't seeded any of these. They come on their own. The cows really go for the clovers."

NOTE: ***The Youngs have since sold their dairy herd to provide more flexibility for family activities. But they continue their controlled grazing program with a 45-cow beef herd.***

Desirable forage plants like white and alsike clover increase on their own with controlled grazing. They provide nutritious summer forage and fix nitrogen to improve pasture fertility.

FARM FOCUS:

The *Marvin and Evelyn Lange* farm – Dairy cows fit well into an integrated farm

The Marvin and Evelyn Lange family operates a 240-acre farm with 40 Holstein dairy cows near Fordyce, in northeastern Nebraska. An 80-acre native grass pasture is an integral part of their dairy-cow feeding program, along with 35 acres of oats, 25 acres of barley, 60 acres of corn and 40 acres of alfalfa. The Langes believe in practicing a full crop rotation, planting legumes for soil building and making best use of on-farm manure. By using these practices they are able to eliminate use of fertilizers and pesticides on their farm.

Their native pasture is on hilly ground and is currently divided into nine paddocks. The Langes plan on adding more paddocks to make it easier to manage the grass and provide the cows with a more stable, nutritious forage selection by moving cows to ungrazed areas often.

The Langes have seen marked pasture improvement since they initially started with just three paddocks in 1984.

"The bluestem is out there like I've never seen it before," said Marvin.

Big bluestem is a native warm-season grass common to the eastern Nebraska prairie. Big bluestem traditionally provided abundant and nutritious summer forage highly sought after by cattle and other grazing animals. But its presence has been greatly reduced by continuous grazing (no rest) that didn't allow the plants to recover from grazing. Controlled grazing allows farmers to manage for plant recovery after grazing and to meet the dairy cow's high nutritional needs.

In addition to native pasture, cover crops and crop residue are also incorporated into the Lange grazing plan. Their cows normally graze foxtail and sweet clover after the oat harvest, removing about 1,000 pounds of dry matter per acre in 1990.

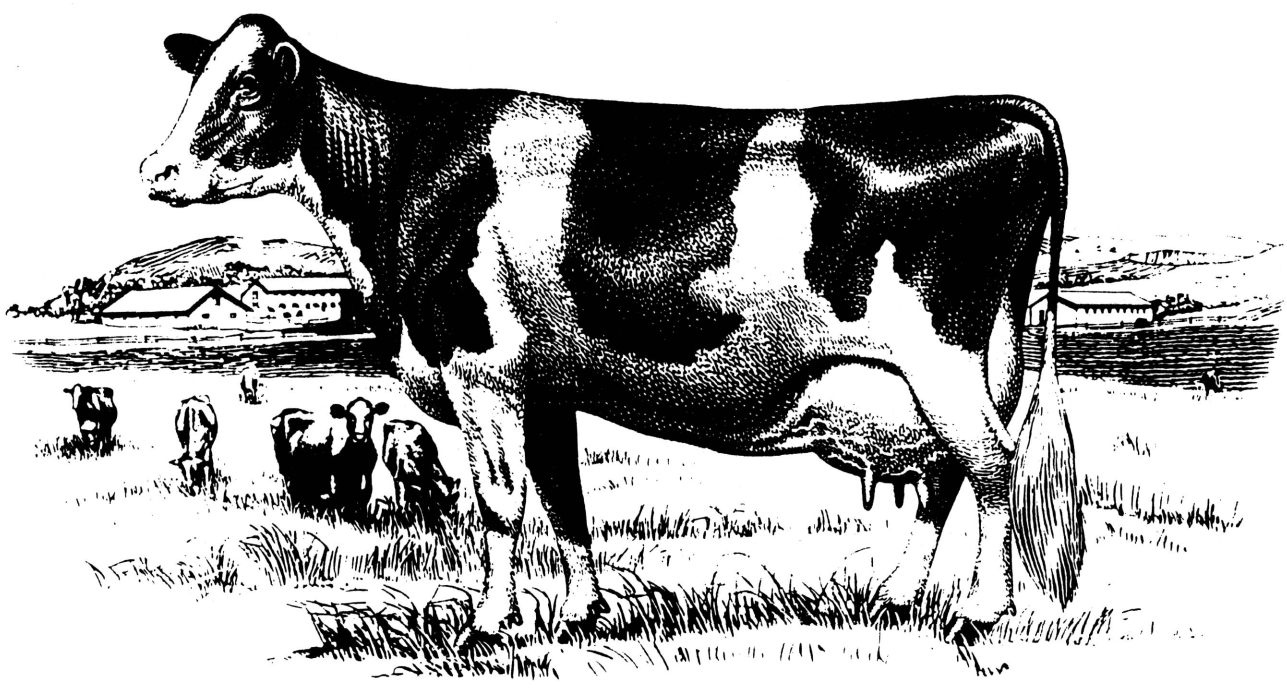
"You do have to watch to make sure the cows don't bloat on clover," said Marvin.

But, he added, there hasn't been many bloat problems: "...otherwise I wouldn't be doing it. You just want to watch out for the fresh growth after a good rain following a dry spell."

The cows also glean corn fields for husks and dropped ears in the fall. Throughout the year, they are supplemented with about 20 pounds/head/day of grain, and also free-choice alfalfa as needed when grazing is limited.

"This summer (1992) all the cows are getting is grass with no alfalfa and they're milking good."

The cows were milking 52-53 pounds/head/day in 1992. The Langes don't plan for maximum milk production, but rather efficient production that makes the best use of resources available on the farm. This is a cornerstone of their integrated dairy operation.



Alternatives by and for Farmers

☛ Manure Management

Manure once aided a farmer in making money by fertilizing crops; now it often costs the farmer money to dispose of it. Furthermore, the concentration of livestock and their manure in large confinement facilities and feedlots poses a risk of contaminating streams, lakes and groundwater supplies with nitrogen, phosphorus and other nutrients.

With the use of chemical fertilizers - and decreased emphasis on the traditional use of manure, grass and legumes for "soil building" - soil fertility management has deteriorated to meeting only short-term fertility needs. This is referred to by some as the "N, P & K mentality" (N, P and K are letters for the primary crop nutrients - nitrogen, phosphorus and potassium, respectively), which regards soil as an inert medium to hold up plants and neglects long-term soil health. Soil building, on the other hand, strives to develop soil health and condition. Healthy soils have much biological activity, well-developed soil structure and high organic matter. A healthy soil:

- Helps crops weather drought because it has a higher water-holding capacity
- Reduces soil erosion with an increased water-infiltration rate
- Serves as a reservoir of crop nutrients in the form of humus and organic matter

To make a healthy soil, one must build organic matter, humus, structure and biological activity, not just fertilize the soil for the current year's crop. Because manure usually contains organic matter and releases some of its nutrients slowly, it feeds soil micro-organisms slowly and contributes to soil health in ways that chemical fertilizers cannot.

To build soil and make best use of on-farm resources, we need low-cost ways of storing and using livestock manures. One way is through on-farm composting. Composting offers farmers a method to convert raw livestock manure into soil-building humus while saving money, fuel and time. Composting is the process whereby a nitrogen source (raw manure and urine), a carbon source (crop residue, straw or newspaper), oxygen (from the air) and water combine to form a favorable environment for micro-organisms. These micro-organisms feed on the nitrogen and carbon sources, creating heat. They break down the organic matter and transform it into a nutrient-rich material called compost that is good for soil building.

The advantages to on-farm composting are:

- Creates a valuable resource from "waste" manure, used bedding and forage residues
- Decreases weight and volume of manure, thereby decreasing hauling costs
- Stabilizes nitrogen and prevents nutrient loss; this gives greater flexibility in terms of time of application
- Kills weed seed and insect larvae through heating
- Provides slower nutrient release

Initial costs of setting up a composting operation can be high, depending upon equipment and approach used. However, creative, low-cost options are possible. The Farm Focus that follows this section discusses both low-investment and high-investment approaches.

Resources for Manure Management and Soil Building

Appropriate Technology Transfer for Rural Areas (ATTRA). Offers free information on: 1) Farm Composting; 2) Sustainable Fertility Management and 3) Soils Series (Components of the Soil Environment, Soil Biology and Nutrient Cycling in the Soil). See "General Resources" for ordering information.

Composting Livestock Manures, 1987. A six-page brochure covering the basics of farm composting. A Center for Rural Affairs publication available separately for $1.50, or included in the *Resourceful Farming Primer*. See "General Resources" for ordering information.

Composting of Farm Manure. Project Focus #8 in the Small Farm Energy Primer, 1980. This publication provides guidelines and includes designs for two "home-built" compost turners. Available from the Center for Rural Affairs, PO Box 736, Hartington, NE 68739; Phone: (402) 254-6893.

On-Farm Composting - A summary of on-farm research and demonstration projects conducted in 1990 and 1991 in Southeast Minnesota. Copies available from the Land Stewardship Project, 2200 4th St., White Bear Lake, MN 55110; Phone: (612) 653-0618.

On-Farm Composting, a "Farming for the Future" booklet published by the Land Stewardship Project, 2200 4th St., White Bear Lake, MN 55110; Phone: (612) 653-0618. This is the practical guide and farm companion to the previously mentioned LSP study. A good source of hands-on information.

The Rodale Guide to Composting, by Jerry Minnich, Marjorie Hunt and the editors of *Organic Gardening Magazine*, 1979. Available from Rodale Press, Inc., Box 14, Emmaus PA 18099-0014. Very extensive publication with vast sources of information, resources, and composting alternatives. A very good how-to guide.

The New Farm, Jan., 1992 Vol. 14, No.1. This issue focuses on manure management, from composting and liquid manure management to soil building and soil testing and selling manure for other uses. Available from Rodale Press, Box 14, Emmaus, PA 18099-0014.

FARM FOCUS:

Manure management with composting on the *Wuebben* farm

Some time ago, Edgar Wuebben of Wynot, Neb., decided his farm would not fall victim to either the N, P and K mentality or manure pollution. Before he started composting, Edgar stockpiled the manure from his dairy in a manner similar to most conventional dairies, hauling the raw manure to the fields in early spring and liberally applying it, "just to get rid of it".

In 1981 Edgar began composting while participating in the CRA's Small Farm Energy Project (SFEP). This project worked with farmers to lower their off-farm energy costs by making better use of the resources already available on-farm. The experiment with compost started when Edgar modified an old auger. This was used to turn the windrows of composting manure in the field. This innovation turned the manure sufficiently but left it spread out and not in a windrow. A bucket loader was needed to pile the windrows after turning them. Manure and bedding that is not piled and kept moist will not compost adequately.

After a couple of years of composting like this, Edgar went to a farm composting demonstration in South Dakota. There he saw a commercial compost turner. Soon after, the Small Farm Resources Project (which followed the SFEP) helped him buy a commercial compost turner. The compost turner cost $5,400. Edgar spent $3,600, and the project cost-shared the remaining $1,800.

The commercial turner has worked well, but Edgar cautions against buying one right away. In fact, if he had to start all over again he doesn't know if he would buy a commercial composting machine at all.

"Commercial compost turners are really expensive today, and I feel a beginning farmer can get by composting like I did at first with a bucket loader and tractor, or build one like a lot of farmers do. The power take-off (PTO) driven machines are also hard on tractors if there is not sufficient horsepower."

Nevertheless, Edgar's composting operation has really taken off. In an average year, Edgar and his sons Terry and Don apply seven tons of compost/acre to about 50-60 acres of crop ground. This amount of compost is from the fall and winter barnyard manure produced by 70 dairy cows (the cows are pastured during the summer) and year-round manure from their calves. This provides enough compost so each field is fertilized every three to four years on Edgar's farm.

"The good thing about compost is that we reduce the volume about three-quarters of what hauling and spreading raw manure is. We spread the compost when the weather and our time schedule is more favorable in the fall and the fields do not get compacted as much as they do spreading raw manure," said Edgar.

To begin the composting cycle, manure and bedding are taken from the milking barn and feedlot area to an area on the farm where the soils are poor (this builds up the poor soils and doesn't take the best farm ground out of production). Here it is windrowed into piles ready to be composted. The piles are about five feet high and eight feet wide. The windrows sit and soak up moisture from snow and rain, heating themselves while waiting for turning. After planting corn, the windrows are turned as needed, maybe two to three times during the summer. Then in the fall, the previous year's compost is spread on the fields.

"When we compost, there is very little smell or fly larvae. This is because the heating kills both along with the majority of any weed seed," said Edgar. "One important point is that the manure to be composted not be too runny. It is very important to keep the carbon content high to soak up all the urine which contains the nutrients."

To do this the Wuebbens add newspaper to the straw bedding and the cows' feed yard. The carbon source is key. The nitrogen in urine and manure can volatilize into the air or leach away with run-off if not soaked up and stabilized.

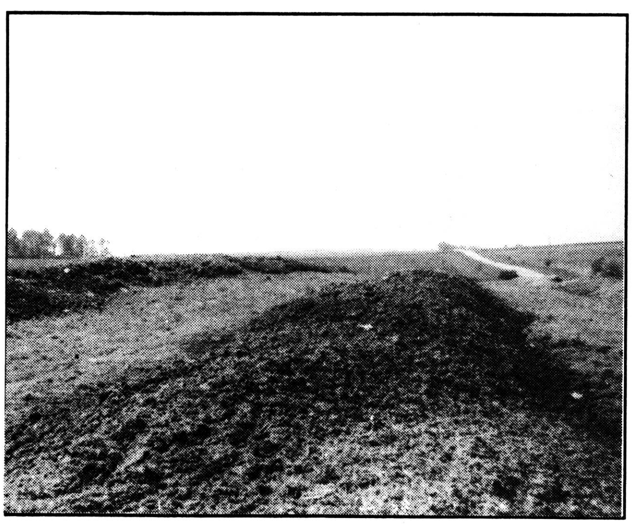
This carbon manure mix must be adjusted on-site, but a good number to use is 20 to 30 parts carbon to one part nitrogen. This is because the microbes responsible for decomposition need carbon for food in order to stabilize the available nitrogen. When microbial activity decreases, then nitrogen is lost.

For optimum composting, the mix should be about 40% moisture and 60% air for good microbial action. To kill most weed and larvae, the compost pile should reach 140 degrees F. It should not, however, go over 150 degrees F as this will cause ammonia nitrogen losses.

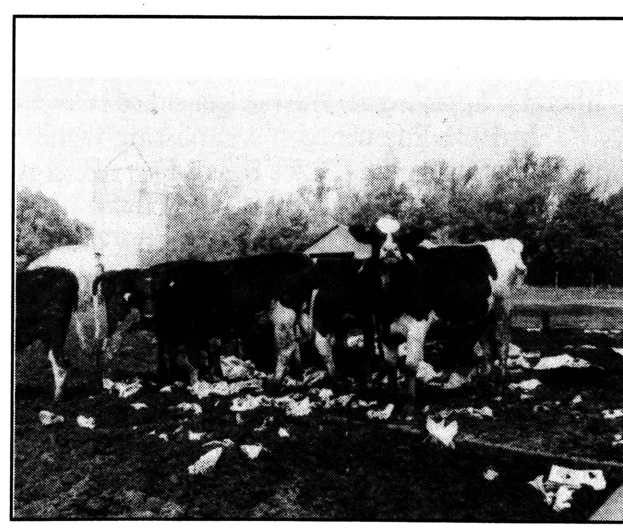
The composted fields are blade-plowed to work the soil. A blade-plow is a V-shaped blade that cuts horizontally two to four inches below the soil. The Wuebbens do not believe in turning the soil, but only loosening it so that earthworms and bacterial activity can break down crop residues and compost.

The Wuebbens believe that composting is the most ecological way a diversified farm can provide for on-farm fertility. Economically, composting along with crop rotations is also a way to reduce or eliminate the need for off-farm fertilizers.

"The soil is more than just nutrients and minerals. Good crops grow because there is good soil health," said Edgar. "What I mean by good health is a high organic matter content and good soil tilth."



Finished compost should be neutral or slightly acidic with a 6.0 to 7.4 pH range, and have a loose crumbly texture with an earthy smell.



Shredded or whole newspaper, used for bedding or soaking up feedlot manure and urine, has no weed seed, is non-toxic (the non-glossies) and is available from local recycling centers.

Alternatives by and for Farmers

☛ Low-Cost Facilities & Equipment

In its November, 1991 issue, *Successful Farming* magazine asked leading economists, consultants and farm business experts to estimate how much it would cost for a family to start a diversified crop and livestock farm in the Midwest. The response: $500,000.

Seeing such a figure in print can be disheartening to a young farm family. But keep this in mind: *Successful Farming*'s experts based their final estimate on the conventional wisdom that using capital-intensive technologies is the only way to be competitive. That isn't necessarily so, and there are people who are substituting their labor, management, creativity and resourcefulness for purchased inputs wherever possible. Beginning farmers can replace financial equity with sweat equity, thus lowering outlays for buildings and equipment.

Resources for Low-Cost Facilities and Equipment

A Guide to Barn Rehabilitation, Mary Humstone, National Trust for Historic Preservation. (Mountains/Plains Office), 511-16th St. Suite 700, Denver, CO 80202. Phone (303)-623-1504. Gives examples of how barns have been remodeled, ideas, checklists and cost analysis.

Buildings for Small Farms, NRAES-6, 1978, Northeast Regional Agriculture Engineering Service, West Virginia University, Morgantown, West Virginia 26506. Very good information on farmstead planning included.

Dairy Housing and Equipment Handbook, 1986. Available from Midwest Plan Service, Box 2120, Agriculture Engineering Dept., Brookings, SD, 57007-1496; Cost: $8.00.

Using Old Farm Buildings, Dexter W. Johnson, July 1988. Report #88-1 (AERO 88-1), Agriculture Engineering, North Dakota State University, Fargo, North Dakota 58105. Looks at moving buildings, remodeling, redesigning and repairing old farm barns. Very informative. Contact the North Dakota Extension Service for further information.

Waikato Milking Systems, 1125 Barberry Drive, P.O. Box 308, Janesville, WI 53547; Phone: 608-752-7900. This company markets New Zealand milking systems that are very well engineered and efficient. The drawback is new systems are expensive for most beginning dairy farmers. However, the same design concepts can be applied with used milk equipment. Video available to get ideas.

FARM FOCUS:

Low-cost dairy facilities on the *Clark & Lynette Grueber* farm

Today, when beginning farmers think of dairying, prohibitive, capital-intensive operations come to mind for many. However, this is not the case for Clark Grueber, a self-made dairy producer with a 17-cow herd on a 16-acre farm near Nelson, Neb.

Clark, whose family owned and operated a dairy until he was 16, started his operation after working on several local dairies around Nelson and at the University of Nebraska's dairy at the research center near Mead.

Clark's facilities are located on his parents' small acreage. Clark began building his 30' by 80' free-stall barn one year before milking full-time at home.

The four-stanchion milking barn cost $4,100 to build, with all of the labor provided by Clark and his father. The lumber came from dismantled barns around Nelson. Used cement blocks were utilized for the barn's foundation and base, and all concrete floor work was done by Clark with his father's help and cement mixer. Six-inch fiberglass insulation was put into the walls and roof. Stanchions and other milking equipment were acquired at local farm auctions.

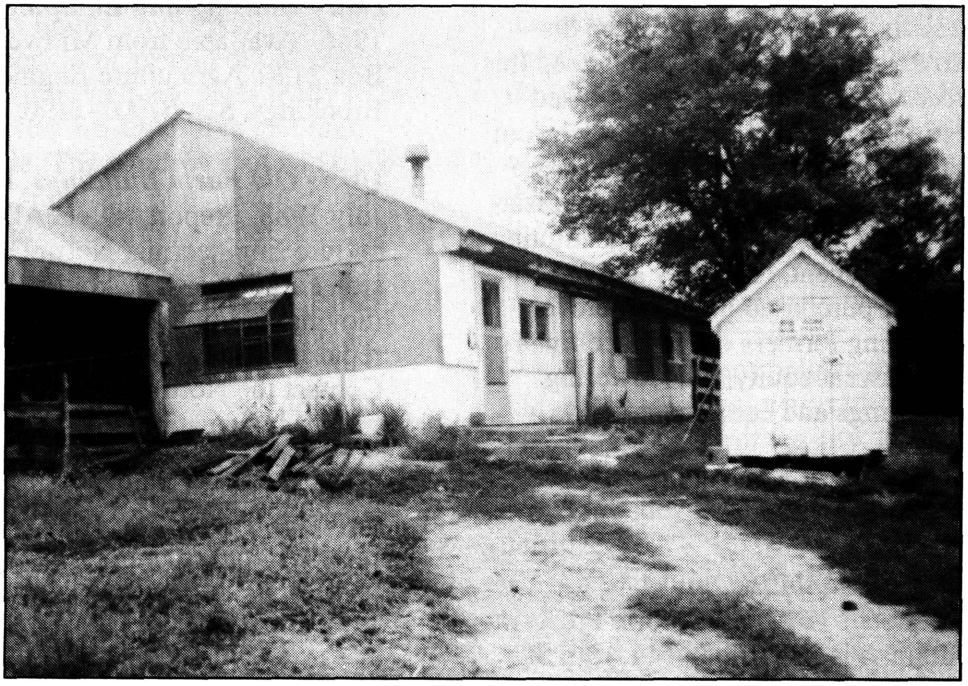
Clark rents ground locally for alfalfa and grass hay, but does not move his herd off of the home place to graze. Presently, Clark cash rents 27 acres of alfalfa hay ground. Before 1990, he was cash renting 80 acres of alfalfa and grass hay ground, but the owner decided to sell this ground and Clark lost his lease. On the five acres of alfalfa at Clark's home place, he uses the compost from the dairy as fertilizer and to improve soil tilth. Clark applies no commercial fertilizer or pesticides to this or his rented ground.

Clark began experimenting with time-controlled grazing on five acres of alfalfa in 1992. The alfalfa ground is split into 19 paddocks, with each paddock being further divided into five or six sections. Clark was grazing 20 cows on this in early spring, but the cows were not able to keep up with the alfalfa growth, so he turned in seven more heifers later on. To prevent bloating, hay is fed in the morning before the cows are allowed to graze. Clark is certain the cows milk just as good or even better. He's also convinced his cost of per pound milk production is lower on grass than when he's feeding silage, grain or hay.

Supplemental grain is purchased from neighbors or a feed mill and mixed for $15 for Clark's three-ton capacity, self-built feed bin. Clark's ration consists of rolled corn and is top-dressed with a dry protein, commercial supplement. Clark feeds according to production and the cow's appearance.

"If cows look thrifty, have a smooth coat, calves are growing, don't show too much rib, or don't run over me going to the feed trough when entering the milking parlor, then they're getting enough feed," said Clark.

The cows are fed individually and generally receive one pound of grain for every three pounds of milk produced. As production decreases, the amount of grain Clark feeds is lowered and vice-versa. Grass and alfalfa hay is fed free choice during the winter, 10 pounds per head in the summer while grazing. Milk from each cow is weighed once per month, facilitated by bucket-type milkers.



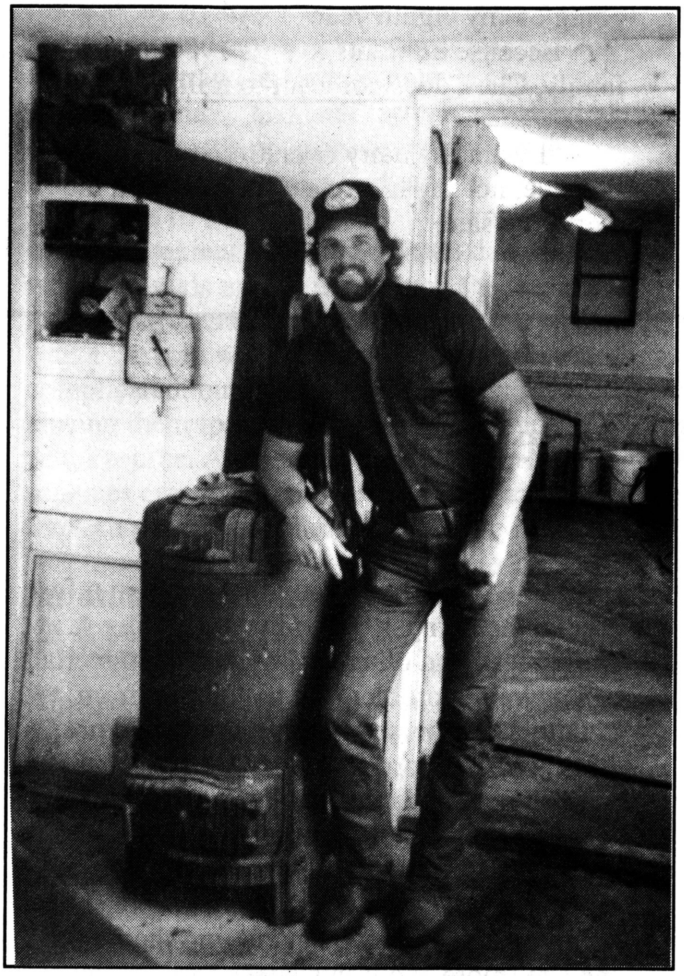
Clark Grueber's 30' by 80' free-stall milking barn cost $4,100 to build. His three-ton capacity, self-built bin is to the right of the photo.

Herd origin

Clark began with 12 cows.

"I bought average cows that others did not want. It would be nicer to start out with better stock but through artificial insemination I improved the herd. Artificial insemination is a must for herd improvement unless you buy good quality heifers from someone else, which is expensive," said Clark.

Clark learned to inseminate artificially while working at the other dairies and now



Clark heats his milking barn with wood. The stove cost $15.

raises all his replacement stock on-farm.

All on-farm heifers are kept to replenish the herd. Clark's heifers calve at two years and four months.

"If you wait three years, you are losing time and money," he said.

Milk production

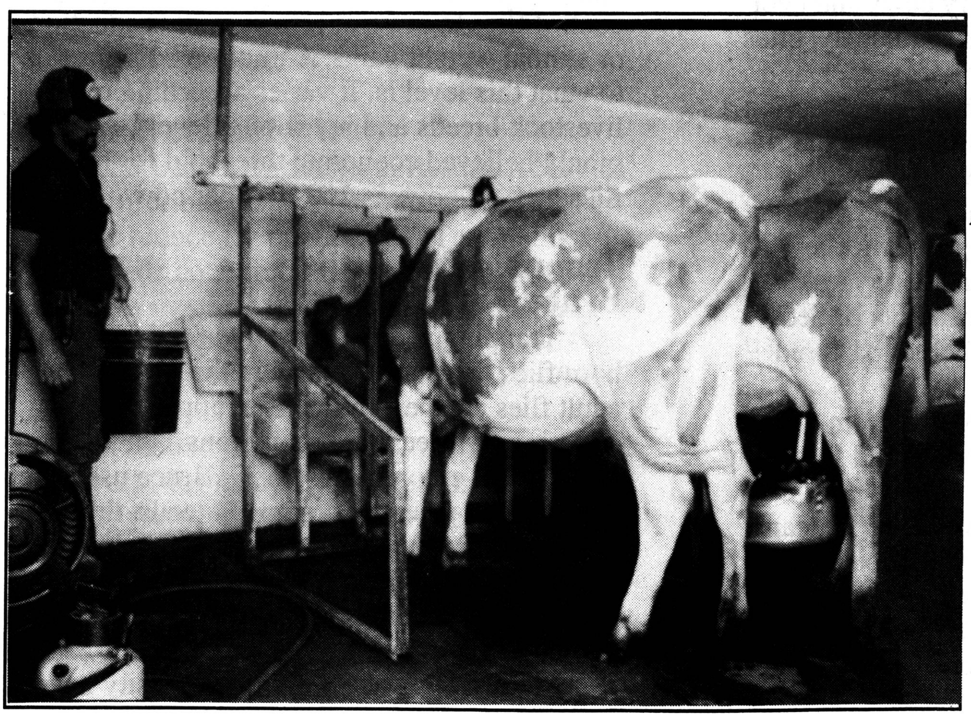
If Clark's cows – excluding first lactation heifers – do not hit 50 pounds of milk per day, they are culled. Each year Clark sells his five or six bottom producers and these are replaced with his replacement heifers.

Health

Clark's biggest health concern is scours in calves. He operates under the assumption that scours originate from the environment and the best prevention is to keep areas dry and draft-free. Portable calf huts are moved with each new calf to prevent disease build-up. When a calf does have problems with scours, it is not taken off milk, but is fed more oat hay as roughage and an electrolyte solution between feedings. Antibiotics are kept to a minimum.

Size and economics

It took Clark five years to pay off the herd, facilities and machinery. All of the milk check went to pay off the operation and get the debt and



Clark uses bucket-type milkers to lower start-up equipment costs. This allows him to record milk production per cow as well.

interest out of the way, while Clark's spouse, Lynette, used her nursing salary to pay for family living expenses. His average work day is six hours except when harvesting hay.

"Most people told me I was not going to make it because I was not big enough. Now I'm going on my eighth year."

Because he wants to preserve time for his family, Clark does not want to milk more than 25 cows.

"I want my dairy operation to fit my lifestyle, not my lifestyle changing to fit the dairy," he said.

Alternatives by and for Farmers

☛ Alternatives for Fly Control

Why alternative fly control?

Many farmers are looking for alternatives to pesticides for fly control. It's not surprising. After all, pesticides are expensive, they potentially threaten human health and the environment, and indications exist they lose their effectiveness as flies build up resistance.

The basics of fly control

Three kinds of flies – the horn, stable and face – cause the greatest annoyance and resultant economic loss to both dairy cows and beef cattle. The horn fly, a small triangular fly, bites the animals at the base of the horns, back and belly to draw blood. The horn fly is most often a problem for animals in a pasture where the flies reproduce in fresh cow patties.

The stable fly, about twice as large as the horn fly, bites the animal's legs and heels. This fly is more of a problem around barnyards where it hatches in rotting straw, hay or bedding. The stable fly can also bother pastured cattle.

The face fly feeds on mucous from the animal's eyes, causing annoyance and spreading the pink eye bacterium.

A fourth fly, the common house fly, can cause annoyance in barnyard situations.

Of course, the best approach for dealing with any fly problem is to prevent it from developing. This is particularly effective with the stable fly and house fly that hatch in refuse around the barnyard. Eliminating rotting straw, spilled feed and other moist breeding materials can prevent a problem fly population from building. Of course, this strategy would not work with the horn flies and face flies that hatch in fresh manure in a pasture situation. But some farmers are practicing prevention in pasture situations as well by following cattle with chickens and even a couple pigs to spread the manure patties, thereby disrupting the fly breeding site (more about this later).

The objective of any fly control program is to keep fly numbers below the economic threshold. The economic threshold is the level at which it becomes economically advantageous to control flies to prevent loss in milk production or animal weight gains. Authorities disagree as to what this level is. It varies according to livestock breeds and nutritional levels. A commonly believed economic threshold for horn flies on beef cows is 200 flies per cow.

Trapping flies & the Bruce Horn Fly Trap

Trapping is one alternative for controlling horn flies. By starting early in the fly season, adult flies can be continually trapped, thus lowering fly breeding populations.

USDA entomologist W.G. Bruce used such an approach when he designed a walk-through horn fly trap for beef cattle before World War II. Following the war, there was a big push for pesticides, and the fly trap was forgotten. More recently, researchers at the University of Missouri and North Dakota State University have revived the fly trap idea and have printed useful fact sheets and construction plans for the walk-through fly trap (see resources).

Seven dairy and beef farmers involved with on-farm research projects developed by the Center for Rural Affairs built and tested the Bruce trap in 1989 and 1990. The trap proved quite convenient for a grass-based dairy farm where animals must pass through the trap on a regular basis as they go to and from the pasture. Using the trap with beef cows can be a bit more complicated, but often possibilities exist for placing the trap between the animals and their water source. Also, multi-paddock grazing schemes create situations where animals move through narrow locations on a regular basis.

Summary & comment on fly trap experiments

The Bruce Horn Fly Trap proved quite effective for horn fly control on cooperating dairy farms (see data presented in Tables 1-3 at the end of this section). However, we were unable to determine its effect on stable and face fly populations. Numbers of face and stable flies on the dairy cows were variable and didn't show any pattern that might appear to be tied to the use of the walk-through fly trap.

Our studies echo similar research efforts on beef cattle in Missouri and North Dakota. Use of the trap does take a conscientious effort by the farmer to insure the trap is operating early in the season to control horn fly breeding populations. Also, some effort is required to accustom animals to the trap.

Other types of fly traps

The USDA Agricultural Research Service offers information and plans for three types of traps to reduce fly populations. The first is a homemade cone trap designed to be baited and placed at strategic locations around the farm. H.M. Brundrett explains this trap in a 1953 USDA report entitled, *A Homemade Fly Trap ET-312.*

A second trap is a sticky pyramid design that works for many fly species, including the face fly for which the walk-through trap doesn't work. A third design utilizes fluorescent lights and is used inside buildings. Information on all three of these traps is available from Lawrence G. Pickens, Research Entomologist, USDA-ARS LSPI, Livestock Insects Laboratory, Bldg. 177A BARC-East, Beltsville, MD 20705; Phone: (301)344-2974.

Poultry and/or multi-paddock grazing

The diversified farm may offer some natural fly control. Chickens scratching around the barnyard can disrupt breeding areas and eat young fly larvae. Virginia farmer Joel Salatin has designed an egg-mobile (hen house on wheels) that he wheels around from paddock-to-paddock in his intensive rotational grazing scheme. The hens scratch the cow patties where horn and face flies lay their eggs. In fact, the fly larvae provide a high-protein chicken feed, and the hens provide high-quality eggs. Some ranchers claim that a multi-paddock grazing scheme also reduces fly numbers since the animals are moved frequently to a new pasture, and the flies are left behind.

Muscovy ducks are known to be particularly aggressive in eating flies and reducing fly numbers. A farmer writing for the *Countryside and Small Stock Journal* (Vol. 76, No. 1, Jan/Feb 1992) reports good control in two research situations and from his own experience.

Parasitic wasps

Researchers at the University of Nebraska and elsewhere are investigating the potential of releasing a parasitic wasp for control of stable and house flies in feedlot and barnyard situations. Recent studies using parasitic wasps in a feedlot situation showed that the wasps were ineffective in reducing fly numbers (Dr. John Campbell, UNL livestock entomologist, personal communication, 6/17/92). However, many people who have used the parasitic wasps for fly control believe in their effectiveness. Some farmers may wish to experiment on their own. The Jan/Feb 1991 issue of *Missouri Farm* magazine provided the following list of potential suppliers for fly predator insects:

- Beneficial Insects Ltd., PO Box 154, Banta, CA 95304; Phone: (209) 835-6158
- Bio-Control, Inc., 54 S. Bear Creek Drive, Merced, CA 95340; Phone: (209) 722-4985
- Henry Field Seed and Nursery Co., 407 Sycamore St., Shenandoah, IA 51602;

Phone: (712) 246-2011
- Foothill Ag Research, Inc., 510 W. Chase Drive, Corona, CA 91720; Phone: (714) 371-0120
- Gurney Seed & Nursery Corporation, 2nd & Capitol, Yankton, SD 57078; Phone: (605) 665-4451
- Praxis, PO Box 134, Allegan, MI 49010; Phone: (616) 673-4672
- Sespe Creek Insectary, 1400 Grand Ave., Fillmore, CA 93015; Phone: (805) 524-3565
- Spalding Laboratories, 760 Printz Rd., Arryo Grande, CA 93420; Phone: (805) 489-5946
- *Suppliers of Beneficial Organisms in North America*, Beneficial Organisms Booklet, Department of Pesticide Regulation, Environmental Monitoring and Pest Management Branch, 1020 N. St., Rm. 161, Sacramento, CA 95814-5604;Phone: (916) 324-4100; e-mail: brunetti@empm.cdpr.ca.gov

Farm biodiversity?

Many believe that insect and other pest problems are a result of the disruption of natural processes and biological complexity. Natural ecosystems are very diverse and include many species of plants and animals. Agriculture often creates very simple environments with large breeding habitats and food sources for particular pests. For example, large concentrations of rotting manure provide extensive breeding habitat for stable and house flies. These conditions, along with the absence of natural controls (e.g. birds, predator insects), create an environment ripe for a population explosion. We shouldn't be surprised when we have a serious fly problem; we helped create it. Some of the previously mentioned alternative fly control methods (e.g. ducks) seek to restore diversity to the farm, thus preventing fly problems.

Wild species are part of natural biodiversity and may help control livestock insects as well. One introduced bird species found in parts of the southern United States, the cattle egret, can make a dent in fly and grasshopper populations (*The Furrow*, July/Aug 1990). That wild birds may control insects is yet another argument for farm diversity that maintains close ties to the natural world.

Insect-resistant livestock breeds

Some livestock breeds are naturally more resistant to flies and other insects. Tropical breeds of cattle (e.g. Brahman) are known to be more insect resistant. This seems logical since insect numbers tend to be greater where growing seasons are longer. Researchers also suspect that certain animals within breeds are genetically predisposed to being more tolerant of flies, suggesting that we might be able to breed for insect resistance (Dr. John Campbell, UNL livestock entomologist, personal communication, 6/17/92).

Resources for Fly Control

Appropriate Technology Transfer for Rural Areas (ATTRA), PO Box 3657, Fayetteville, AR 72702; Phone: 1-800-346-9140. Offers a comprehensive free packet of information on fly control covering most aspects discussed in this section, including up-to-date sources of parasitic wasps.

A Walk-Through Fly Trap to Reduce Horn Flies on Pastured Cattle. Detailed pamphlet with photos covering a steel-framed version of the Bruce Horn Fly Trap. Copies are available from the Department of Entomology, 263 Hultz Hall, North Dakota State University, Fargo, ND; 58105; Phone: (701) 237-7916

USDA-ARS, LPSI, Livestock Insects Laboratory, Bldg. 177A, BARC-East, Beltsville, MD 20705; Phone: (301) 344-2974. Plans for baited, fluorescent-light and sticky-pyramid fly traps are available; based on the work of Dr. Lawrence Pickens.

"Walk-Through Trap to Control Horn Flies (Diptera: Muscidae) on Pastured Cattle," by Dr. Robert D. Hall and Kathy E. Doisy, 1989, *Journal of Economic Entomology*, Vol. 82, No. 2. These researchers revived the use of the Bruce Horn Fly Trap. This article includes references to the original use of walk-through fly trap technology.

Walk-Through Trap to Control Horn Flies on Cattle. Detailed pamphlet with photos covering a wooden-framed version of the Bruce Horn Fly trap. Copies are available from the University of Missouri- Columbia, Extension and Agricultural Information, 1-98 Agriculture Building, Columbia, MO 65211; Phone: (314) 882-8199.

NOTE: ***The ambitious information seeker may wish to consult old USDA Yearbooks of Agriculture and technical bulletins, as well as old agricultural textbooks. The pre-WW II (pre-chemical) era spawned a multitude of non-chemical approaches to insect control. Unfortunately, much of this work was dropped with the advent of insecticides. Only now are we beginning to revisit this early innovative work.***

Table 1. 1989 Fly Trap Experiment No. 1

Farm		L. Lange	M. Lange		
Treatment		Control	Fly trap		
	Date	Flies/side[1]	Flies/side[1]	% Control	P[2]
	Jun 2	24	9	63	.001
	Jun 6	41	10	76	.001
	Jun 14	63	16	75	.001
	Jun 21	37	13	65	.001
	Jun 27	59	7	88	.001
	Jul 6	52	12	77	.001
	Jul 11	40	16	60	.001
	Jul 19	36	11	69	.001
	Jul 25	26	8	69	.001
	Aug 1	10	8	20	.001
	Aug 8	26	7	73	.001
	Aug 15	17	7	59	.001
	Aug 22	20	6	70	.001
	Sept 1	37	9	76	.001
	Sept 16	44	15	66	.001
Average		35	10	71	

1. Actual average horn fly count per side for 25 cows.
2. Data were converted with $\log_{10}$ of n+1 for statistical analysis. Statistical differences in fly numbers by date were determined using Student's t-test (T.M. Little and F.J. Hills. 1978. Agricultural Experimentation. John Wiley & Sons. pp. 38-39). Probability level (P) is reported as the chance that the number of flies was not different between treatments. (Example: P=.001 signifies that on Sept 16 there is only one chance in one thousand that 44 and 15 are the same.)

Table 2: 1990 Fly Trap Experiment (1989 experiment No. 1 repeated)

Farm		L. Lange	M. Lange		
Treatment		Control	Fly trap		
	Date	Flies/side[1]	Flies/side[1]	% Control	P[2]
	Jun 13	33	8	76	.001
	Jun 18	53	6	89	.001
	Jun 26	75	5	93	.001
	Jul 2	67	9	87	.001
	Jul 11	36	3	92	.001
	Jul 16	44	5	89	.001
	Jul 24	48	4	92	.001
	Aug 1	60	5	92	.001
	Aug 13	94	5	95	.001
	Aug 27	123	9	93	.001
	Sept 10	169	11	93	.001
Average		73	6	92	

1. Actual average horn fly count per side for 25 cows.
2. Data were converted with $\log_{10}$ of n+1 for statistical analysis. Statistical differences in fly numbers by date were determined using Student's t-test (T.M. Little and F.J. Hills. 1978. Agricultural Experimentation. John Wiley & Sons. pp. 38-39). Probability level (P) is reported as the chance that the number of flies was not different between treatments. (Example: P=.001 signifies that on Sept 10 there is only one chance in one thousand that 169 and 11 are the same.)

Table 3: 1989 Fly Trap Experiment No. 2

Farm		D. Pfanstiel	G. Young		
Treatment		Control	Fly trap		
	Date	Flies/side[1]	Flies/side[1]	% Control	P[2]
	Jun 2	33	29	12	.100
	Jun 6	29	21	28	.100
	Jun 15	31	18	42	.005
	Jun 21	27	16	41	.025
	Jun 27	41	12	71	.001
	Jul 6	39	13	67	.001
	Jul 11	41	19	54	.001
	Jul 19	40	13	68	.001
	Jul 25	31	8	74	.001
	Aug 1	26	11	58	.001
	Aug 8	27	5	81	.001
	Aug 15	24	4	83	.001
	Aug 22	23	9	61	.001
	Sept 1	32	10	69	.001
	Sept 16	32	7	78	.001
Average		32	13	59	

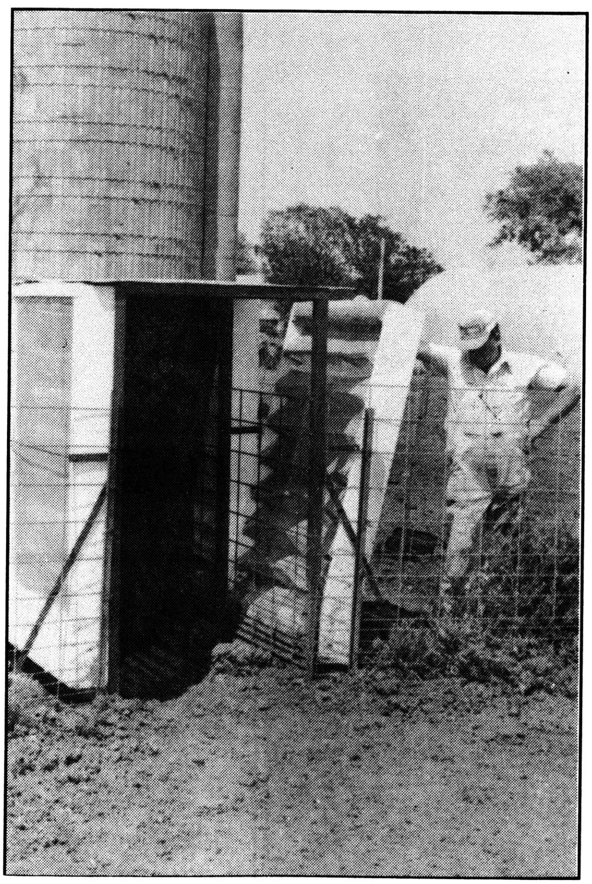
1. Actual average horn fly count per side for 25 cows.
2. Data were converted with $\log_{10}$ of n+1 for statistical analysis. Statistical differences in fly numbers by date were determined using Student's t-test (T.M. Little and F.J. Hills. 1978. Agricultural Experimentation. John Wiley & Sons. pp. 38-39). Probability level (P) is reported as the chance that the number of flies was not different between treatments. (Example: P=.001 signifies that on Sept 16 there is only one chance in one thousand that 32 and 7 are the same.)

FARM FOCUS:

The *Marvin & Evelyn Lange* farm – The idea of trapping flies has many applications

Marvin and Evelyn Lange run a diversified, 240-acre, 40-cow Grade B dairy farm near Fordyce, in northeastern Nebraska. The Langes are always searching for ways to do "more with less" on their farm and are concerned about the negative health effects of using pesticides.

In cooperation with the Center for Rural Affairs, other local farmers and a local welding shop, Marvin built a steel-framed walk-through fly trap similar to the North Dakota design (see resources). The trap was built with a combination of new and used materials, costing about $300. Marvin used tin from old water heaters for the roof and instead of canvas flaps inside the trap, he installed a lighter-style of used carpet.



Each of six trap elements is removable.

On May 1, 1989, the Langes' Holsteins began passing through the trap frame as they went to and from the pasture. On May 9, Marvin installed the screened trapping elements on the sides of the trap. He delayed installing the elements for eight days to allow time for the cows to become acquainted with the trap. He gradually added carpet strips in order to accustom cows to passing through the trap without seeing light on the other side.

On a weekly basis, Center for Rural Affairs staff monitored horn fly, stable fly and face fly numbers on the cows between June 2 and Sept. 16, 1989. They utilized standard fly counting procedures as recommended by livestock entomologists. The fly numbers on Marvin and Evelyn's dairy cows were compared with those on a pastured dry herd of Holsteins on the farm of Marvin's brother, Linus Lange. Linus, who lives a quarter-mile away, used no form of fly control whatsoever. Table 1 shows the results of the 1989 fly counts. The trap's control of horn flies varied from 20% to 88% on 15 dates with an average control of 71% for the season. Fly populations never exceeded 63 per side throughout the season, even with no fly control on the control herd.

In 1990, fly counts were taken on 10 dates between June 13 and Sept. 10 (Table 2). Results varied from 76% to 95% control of horn flies with a season average of 92% control over the comparison herd with no fly control. Toward the end of the season, fly numbers on the herd with no fly control rose to 169 flies per side, and the cows were obviously being bothered. The cows belonging to Marvin and Evelyn consistently had a very low number of horn flies throughout the season. That the cows started passing through the trap in late April with all trapping elements and screens installed seemed to have an effect on adult horn flies early in the fly season and lowered breeding populations of horn flies for the entire season.

"The cows aren't always fighting flies now," said Marvin. "They're more content."

Marvin believes he gets a 5% to 10% increase in milk production by following his horn fly control program.

He hasn't reported any problems using the walk-through trap. His cows became accustomed to using the trap within one week. Eventually, the cows liked the trap so well they started stopping inside on the way through to do a complete job of fly removal.

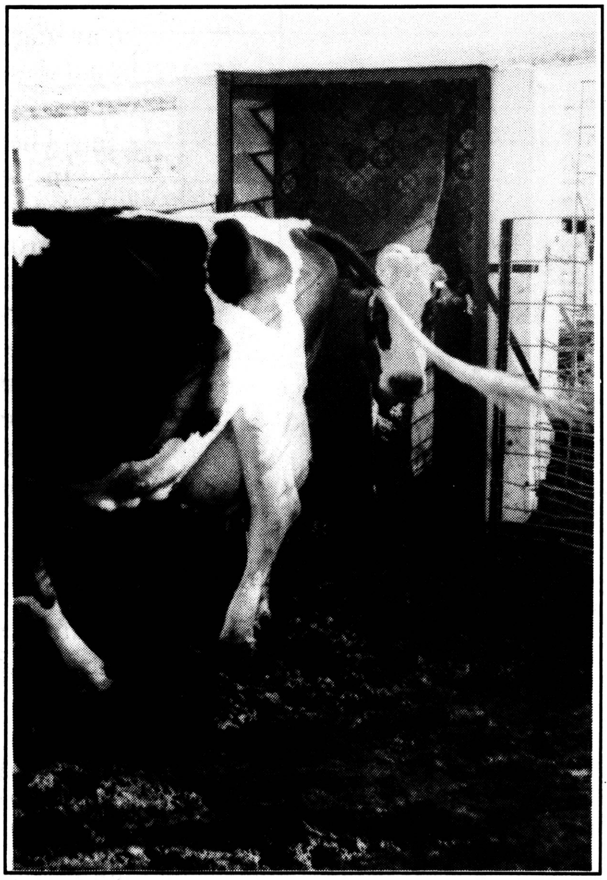
The trap has been relatively maintenance free. Only in the fourth year of the trap's use did the Langes need to replace some of the carpet strips inside. The Langes take good care of the trap and store the trapping elements in a protected shed during the fall and winter seasons.

Seeing how the walk-through fly trap captured flies as the cows passed through, Marvin decided to apply the same idea to capturing flies in the dairy barn. The Lange children and Center for Rural Affairs intern, Frank James, built trapping elements to place in the windows of the milking parlor and milk room. These window traps take advantage of a fly's natural tendency to go to the light in the windows of an unlighted barn, thereby getting caught.

"In the morning, when the cows come in, the milking parlor is just buzzing with flies. By the afternoon, it's quiet except in the fly traps," said Marvin. "It beats using fly spray or fly bait all the time, and there's no chemical or spray involved...I don't want to keep buying inputs all the time, there's no end to it."

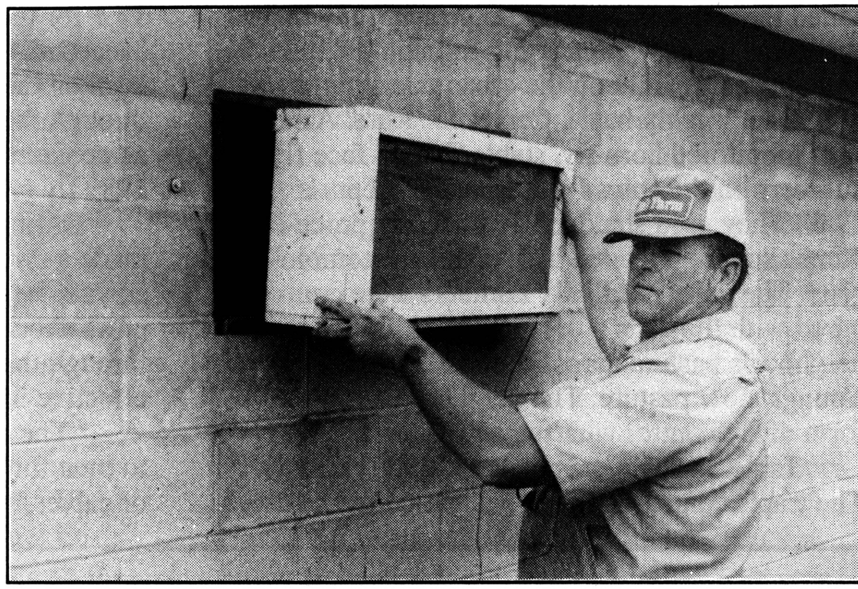
Most of the flies caught in the window box traps are house flies, but a few stable flies also come in the barn and get caught.

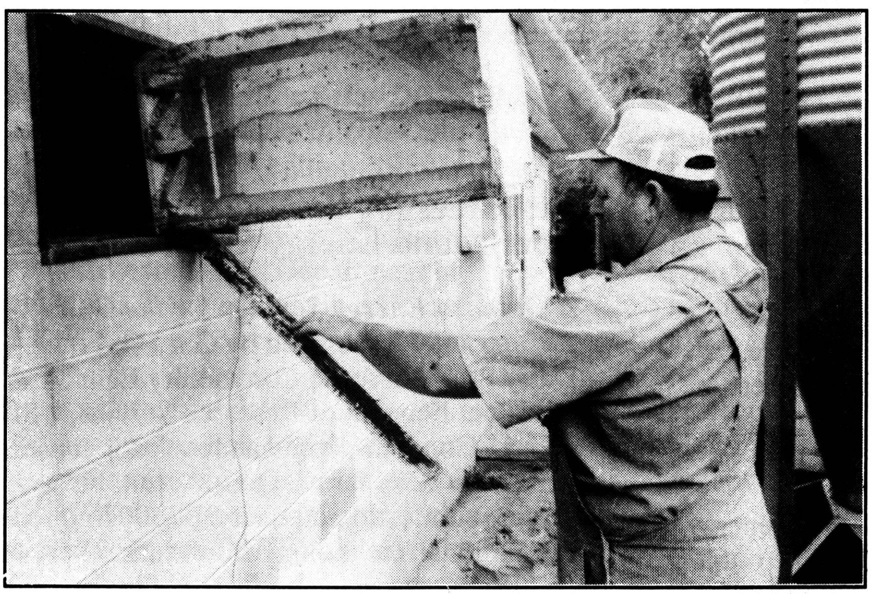
The walk-through and window fly traps are not the only elements of the Lange fly control program, however. The farm's poultry do their share by scratching around the barnyard. The chickens also come running for an easy meal when flies are emptied from the window box fly traps.



Note cow's head emerging through carpet doors as the herd returns from the pasture.

The frame for the window box fly trap is made from 1" by 8" lumber: The outer dimension fits the size of the milking parlor windows.





The bottom of the window box fly trap is detachable to allow for removal of dead flies.

FARM FOCUS:

Homemade trap sheds the flies on the *Gary & Delores Young* farm

Gary and Delores Young operate a 320-acre, diversified crop-livestock farm near Magnet, in northeastern Nebraska.

In 1989, Gary built a wooden-framed version of the walk-through fly trap, similar to those built by researchers at the University of Missouri (see resources). The trap cost Gary less than $300 because he used some scrap lumber for the frame and salvaged corrugated tin for the roof. Used light carpet served for the doors and strips inside the trap. Gary designed the inner width of the trap to be 39 inches – wider than the plans called for to accommodate his large Holstein dairy cows.

Gary started using the trap with the

screened trapping elements on May 9, 1989. He added the carpet doors and strips gradually to accustom the cows to passing through the trap without seeing light on the other side.

On a weekly basis, Center for Rural Affairs staff monitored horn fly, stable fly and face fly numbers on the cows from June 2 to Sept. 16, 1989. They used standard fly counting procedures as recommended by livestock entomologists. The dairy herd's fly numbers were compared with those on a dry herd of Holsteins in a neighbor's pasture across the road from the Youngs' cow pasture. The neighbor used no form of fly control whatsoever.

Table 3 shows the results of the fly counts. The trap's control of horn flies varied from 12% to 83% on 15 dates with an average control of 59% for the season. Fly populations never exceeded 41 per side throughout the season, even on the control herd that was not passing through the trap. Flies may never have reached an economic threshold for control during the 1989 fly season.

During the fall of 1989, Gary and Delores made a switch in their operation from dairy cows to beef cows and sheep. It took the beef cows about a month to get used to passing through the trap. However, Gary felt it was quite effective in reducing fly problems.

"The neighbors needed to get their cows in to treat for pink eye...I didn't need to for cows or calves," he recalled.

Alternatives by and for Farmers

☛ Renewable Energy

The oil price shocks of 1973 and 1978 brought home a basic reality to U.S. citizens: we're addicted to energy. Agriculture shares in this dependence upon fossil fuel energy. While agricultural productivity has doubled since 1950, its energy use has quadrupled (Robert A. Hefner III, "An Econergenic Policy for 21st Century America," June, 1992, p. 10; The Hefner Foundation, Oklahoma, OK).

However, Between 1974 and 1987, energy use in U.S. agriculture fell by 16% while output increased by 20%. Energy conservation has been a major player in making agriculture more sustainable energy-wise.

However, little has been accomplished in the area where agriculture has great potential: renewable resource use. Some potential renewable resources include using legumes for nitrogen in place of petroleum-based fertilizers, crop rotations for pest control in place of petroleum-based pesticides, and time-controlled grazing that allows livestock to harvest their own high quality feed from land protected by grass.

Another option is harvesting the sun's energy directly through solar collectors. Farmers in the Center for Rural Affairs' Small Farm Energy Project did just that, and most continue more than a decade later.

Resources for Renewable Energy and Energy Conservation

A Guide to Energy Savings for the Dairy Farmer (1977, prepared by Gary G. Frank, Dairy Program Area, Commodity Economics Division, Economics Research Service, USDA, 55 pp.) Good, in-depth handbook for conserving energy on dairy farms. Out-of-print, but available as publication number PB270076 through the National Technology Information Service (NTIS), Springfield, VA 22161. Phone: 1-800-553-6847. Cost: $19.50 plus $4 shipping; or may be available through a library.

Build Your Own Solar Water Heater, by Stu Campbell with Doug Taff (1978, Garden Way Books). Very readable and includes extensive drawings and illustrations. Out-of-print, but possibly available through a library.

Cutting Energy Costs – the 1980 Yearbook of Agriculture (1980, USDA). Contains "An Energy-Saving List for Dairy Production" by L.E. Stewart and R.F. Davis (pp. 49-55). A good comprehensive reference for reducing farm energy use and costs. Out-of-print, but available in public libraries.

Energy Efficiency and Renewable Energy Clearinghouse, PO Box 3048, Merrifield, VA 22116; Phone: 1-800-DOE-EREC. Provides free information covering renewable energy and energy efficiency. Specialists are available to discuss technical and financial aspects of renewable energy applications (eg. biogas from manure). NCI Information Systems, a private, for-profit company, provides this service under contract to the National Renewable Energy Laboratory, U.S. Dept. of Energy.

Energy Information Directory – 1994. Free listing of sources for energy information. Updated yearly. Available from the National Energy Information Center, EI-231, Energy Information Administration, Forrestal Bldg., Rm. 1F-048, Washington, D.C. 20585. Phone: (202) 586-8800; e-mail: INFOCTR@EIA.DOE.GOV

Installation Guidelines for Solar DHW (Domestic Hot Water) Systems in One- and Two-Family Dwellings. (2nd edition, 1980, prepared by Franklin Research Center for Div. of Energy and Bldg. Tech. Stds., Office of Policy Development and Research, U.S. Department of Housing and Urban Development in cooperation with U.S. DOE, 112 pp.). Very thorough book on how to set up a domestic hot water system that is used in solar dairy water heating applications. Many drawings, photos, and descriptions. Out-of-print, but available as publication number PB82144676 through the National Technology Information Service (NTIS), Springfield, VA 22161. Phone: 1-800-553-6847. Cost: $27 plus $4 shipping; or you may be able to track down a copy through a library.

National Alternative Fuels Hotline. Phone: 1-800-423-1363. Free information on alternative fuels including ethanol, methane, etc. Service of the National Renewable Energy Laboratories, U.S. Department of Energy.

National Center for Appropriate Technology (NCAT), PO Box 3838, Butte, MT 59702. Private, non-profit organization involved with renewable energy and energy conservation since 1976. Formerly provided energy information and technical assistance through the National Appropriate Technology Assistance Service (NATAS). This service is now provided by EEREC (see above), but NCAT still offers a catalog to order many excellent energy and related publications from its past work.

National Technology Information Service (NTIS), Springfield, VA 22161. Phone: 1-800-553-6847. Sells many out-of-print government documents, such as the energy publications that proliferated in the late 1970s and early 1980s. It will also conduct a publications search for a fee.

Present Value: Constructing a Sustainable Future, by Gigi Coe (1979, Office of Appropriate Technology, State of California, pp. 14-15, 67). Discusses increasing energy efficiency at dairies, solar water heating and dairy heat exchangers (for heating water and cooling milk). Out-of-print, but possibly available through a library.

Small Farm Energy Primer, 1980. This is a summary of the Small Farm Energy Project (1976-1983) of the Center for Rural Affairs. On-farm innovations presented include solar dairy water heating, solar grain drying, fixed and portable solar collectors, methane production from manure, and other strategies and tools that lower farm energy costs. Copies of primer (Cost: $3, plus $1 shipping) and a list of other project publications available from the Beginning Farmer Support Network, Center for Rural Affairs, PO Box 736, Hartington, NE 68739.

NOTE: ***Many states have an energy office based out of their state capitals. For example, Minnesota offers a toll-free number for energy information at 1-800-657-3710. Also, Rural Electric Cooperatives sometimes offer energy conservation support. A few regional energy organizations and local projects exist; consult directories or hotlines to help locate any in your area.***

FARM FOCUS:

Dairy solar water heating on the *Marty & Linda Kleinschmit* farm

When Marty Kleinschmit designed and built his Thermosiphon Dairy Water Heating Solar Collector in late 1979, he didn't know if it would become a valuable asset of the family dairy farm of the 1990s. But Marty is now convinced solar dairy water heating is an effective, cost-saving tool for today's dairy farmer.

"This solar collector can save about 40% of the cost of heating dairy barn water…which amounts to about $20 per month," said Marty, who farms near Hartington, Neb.

Marty's system involves a flat-plate liquid solar collector and a storage tank/heat exchanger. Antifreeze solution circulates through the collector and into the larger of two tanks. The antifreeze then heats a smaller freshwater tank within the large tank. If necessary, the preheated water contained in the small tank is then further heated for use in the dairy (see figure 1).

No pumps are used because the system operates on the principle that hot liquids tend to rise. As the black collector becomes hot from the sun, the antifreeze in the pipes absorbs heat and rises from the top of the collector into the outer storage tank. From the bottom of the tank, antifreeze cooled by the freshwater tank flows into the bottom of the collector to be warmed again. As the antifreeze continues to make this cycle, water in the freshwater storage tank picks up the heat. The 4:1 mixture of propylene glycol and water should not freeze above -20 degrees F, making winter operation possible.

Construction and safety

Normally, safety considerations would not allow this design for home water heating systems because antifreeze might leak into the inner tank and affect the home drinking water supply. Most safety codes require two metal surfaces separating antifreeze from potable water. However, Marty incorporated a safety feature into the system. The propylene glycol is classified as a non-toxic (marine-type antifreeze) that is biodegradable and will not contaminate water supplies.

The collector plate was made from special tubing designed for solar collectors. The 5 foot long copper tubes have copper fins which are electronically treated with a black finish. The half-inch tubing is soldered to 1 inch tubing to form the 5' by 8' collector. Corrugated phylon fiberglass covers the collector. A layer of common household aluminum cooking foil lies behind the copper tubing to reflect heat and 3 inch fiberglass insulation lies behind the foil to keep the heat produced on the inside of the solar collector box. The collector box is made from treated 2" by 6" lumber.

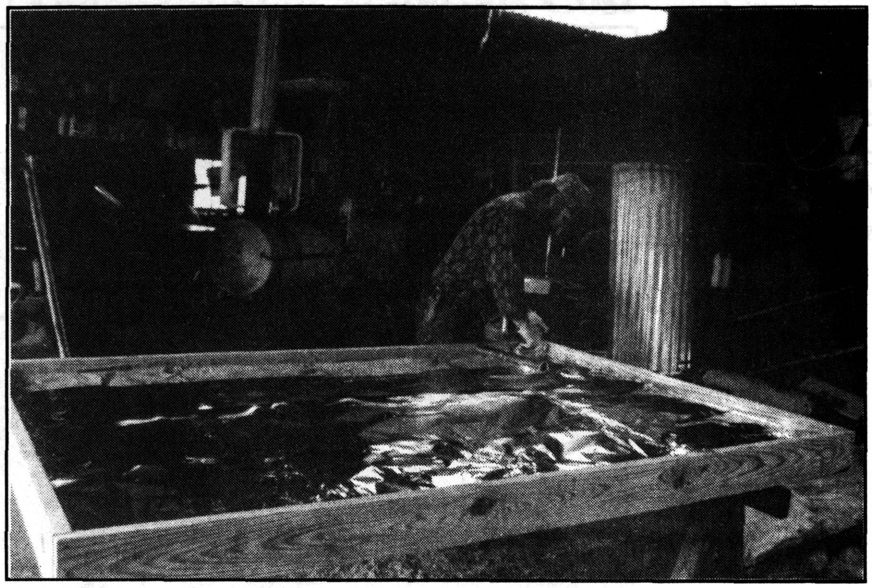
Marty built his storage tank/heat exchanger from 50- and 80-gallon water heater tanks salvaged from the local area. He cut the top out of the 80-gallon tank so the 50-gallon tank would fit into it. The seam was sealed with an epoxy body putty for cars to seal heat and steam in while keeping dirt out. Fittings to connect the outer tank with the flat plate collector were installed at the top and bottom of the outer tank. Because the 50-gallon freshwater tank came from a water heater, fittings for cold-water inlet and hot-water outlets were intact on the top of the tank.

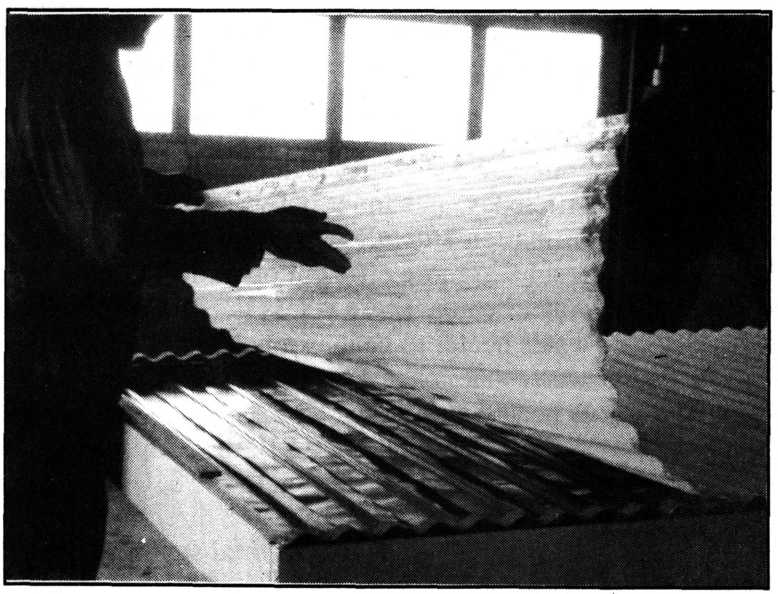
"If building the water storage tank over again, I would use a non-corrosive inner tank such as stainless steel," said Marty. "I have not had problems with the present tanks; however, this would be an added safety feature."

The total cost of the collector was $750, but Marty said it could be constructed cheaper using old vehicle radiators or air-conditioning condensers for the collector plate or old boilers for the water storage tanks. The key is to keep the inside of the solar collector box airtight so dust and dirt do not settle on the copper fins and watertight so corrosion will not occur.

Marty calculates that the pay-back time for the collector when it was first built and most efficient was a little over four years (see table 1). The 1992 reconstruction was needed because the original collector box was not made from treated lumber, nor did the box have a metal flashing to direct water from the top. Water did not leak into the collector, but wood rot did develop on the two bottom and top corners where water was able to soak in.

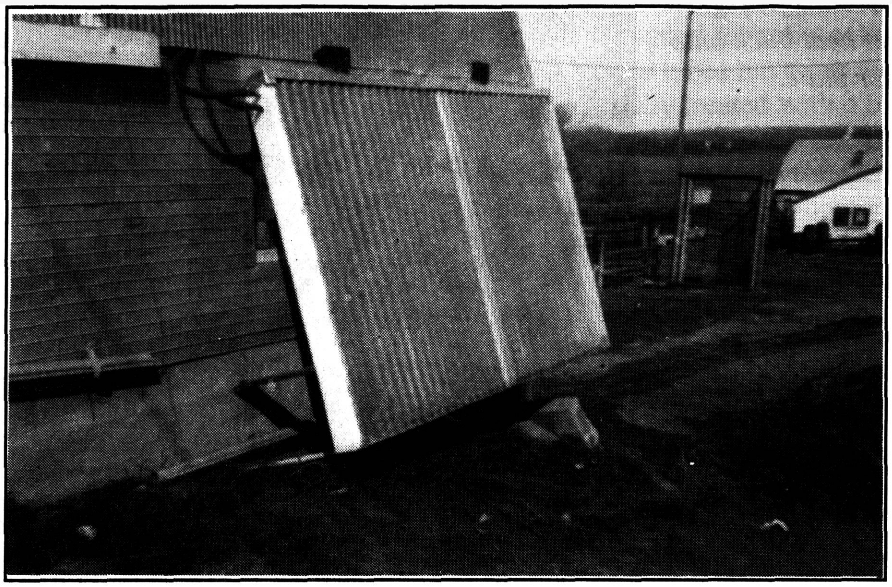
Aluminum foil covers the fiberglass insulation to reflect heat back onto the copper collector plate.





The copper collector plate with its fins is covered by phylon fiberglass, thus allowing solar heating to take place.

The solar collector in place and tilted to absorb more summer sun.



Operating results

To find out how well the collector continued to work, Marty kept track of temperatures before morning and evening milkings during the month of April, 1992.

His data showed that on an average sunny day the collector harvested a little over 28,000 BTUs of energy, and on cloudy days it harvested a little over 10,000 BTUs of energy. Therefore, the collector is about 43% efficient on sunny days, which is considered excellent for solar collectors. Marty pays an average of 5 cents a kilowatt hour for his electricity. So on a sunny day the collector earns about 40 cents, totaling around $12 a month, or about 22 cents on a cloudy day, totaling around $7 a month. If on average the collector saves $10 a month in electricity costs, then it will take approximately 13 months to pay for the 1992 repairs (see table 2).

In addition, the storage system for the collector-heated hot water adds overall system efficiency. The inner hot water tank and the insulation around the complete storage tank unit results in more efficient operation of the electric water heater. There is less need for the electric water heater to heat as much water and the water that is heated by the electric water heater is heated less often. This second "system efficiency" accounts for a $10 monthly savings in water heating in addition to the $10 savings in electricity from water heated directly by the solar collector. Thus, the total savings is $20 per month.

Figure 1

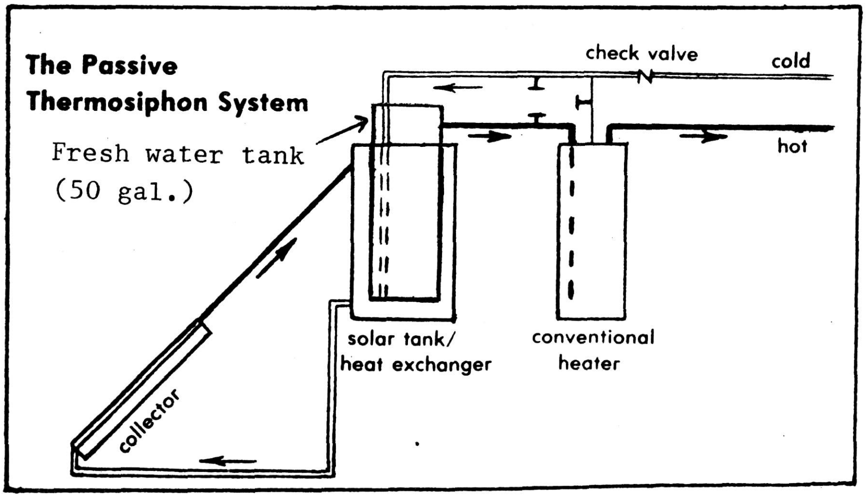


Table 1 (1979)

Thermosiphon Materials Cost

Copper tubing & fittings	$275.50
Two tanks (salvage)	$150.00
Propylene glycol	$141.00
Insulation	$20.00
Lumber & fiberglass	$104.00
Miscellaneous materials	$70.00
Total cost	$740.00

Table 2 (1992)

Thermosiphon Repair Materials Cost

Lumber (treated 2" by 4"	$95.00
Aluminum foil	$4.00
New insulation	$8.00
New antifreeze (4 gallons)	$14.00
Miscellaneous materials	$10.00
Total cost	$131.00

General Resources

An Agriculture That Makes Sense: Profitability of Four Sustainable Farms in Minnesota. This is a case study that examines in detail the methods used by four crop and livestock farms to obtain profit margins that are as much as three-times those of their larger neighbors. Management intensive grazing and low-cost facilities play major roles in all of these operations. To order, send $5 (add $2.90 shipping & handling for the first book, $1 for each additional copy; MN residents add 6.5% sales tax) to: LSP, 2200 4th St., White Bear Lake, MN 55110; Phone: (612) 653-0618. A follow-up case study, ***Profitability of a Sustainable Hog and Beef Farm in Minnesota*** can be ordered from the same address for $4.

Appropriate Technology Transfer for Rural Areas (ATTRA), PO Box 3657. Fayetteville, AR 72702; Phone: 1-800-346-9140. ATTRA is a governmental service that provides informational packets on topics related to sustainable and alternative agriculture. This information is up-to-date and covers a broad range of sources. This is the easiest, cheapest and most thorough way to research a topic of choice. Responses generally take two to four weeks.

Center for Holistic Resource Management, 5820 Fourth St., NW, Albuquerque, NM 87107; Phone 1-800-654-3619. A non-profit organization providing training and support to people practicing Holistic Resource Management, a goal-oriented process for managing people, land and finances. Many people around the world are finding Holistic Resource Management useful for improving profitability, productivity and ecological health on farms and ranches. While not specifically a grazing technique, Holistic Resource Management does provide useful guidelines for implementing time-controlled grazing, particularly in low rainfall areas.

The Center offers two useful books – *Holistic Resource Management,* by Allan Savory (1988, Island Press) and *Holistic Resource Management Workbook,* by Sam Bingham (1990, Island Press) – and a quarterly newsletter that updates the Holistic Resource Management process.

Cooperative Extension Service in your state. Innovative extensionists and cooperating farmers are now providing more information on low-cost, sustainable farming practices. Some states are more progressive than others. Contact your local extension office to see what's available in your state.

Healthy Harvest IV – A Directory of Sustainable Agriculture and Horticulture Organizations, 1992. A comprehensive world-wide listing of 1,400 plus organizations, farmer-based and otherwise. An updated version (No. V) is scheduled to come out in late 1995. Available from AgAccess, 693 Fourth St., Davis, CA 95616; Phone: (916) 756-7177; Cost: $19.95, plus $4 shipping.

Resource Audit and Planning Guide. Staff of the Small Farm Resources Project developed this integrated farm management tool in collaboration with northeast Nebraska farm families. It provides forms to guide families through the process of defining their goals, inventory resources, evaluating enterprise options using gross margin analysis (as developed by British agricultural economist David Wallace), and developing a whole-farm plan. Available at the cost of $5, plus $1.50 postage from the Center for Rural Affairs, PO Box 736, Hartington, NE 68739; Phone: (402) 254-6893.

Resourceful Farming: A Primer for Family Farmers, 1987. Contains information on sustainable farming concepts and practices. Developed during the Small Farm Resources Project (1983-1987). Available from the Center for Rural Affairs, PO Box 736, Hartington, NE 68739. Cost: $7, plus $1.50 shipping.

Sustainable agriculture farmer organizations in your state or region. Interacting with other farmers is often the best source for practical sustainable farming information and support. In addition, participating in these organizations can provide much needed moral support for trying new ideas and working out details. ATTRA can provide the contact and address for the organization in your area.