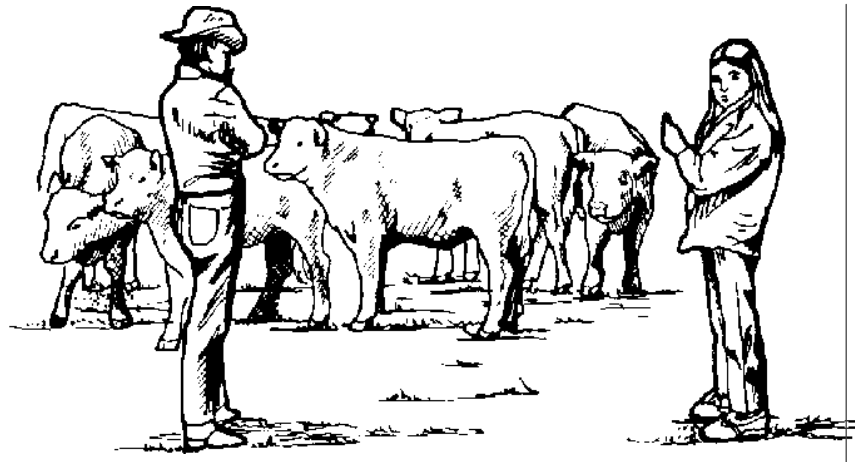
800-346-9140

ATTRA
Appropriate Technology Transfer for Rural Areas

SUSTAINABLE BEEF PRODUCTION

LIVESTOCK PRODUCTION GUIDE

ATTRA is the national sustainable agriculture information center funded by the USDA's Rural Business -- Cooperative Service



Abstract

This publication is designed to serve as an overview of production and management of beef sustainably. It introduces concepts of sustainable beef production, which a farmer or educator can use as a guide to enhance the sustainability of a farm. The two key factors in assessing the sustainability of a farm are profitability and stewardship of natural resources. To be sustained over a short term, the enterprise must be profitable; to be sustained over a long time period, the management of the natural resources such as soil and water must be considered. Planning a beef cattle program should begin with the whole farm. One way to view cattle producers is as grass farmers. The product being produced and sold is "grass", through the cattle.

Consideration of the type of cattle enterprise and the type of cattle which will best fit the resource base is a next step. Another key decision also is determining what product is being sold, as well as where and how. An increased interest in natural beef and organic marketing is allowing some producers to develop niche marketing approaches. Details such as health programs and the everyday handling of cattle also impact the management of the operation. There is social concern about the overuse of antibiotics and other products, such as implants.

SUSTAINABLE BEEF PRODUCTION IS:

- ✓ **Stewardship of natural resources**
- ✓ **Profitable**
- ✓ **Addresses consumer concerns about beef production**
- ✓ **Beef producers could be viewed as "grass farmers" in the business of converting plant material into an animal product and harvesting "solar dollars."**
- ✓ **Sustainable beef production uses a whole-systems approach of land, water, energy, labor, technology, and capital management to meet the goals of the ranch and develop diversity and resiliency.**

WHAT'S INSIDE:

Introduction

Sustainable beef production has as its focus the long-term health of the environment, while maintaining the economic viability of the farm and addressing consumer concerns about the beef they eat.

Sustainable beef production optimizes the use of pasture while reducing the dependence on grain and harvested forage. Forage-based production utilizes a feed source not directly available to humans, often on land not suitable for cropping. Cattle, as ruminant herbivores, may be thought of as "solar-powered grass combines," having the ability to convert plant material into high-quality beef for human consumption. Raising grain to feed ruminants requires higher fertilizer and pesticide inputs and consequently, is more energy-intensive and possibly more expensive than pasture. Land that is too erodible for annual cropping can be maintained as permanent sod.

On land suitable for row crops, pasture is sometimes included in a crop rotation plan. Pasture, when properly managed, interrupts the life cycles of annual weeds and other crop pests and builds the soil by adding organic matter. Manure disposal problems are reduced on pasture, since nutrients are naturally spread on the soil and recycled as fertilizer. Sustainable beef production is economically viable. With pasture-based production, costs for chemical inputs (fertilizers, pesticides, and herbicides) are reduced. Since pastured livestock harvest the feed themselves, inputs of machinery and energy are reduced because there is less need to harvest mechanically. Less capital is needed, since pasture, animals, fences, water, and management are the main inputs.

Sustainable beef production emphasizes alternative health practices to keep animals healthy and costs low. Preventative methods are used to reduce pest, parasite, and stress problems. A livestock component diversifies a grain farm, while manure and forages can reduce input costs and soil erosion in cropping systems.

Alternative marketing can increase the economic viability of the beef operation. For example, by marketing a value-added beef product directly to customers, profits go to the producer instead of a middleman. Swings in market prices will not affect a producer who direct-markets as much as one who markets beef conventionally. Value-added markets, such as organic, natural, and grass-fed, are potentially attractive to customers, many of whom are interested in meat products that have been raised in environmentally sound ways and without the routine use of medications and growth hormones.

There is potential to improve the regional economy by processing the beef that is produced locally instead of sending it out of state. Many consumers will, therefore, support locally grown beef.

Sustainable beef production addresses social concerns about food safety and environmental degradation. Many consumers want “lean, clean beef.” The "war" on fat is a major focus in the beef industry and has resulted in leaner beef products. Many consumers fear that livestock
feed additives such as hormone implants and routine use of antibiotics could adversely affect their health. Some even want certified organic beef raised with no pesticides in feed and no synthetic parasiticides. Other consumers want to buy products they believe have been raised in an environmentally sound way.

Sustainable beef production uses a whole-farm systems approach of land, water, energy, labor, technology, and capital management to meet the goals of the farm or ranch and develop diversity and resiliency. In an integrated system, animals and plants are adapted to the site and operation goals, records are kept to measure progress, and marketing fits with the skills and interests of the ranch.

Controlled grazing

A common type of grazing in the U.S. is continuous grazing, characterized by animals having unrestricted access to a pasture. However, animals soon eliminate the most palatable plant species because they graze them continually. Less desirable plants, on the other hand, are undergrazed and may spread in the pasture. Weeds can become a problem and overgrazing can accelerate erosion as compared to some type of rotational grazing.

A rotational grazing system that results in more efficient use of pasture is controlled grazing or management-intensive grazing (also referred to as MIG or rotational grazing). In controlled grazing, pastures are divided into smaller paddocks. The stock graze the forage
down to a pre-determined level and then are moved to another paddock, not returning to the first paddock until the plants have regrown to the desired height. Stocking rate can be increased and pounds of meat per acre are increased. One study has shown that when steers were rotated through 10 paddocks, the land supported 41% more steers per acre, compared with continuous grazing (1).

Controlled grazing systems have initial costs of electric fencing and watering facilities. Cattle become trained to electric fences and frequent paddock changes. Water needs to be accessible from every paddock. Alleyways give animals access to one water source from several paddocks placed side by side. Many producers do not let their cattle in ponds or streams due to contamination with excrement and muddy banks, or they limit access with fencing. Some watering systems use electricity, solar, or wind pumps to pump water to a central holding tank, and gravity carries it to other tanks. Above-ground pipes and portable waterers can create flexible, moveable water systems. For further information on fencing and watering in rotational grazing systems, request ATTRA's publication *Introduction to Paddock Design and Fencing and Water Systems for Controlled Grazing*.

The ATTRA publication *Rotational Grazing*, available upon request, provides information on paddock layout, grass growth cycles, and books and other resources for rotational grazing.

Sustainable pasture management

Improving the management of an existing pasture may be more cost effective than establishing a new one, since seed, tillage and weed control are expensive. Also, it is possible that many pasture problems--such as sparse plant cover, weed invasion and slow growth--are caused by current grazing management. When rotational grazing is used, plant species that have not been present in the past may begin to grow.

Managing fertility is important in sustainable pasture management. When animals graze, nutrients are returned to pastures in the form of manure. Rotational grazing systems can be designed to distribute the manure more uniformly than continuous grazing. In any grazing system, cattle tend to congregate at watering and mineral feeding areas and shade; these areas can become "nutrient sinks."
Various plants contribute to soil fertility as well. If legumes are present, they can increase the total nitrogen content of the soil because they can convert the nitrogen in the air into a form that they can use. Deep-rooted plants bring up nutrients from lower soil profiles.

Extending the forage season is important in sustainable pasture management. Feeding hay and silage is expensive compared to grazing due to labor and machinery costs, but conserved forage for the dormant season is needed in most parts of the country. Also, in rotational grazing systems, since it may not be possible to graze all the spring growth when it is most palatable, the forage may need to be harvested to ensure good quality later in the grazing season.

For more information, request the ATTRA publication *Sustainable Pasture Management*.

Matching forage and livestock resources

Matching animal production and forage production makes effective use of pasture resources. For example, stocker cattle may require higher quality forage than cow/calf herds; however, this depends on the level of milk production of the cows.

Forward grazing, a practice that increases pasture efficiency, involves grazing animals with higher nutrient requirements, such as stocker cattle first, so that they have a high intake of quality forage. Animals requiring a lower level of nutrition, such as non-

lactating cows, are grazed second. Calves are sometimes allowed to creep graze high-quality forage ahead of the cows to provide extra nutrition.

Matching the reproductive cycle of the cow to forage production by calving in the spring instead of the winter takes advantage of lush spring forage growth at a time when the cow needs maximum nutrition. Calf health benefits from the warm, dry ground compared to the mud and cold of late winter. However, calving in the spring may require the cows to be bred back later during the summer slump when forage production is low and offers less nutrition. It may also require the calves to be sold at the lowest point in the annual market cycle. Refer to ATTRA's publication *Matching Livestock and Forage Resources in Controlled Grazing* for more information.

Multispecies grazing can increase net return per acre, since cattle, sheep, and goats do not eat exactly the same types of plants. Cattle tend to graze grasses, sheep eat grass and forbs (herbaceous plants), and goats prefer browse (leaves, stems, and twigs). The addition of goats to a cattle operation is a viable option; goat meat is lean and market demands for it have been increasing. When sheep are bonded to cattle, sheep losses to predators decrease. Another benefit of multispecies grazing is parasite control; however, including sheep or goats in a cattle operation will require extra fencing and management costs. ATTRA can provide further information on multispecies grazing.

The ATTRA publication *Meeting the Nutritional Requirements of Ruminants on Pasture* addresses the impact of grazing management on nutrition, supplemental feeding on high quality pasture, and feed budgeting to efficiently manage pasture. Further information is also provided on matching livestock and forage resources.

Alternative feeds

Millions of tons of crop residues have potential as feedstuffs. Low-quality crop residues such as straw and stover may be treated with ammonia (urea is a source) or alkali to improve digestibility of fiber and protein. Cattle can derive considerable feed value in the winter from grazing the residue left in the field after corn harvest, particularly from spilled grain and husks. Cash crops (soybeans, wheat, millet, etc.) spoiled by bad weather may be utilized as well.

By-products can be used as feedstuffs in sustainable beef production. Cereal milling by-products (grain screenings) and wheat milling by-products (bran, middlings, mill run, shorts) are useful cattle feeds. Food processing and industrial by-products include molasses, reclaimed bakery products such as bread and cookies, beet pulp, dried citrus pulp, and vegetable canning by-products. Cull vegetables (onions, carrots) have even been fed. Sources of protein for livestock are distillery and brewers' grain and fishmeal; corn gluten feed is a good source of by-pass protein and digestible fiber (2).
Alternative feeds such as roots and tubers (sugar beets, mangels, sweet potatoes, turnips) can be produced on-farm and fed or grazed for their energy content or nutritious greens. Lesser-known grains such as amaranth and buckwheat are also sometimes used. The annual reference issue of *Feedstuffs* (3) magazine lists the nutrient makeup of many nontraditional feeds useful in ration-balancing.

Resource management

Working with available on-farm resources instead of high capital inputs helps to reduce risks and increase profit margins. For example, an alternative to owning expensive heavy machinery that only sees occasional use is to borrow or rent machinery or services. Leasing land instead of buying it presents an opportunity for young people to get into ranching.

Management programs, such as SPA and Integrated Resource Management, are helpful for record-keeping and evaluating an operation. These functions are vital to judge the economic health of the operation and to measure progress towards goals.

Holistic Management is a decision-making process that promotes the establishment of a single holistic goal, which includes quality of life, plans for income generation, and the future vision for the land. The

holistic practitioner considers the effects on the goal of daily and long-term decisions. Contact Alan Savory's Center for Holistic Management (4) for more information.

Breed selection

Producers should choose a breed that matches the needs of the operation and the market they will be selling to. Instead of raising feed to support a particular type of cattle, a rancher should choose a breed that effectively uses the forage the land can economically produce. Choosing a breed adapted to an area helps lower inputs. Some breeds show heat tolerance and parasite resistance; others tolerate cold.

Producers can select for traits in the herd, such as fertility, mothering instincts, parasite resistance, and performance on forage. In the past, a few production traits, such as heaviest calf weaning weight, have been emphasized for breed selection. An optimal cow includes a balanced variety of traits: a very fertile, moderate-sized crossbred cow. Strict culling of cows that do not fit the operation's standards can improve the herd, its adaptation to a particular farm and environment, and, ultimately, profitability.

Producers interested in animals that can produce well and finish on forage should look for a bull that has been performance-tested on forage instead of on grain. The South Mississippi Forage Bull Test Sale (5) has tested bulls on forage.

Health

Preventative management for health

Proper nutrition, reduction of stress, sanitation, and culling of problem animals help maintain a herd in good health, which can increase resistance to disease and pests. Although some producers do not vaccinate, most give vaccinations appropriate for the geographic area and according to regulations.

The American Holistic Veterinary Medical Association (6), can refer ranchers to veterinarians who specialize in homeopathic treatments of large animals. ATTRA can provide more information on this subject.

Low-stress handling

Stress can result in disease and weight loss, reduces the value of meat, and interferes with reproduction. Stress occurring during handling and shipping may trigger respiratory disease. Stress occurring in feedlots, as unacquainted animals are concentrated together, may result in lower gains. Since cattle are herd animals, they have a social dominance order that is disturbed when new animals are added to the group. Stress prior to slaughter is thought to cause "dark-cutters," meat which is almost purple. Dark-cutters are discounted because they are difficult to sell.

Awareness of flight distance

The "flight distance" is the closest distance a dominant animal of the same species can approach a less dominant one. In cattle the distance is about 2 to 3 body lengths. The flight distance for approaching humans depends on what the animal has experienced in the past with humans. To herd beef animals, if a human approaches a cow on head, she will back up or whirl. If she is approached head on but slightly to the side, she will move to the other side. If she is approached broadside but slightly in front of her front shoulder, she will go backwards; if approached slightly behind her shoulder, she will go forward. To move animals directly forward in a pasture, the herder should be positioned about 20 degrees off to one side and behind the herd (7).

Animal handling to reduce stress is discussed in Burt Smith's book, *Moving 'Em: A Guide to Low Stress Animal Handling* (7). This book covers low-stress handling of animals during herding, loading, shipping and receiving.

Awareness of the "flight zone" that cattle have around them aids in moving cattle with minimum stress. When a person invades the flight zone, cattle will move to escape (see box). Smith has developed a 52-minute

video, "Basic Herding: A Home Study Course (8)," which includes a manual and guide.

Burt Smith and Bud Williams recommend low-stress pasture weaning in which the calves are kept on pasture and nothing changes except that the cows are separated. Calves are not penned up and their diets are not changed. A three-strand electric fence can separate the cows and the calves, which may be put on a fresh paddock adjacent to their mothers. Fence walking and bawling is minimized.

Temple Grandin (9) at Colorado State University is an expert in livestock handling. She designs handling systems that take advantage of natural stock behavior, such as a tendency to move towards light. Her corrals have curved lanes and round pens so cattle cannot crowd together in a corner. Her designs of loading ramps, squeeze chutes, pens, and gates, herd cattle without jerky motions and minimize clanging or loud noises. Her restraining devices have solid sides to prevent cattle from seeing people within the flight zone, and a solid barrier in front of the headgate blocks the view of an escape path. Grandin is author of the book *Corral Designs* (10) and editor of *Livestock Handling and Transport* (11).

Fly Control

Pests affecting livestock include flies (horn, face and stable), ticks, grubs, and lice. Integrated pest management (IPM) is an important strategy for controlling pests with a minimum of pesticide use. IPM combines biological, physical, and cultural techniques to reduce pests to economically tolerable levels.

ATTRA has a publication available called *Alternative Fly Control*. It discusses cultural controls for flies, such as cleaning up moist manure, spilled feed and damp bedding. Parasitic wasps are used as a biological control for flies that affect animals in confinement. Other biological controls include range chickens which pick apart dung pats on pasture and eat fly maggots. Also, dung beetles have been studied for their ability to bury manure piles, thus lowering populations of horn flies and other dung-breeding flies. Physical control includes a walk-through trap for controlling horn flies on pastured cattle, which has been found to be as effective as insecticidal ear tags. Light traps, baited traps, electrical traps, and sticky tapes are useful ways to physically control flies in barns. Least-toxic chemical control is also discussed.

Parasites

Reducing the use of synthetic dewormers on the farm is important to reduce costs and to reduce parasite resistance to dewormers. Taking fecal samples to a vet for examination gives an idea of the parasite load.

Beef cattle are subject to intestinal and stomach worms and coccidia. The brown stomach worm (*Ostertagia ostertagi*) is the most common worm in cattle. This parasite has the ability to seasonally inhibit its maturation inside the animal (towards the end of spring in the South and the end of fall in the North) to avoid unfavorable times on pasture. Parasite populations can build up in the animal and, after the inhibition period, the worms all mature at once and make animals very sick. Producers should be knowledgeable about parasite life cycles in order to provide more effective control. Refer to the ATTRA publication *Integrated Parasite Management of Livestock.*

Least-toxic deworming

Although producers believe that diatomaceous earth (DE) controls internal and external parasites in livestock, it has not been shown scientifically that DE is effective. DE is the fossilized remains of diatoms, tiny sea creatures with microscopic cutting edges. DE is generally fed to cattle in the mineral mix. Theoretically, DE pierces the outer protective layer of parasites and fly larvae in the gastrointestinal tract and manure, respectively.

Other least-toxic alternatives for deworming exist in herbal and folk medicine, in this country and others. For example, garlic has a history as a worm preventative.

Producers may find it necessary to use chemical dewormers. Dewormings should be strategically carried out in order to reduce the number of treatments. Producers should check with their state parasitology specialists to determine the most effective times to deworm cattle in their states. Some research has shown that it is not cost-effective to worm adult cattle at all.

Livestock pests usually develop resistance to pesticides over time, resulting in reduced pest control. Some cattle breeds, such as Brahman, and individual animals show natural resistance to pests.

Inter-species grazing

Rotating livestock species such as cattle and sheep that do not share the same parasites aids in control. One species sanitizes the pasture for the other.

Clean pasture

Clean pasture is pasture that has not been grazed by the host animal (cattle) for 12 months. It may be new pasture, pasture grazed by livestock that do not share the same parasites, or pasture that has been hayed or rotated with row crops. Dewormed animals should be placed on clean pasture if possible to prevent re-infection. Do not move the animals for 24 hours after being de-wormed to allow all dead worms to be passed and lower reinfestation of clean pasture.

Dung-burying beetles help disperse dung pats, reducing the environment for parasites. Free-ranging chickens also help reduce parasites by picking apart fresh dung pats, which dries the pats out faster and destroys a harbor for parasites. Drought controls parasites. Livestock in arid areas have fewer problems with internal parasites, but they are susceptible when moved to areas with heavy parasite loads.

Some individuals and some breeds show more resistance to parasitic infection than others. Selection programs can be designed to take advantage of this.

Wildlife/Environmental concerns

Rangeland evolved with herbivores, and proper management of grazing animals can be beneficial to rangeland health. Grazing is a natural process on rangeland. However, rangelands may still be recovering from misuse in the late 1800's when settlers brought large herds of cattle and sheep. The misuse caused increased soil erosion, loss of desirable plant species, and invasions of weeds (12). Rangeland conditions have been improving since the 1930's due to grazing systems, brush control techniques, and reseeding. The absence of grazing does not mean an automatic improvement in rangelands (13).

It is necessary to protect riparian areas (the natural vegetation near streams) from prolonged cattle grazing. Riparian vegetation keeps stream banks from eroding and prevents nutrients from entering streams and causing pollution downstream. Continuous congregation of cattle around streams can cause the soil to erode from the banks and enter the water, creating conditions detrimental to fish.

Low to moderate grazing at optimal times is not detrimental to riparian areas. On rangelands, late season or dormant periods are optimal grazing periods for riparian areas (14). Fencing and rotational grazing can limit access to streams, and water can also be provided from troughs, ponds, or wells. Some farmers are developing riparian pastures, which are grazed rotationally at times most protective of the riparian zone.

Wildlife and lease hunting can be sources of income on ranches. Wildlife habitat can be improved on a ranch by providing cover for game. Water and salt sources may also attract wildlife. Rotational grazing provided more cover than continuous grazing for bobwhite quail as well as higher beef production in a southwest Texas study (15). Cattle are sometimes grazed in refuge areas in order to improve wildlife habitat by encouraging plant succession and diversity.

Agroforestry combines trees with livestock or crop production. Trees have a role in pastures and range and along permanent fencelines. Trees are multi-purpose, providing shade and shelter from wind,

as well as aiding in erosion control. Trees provide timber, firewood, nuts, fruits, enhanced conditions for wildlife, and livestock forage. Black walnut trees can be intercropped with annuals and, when the trees grow larger and create more shade, with forage. However, haying can become a problem with trees in pastures. With good management and genetic selection, black walnut provides nuts after 10 to 12 years, commercial thinnings at 40 and 55 years, and one of the highest quality timbers after 70 years (16). Livestock are sometimes grazed in forest plantations to control brush and reduce weed competition to the trees.

Social Concerns

A 1991 Food Marketing Institute survey found that 56% of the public were worried that antibiotics and hormones might be present in meat.

Antibiotics inhibit bacteria and are commonly fed in low levels (subtherapeutic) to livestock to increase growth. An article in *The New England Journal of Medicine* suggested that the use of antibiotics in livestock feed can result in the transfer to humans of bacteria (salmonella) strains resistant to antibiotics (17). Antibiotic use in livestock production has not been definitely proven to harm human health, but the issue will continue to be a major one for consumers.

Most feedlot cattle are implanted with hormones to promote growth. Although the FDA limits the amount of added hormone in one pound of meat to be no more than one percent of what a prepubertal boy would naturally produce in a day (18), residuals from improper use remain a public concern.

Other social concerns about beef production include the amount of fat and cholesterol in beef, competition for food resources (i.e. raising grain for beef feed or human food), greenhouse effect and global warming from methane produced by ruminants, the clearing of tropical forests for cattle pastures, and degradation of rangelands by poor grazing management practices. The book *Impacts of Livestock Production on Society, Diet/Health and the Environment* (19) addresses these issues.

Marketing

Beef producers who market beef conventionally by selling at sale barns fall prey to low prices brought on by fluctuating cattle cycles. The book *Cowboy Marketing* (20) describes how to increase profits within the conventional channels by producing a more marketable product and by improving marketing skills. The publication *Value-Added Cattle: Guidelines for Cow-Calf, Stocker, Feeder* discusses how value can be added when selling to feedlots or packers. Value is created when a product meets or exceeds the customer's expectations every time (21). A value-added product needs to be marketed to a customer who appreciates the value. Value can be added conventionally by retained ownership, improving the carcass value, and ranch-to-rail programs that inform a producer about the performance of his/her cattle in the feedlot and the eating quality of the meat.

Value can also be added by creating specialty products sold in non-conventional ways such as direct marketing. Niche markets (lean, "natural," organic, humane, "green," pasture-finished, etc.) are useful because many consumers are willing to pay a premium for
specialty beef. Please see the ATTRA publication *Alternative Beef Marketing* which discusses value-added beef , niche markets, and direct marketing.

Further resources

In the information era, acquiring knowledge is an asset for generating wealth. In addition to the materials already mentioned in this publication, other useful periodicals, books, organizations, and workshops can provide information.

The Stockman Grass Farmer (22), published monthly, has many informative articles about turning grass crops into money through livestock, as well as notices of conferences and other resources. A monthly section, "The Grass Farmer's Bookshelf," features the major books on grazing, as well as videos and audios. *Pasture Profits with Stocker Cattle* (23) , by editor Allan Nation, offers innovative suggestions for increasing profits with stockers.

The Noble Foundation (24) and the University of Missouri's Forage Systems Research Center (25) are examples of organizations that offer grazing information and workshops. The Kerr Center for Sustainable Agriculture (26) practices rotational grazing, multi-species grazing, and alternative parasite control for cattle. There are many other organizations and local, grass roots groups which promote grazing, sustainable beef production, and alternative marketing.

Refer to conventional publications on beef production for specific information on topics such as reproduction, artificial insemination, fertility testing of bulls, pregnancy checking, culling, castration, dehorning, branding or eartagging, etc.

Summary

Sustainable beef production uses a whole-system approach of resource management to meet the goals of the ranch. Optimizing the use of pasture while reducing feed grain and harvested forage lowers inputs and is ecologically sound. Sustainable beef production addresses social concerns about food safety and environmental degradation. Preventative methods to reduce pest, parasite, and stress-related problems and alternative marketing can increase the economic viability of the operation.

In addition to the ATTRA publications listed throughout the text, ATTRA has a beef cattle farm sustainability checksheet that can be used to assess the sustainability of a farm. It is comprised of over 200 questions and can be requested through the office.

References:

1) Anon. 1993. Moving pastures. Science of Food and Agriculture. January. p. 6.

2) Cheeke, P.R. 1991. Applied Animal Nutrition: Feeds and Feeding. Macmillan Publishing Company, New York, NY. 504 p.

3) Feedstuffs
Circulation Manager
P.O. Box 37183
Boone, IA 50037
800-888-7580

4) Alan Savory's Center for Holistic Management
1010 Tijeras Avenue NW
Albuquerque, NM 87102
800-654-3619

5) Frank Holmes, Test Manager
565 Stallings Bridge Rd.
Tylertown, MS 39667
601-876-5204

6) American Holistic Veterinary Medical Association
2214 Old Emmorton Road
Bel Aire, MD 21015
410-569-0795

7) Smith, B. 1998. Moving 'Em. A guide to low stress animal handling.
The Graziers Hui
PO Box 1944
Kamuela, HI 96743 352 p. $24.95

8) Basic Herding: A Home Study Course Video
Burt Smith
P.O. Box 1944
Kamuela, HI 96743
808-883-9271
$98.50 includes video, manual, and guide.

9) Dr. Temple Grandin
Department of Animal Science
Colorado State University
Fort Collins, CO 80523

10) Grandin, Temple. Corral Designs. Colorado State University, Fort Collins, CO. 60 p.

11) Grandin, Temple (ed.). 1993. Livestock Transport and Handling. CAB International. 350 p. Order from:
CAB International North America
University of Arizona
1230 N. Park Ave., #102
Tuczon, AZ 85719
800-426-3797

12) Sharrow, Steven H. 1994. Sheep as a silvicultural management tool in temperate conifer forests. Sheep Research Journal, Special Issue: 1994. p 97.

13) Havstad, K.M. 1994. Sheep grazing as a range improvement tool. Sheep Research Journal, Special Issue: 1994. p. 72.

14) Glimp, Hudson A. and Sherman R. Swanson. 1994. Sheep grazing and riparian and watershed management. Sheep Research Journal, Special Issue: 1994. p. 65.

15) Campbell-Kissock, L., L.H. Blankenship, and L.D. White. 1984. Grazing management impacts on quail during drought in the northern Rio Grande plain, Texas. Journal of Range Management. Vol. 37. p. 442.

16) Brusko, Mike. 1988. Have your woodlot and harvest it too. The New Farm. February. p. 26, 41.

17) Spika, J.S. et al. 1987. Chloramphenicol resistant salmonella newport traced through hamburger to dairy farmer. New England Journal of Medicine. Vol. 316. p. 565.

18) Herman, R. 1989. Steroids in your hamburger. Washington Post Health. January 10. p. 11.

19) Cheeke, Peter R. 1993. Impacts of Livestock Production on Society, Diet/Health and the Environment. Interstate Publishers, Danville, IL. 241 p.

20) Nixon, Jay. 1995. Cowboy Marketing. Jay Nixon, Karnes City, TX. 130 p.

21) Coffey, Chuck, Jim Pumphrey, and Jackie Brightwell (ed.). No date. Value-added Cattle: Guidelines for Cow-Calf, Stocker, Feeder. Oklahoma State University, Stillwater, OK. 68 p.

23) Nation, A. 1992. Pasture Profits with Stocker Cattle. Green Park Press, Jackson, MS. 192 p.

24) The Samuel Roberts Noble Foundation
Box 2180
Ardmore, OK 73402
405-223-5810

25) Forage Systems Research Center
RR #1, Box 80
Linneus, MO 64653
816-895-5121

26) The Kerr Center for Sustainable Agriculture
P.O. Box 588
Poteau, OK 74953
918-647-9123

Further Reading:

Baker, F. H., F. E. Busby, N. S. Raun, and J. A. Yazman. 1990. The relationships and roles of animals in sustainable agriculture and on sustainable farms. The Professional Animal Scientist. Vol. 6, No. 3. p 36-49.

Taylor, D. C. and D. M. Feuz. 1993. Beef cattle producer and "sustainability" and "organic" indices. Economics Staff Paper 93-6. Economics Department, South Dakota State University. Brookings, South Dakota. 23 p.

BY ANNE FANATICO, RON MORROW, AND ANN WELLS
NCAT AGRICULTURE SPECIALISTS

AUGUST, 1999

The ATTRA Project is operated by the National Center for Appropriate Technology under a grant from the Rural Business-Cooperative Service, U.S. Department of Agriculture. These organizations do not recommend or endorse products, companies, or individuals. ATTRA is located in the Ozark Mountains at the University of Arkansas in Fayetteville. People may contact ATTRA staff members at P.O. Box 3657, Fayetteville, AR 72702, 800-346-9140.