

## **Balancing the Economical and Social Importance of Ruminants with their Environmental Impact**

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### **Abstract**

The challenge of the past was to enhance total production from animal agriculture via the manipulation of individual animal efficiency. The need to overcome worldwide hunger will continue to be a focus for ruminant agriculture. However, increasing pressure from some consumers, manifested in increasing governmental regulation, will require that food producers allocate resources to meet societal expectations in regards to both real and perceived issues related to 1) the environment, 2) food safety, and 3) animal welfare. In the future, pastoralists will have to evaluate new technologies in light of the impact on the aforementioned issues. Grazing enterprises will play an important role in the development of sustainable agricultural systems, as they are less dependent on mechanization, fossil fuels, and other non-renewable resources.

However, management systems will have to be maintained that are focused on economic effectiveness as opposed to maximization of individual animal performance, better monitoring of forage, land and water resources, and enhanced value attributes as perceived by consumers. In addition, government policy must recognize the value of agricultural land holdings as a means to the enhancement of rural communities, natural ecosystems, and diversified economies. Producers of animal agriculture products, policy makers, and regulators will increasingly be interested in information that assists them in making appropriate decisions in regards to production systems, ecosystems, and community systems.

Keywords: management systems, environmental impact, food safety, animal welfare, economics, culture

### **Introduction**

Agriculture is undergoing a dramatic set of functional changes due to economic, social, and governmental forces. Rising standards of living in the world have allowed more attention to be focused on the health of ecosystems and the establishment of environmental values as a component in decision-making. Despite the fact that human population change is estimated to reach zero population growth by 2100 or sooner (1), tightening of available food supplies as a result of slowed agricultural productivity and rising numbers of humans over the next century will strain the global food production and distribution system.

Lands that are cultivated are approximately the same acreage today as they were forty years ago. Expansion of tillable acreage in some regions is largely offset by reductions in other areas due to development, forestation, loss of soil fertility, or conversion to other uses. Global demand for food will be driven by rising numbers of people and changes in per capita income. About one-half of the calories and 45 percent of the protein consumed by humans are from cereal grains. Animals provide 16 percent of the calories but approximately 37 percent of the protein (2).

Individual animal productivity has largely been the focus of both scientists and agricultural managers over the past century. For example, in the U.S. from 1925 to 1995, carcass weight per breeding cow rose by 126 kgs. During the same time period, milk marketed per cow increased 4,370 kgs. Live weight sold per breeding ewe increased more than 33 kgs. (3).

There are approximately 1.3 billion cattle, 1.1 billion sheep, 709 million goats, 162 million buffalo, 19 million camels, 13 million yaks, and 13 million llamas in the world's animal agriculture system (2). A

majority of these animals spend a significant period if not all of their lives in rangeland environments. The notable exceptions for ruminants would be intensive dairy enterprises and finishing feedlots.

On a worldwide basis, animal products supply 16 percent of human caloric intake and 37 percent of human protein needs. In the United States, farm cash receipts from the sale of livestock and poultry generates \$93 billion worth of revenue (31 billion from cattle and calves, \$23 billion from dairy products, and \$0.56 billion from sheep and wool) (3). In addition to the contribution to food and fiber supplies, ruminant animals provide draft power, insurance against climatic risk such as drought, religious significance, and stores of wealth.

In the future, despite the fact that zero population growth may be achieved within the next century, world food supplies are likely to tighten as a result of continued albeit slower human population growth and limits to increases in crop yields (1).

As consumer incomes rise, the demand for animal products increases. The net effect of this trend is that as levels of affluence rise, the role of animal products in the human diet becomes more important. Increased demand for food will place additional pressure on those lands that are already tilled and in some cases marginal ground will be placed under the plow. Ruminant animals play a critical role in meeting rising demands for food as they can convert high roughage diets into high quality proteins while contributing to sustainable landscapes.

Precise measurement of the benefits and costs associated with animal agriculture is not feasible on a cross-cultural basis. The measures by which benefits are accrued from ruminant animals can only be assessed within the cultural context of a particular society. To do otherwise would be to fall prey to the conflict and loss of cultural integrity that occurs when agrarian systems are viewed from an egocentric point of view. Thusly, this paper will largely reflect a North American perspective.

Despite the multiple benefits from animal agriculture, emerging societal pressures require that production systems must be adapted that acknowledge concerns relative to the welfare of animals, the environment, workers, communities, consumers, and producers (4).

### **Environmental Issues**

The primary concerns relative to the effect of ruminant animals on the environment are as follows – water, manure, odor, urban sprawl, and rangeland health. Perspectives about manure have shifted from one of viewing animal waste as a useful by-product to a perspective of classifying animal waste as a pollutant. Certainly changes in production systems, coupled with the dramatic migration of human beings from farm to urban environments and the concurrent loss of agricultural knowledge, have precipitated these changes. The scale of intensive agriculture coupled with the encroachment of urban sprawl into rural areas has created circumstances where manure management has become highly politicized and hotly debated. Furthermore, the integration of animal enterprises to cropping activities has a significant influence on how manure is viewed.

The potential benefits of incorporating manure into a farm management plan include the following:

- reduced soil erosion
- decreased carbon to nitrogen ratios
- improved cat ion exchange capacity
- increased organic matter
- improved soil structure
- improved nutrient efficiency (5)

One cannot, however, overlook the realized and potential negative impacts resulting from intensive ruminant animal management systems such as large feedlots and dairies. The primary issues arising from

intensive systems (where large numbers of animals are concentrated into a relatively small area) include animal waste management, water quality, and air quality.

Manure management strategies tend to focus on nitrogen, phosphorus, and potassium. The primary factors that contribute to diminished water quality as a result of the decomposition of livestock waste includes pathogens, nitrate, ammonia, phosphorus, salts, and organic salts. Nitrate receives a high degree of attention in waste management plans due to problems associated with run-off from fields where manure has been applied as a fertilizer, direct run-off from confined animal facilities, direct run-off from solid waste storage sites, and the potential of groundwater contamination as a result of seepage.

Ground and surface water contamination occur when manure is incorrectly handled, stored, or applied to land. In an active feed yard, a layer of soil and manure becomes sufficiently compacted to create a seal that serves as an effective barrier against seepage. If the integrity of this sealed layer is assured then water infiltration can be kept to less than 0.05 inches per day (6). It is critical that this compacted layer be left undisturbed during pen cleaning.

Run-off problems can be minimized via employment of Best Management Practices (BMP) such as building up-gradient ditches, dams, grass filter strips, filter fences, and other appropriate controlled drainage systems. Lagoons or ponds may be required to contain wastewater and run-off.

Applying manure or waste water directly to agricultural lands requires thorough knowledge about the following factors associated with a particular site – soil type, slope, irrigation practices, precipitation levels, crop nutrient requirements, nutrient levels of manure, and proximity to waterways or wells. The goal of manure management is essentially to collect, store, and apply wastes to lands at appropriate agronomic rates with the objectives of optimizing crop growth rates, economic returns, and protecting water quality (6). BMP for manure handling are provided in Table 1.

Air quality problems are typically rooted in management of odors from waste as well as dust generated from intensive animal management facilities. Improved facility management and more precious formulation of diets fed to animals can be utilized to reduce ammonia emissions. Feedlots and dairies have successfully utilized sprinkler systems to reduce dust. Additives can be induced into waste lagoons that convert nitrates into nitrites as a means to reduce offensive odors.

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**TABLE 1. Summary of Best Management Practices for Manure Handling, Storage, and Application**

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- ◆ Analyze for nutrient content
  - ◆ Account for available N from the total system
  - ◆ Apply to land areas large enough to accommodate manure volume
  - ◆ Calculate long-term manure loading rates
  - ◆ Maintain records of manure and soil analysis; application volume, timing, and methodology; additional fertilizer applications, and plant yields
  - ◆ Base manure application rates upon site-specific nutrient plans
  - ◆ Incorporate manure soon after application to avoid run-off
  - ◆ Determine application protocol based on soil composition and risk of aquifer contamination
  - ◆ Apply manure uniformly utilizing correct calibration
  - ◆ Utilize buffer zones to prevent water contamination
  - ◆ Use grass stripes to catch and filter nutrients and sediments from run-off
  - ◆ Use rotational application schemes when planting high N use crops or forages
  - ◆ Locate manure stockpiles away from wells
  - ◆ Divert run-off via ditches, terraces, etc
  - ◆ Maintain integrity of manure-soil seal when cleaning feedlot pens
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Adapted from Colorado State University, 1994

One of the most critical challenges to agricultural productivity and sustainability in the future will be excessive regulatory action by government. The regulation of non-point source pollution in the U.S.A. is a case in point. The Clean Water Action Plan, an executive order of Vice-President Gore, creates a massive bureaucratic structure that places impossible burdens on agricultural producers. The plan contains 111 key actions ranging from developing unified watershed assessments to establishing forest transport regulations to creating wetland restoration targets. This plan never received Congressional consideration or underwent public review. It is so sweeping that virtually all land-based activities in the United States will function under new or additional regulation.

While effective monitoring of natural resource health is critical to the future profitability and survival of agriculture, federal mandates that remove local control are unacceptable when they create untenable situations for landowners and resource managers.

Rangeland health is of utmost concern to the sustainability of ruminant animal agriculture. Grasslands have co-evolved with large herbivores across the ages. North America supported approximately 150 million large herbivores (bison, deer, elk, and antelope) as well as countless numbers of small herbivores prior to the influence of Europeans on the continent (7). In this symbiotic relationship the grazing animal benefits nutritionally while the grassland benefits from grazing activity that serves to remove plant material, breaks up mature plants, and tills soil via hoof action (8).

Degradation of grassland ecosystems arises not from grazing but from insufficient or poor grazing management. Furthermore, the greatest threat to the earth's grasslands is from conversion to farmland and urban development. Sixty percent of the Great Plains region of North America, a vast expanse of grassland, has been converted to farmland (9). By comparison the impact of grazing livestock seems relatively insignificant. Nonetheless, the fertility of the earth's soil is of paramount importance. Recent popular press accounts in the United States media have related a report from the Consultative Group on International Agricultural Research that suggests that 40 percent of all agricultural lands are seriously degraded.

There is no question that unrestrained and poorly timed grazing can wreak havoc on rangelands and riparian areas in particular. It is also quite clear that a majority of the damage done to the western rangelands of the United States was accomplished in the late 1800s as a result of the boom of the open range livestock industry. Grazing by domesticated livestock went largely unchecked west of the 100<sup>th</sup> meridian from the 1860s until the passage of the first grazing regulation in 1905. The landmark Taylor Grazing Act didn't become law until 1934. The last half of the 19<sup>th</sup> century can be characterized as a period of habitat damage while the past 80 years can be classified as a time in which range condition has generally stabilized and in most cases vastly improved.

Rangeland ecosystems are controlled primarily by the following factors: 1) variation in topography and soil; 2) variation in climate and weather; 3) grazing activity by herbivores (domestic, feral and wild); 4) fire; and 5) widely variable and diverse impacts by humans (10). Understanding these relationships is not accomplished via simplistic, linear means. "Broad-brush portrayals of the effects of grazing on ecosystems are guaranteed to be wrong" (9). It is unreasonable to assume a consistent or static response from all ecosystems and all components of ecosystems to grazing. Thus, it is very difficult to fully appreciate and deal with management decision-making on an ecosystem basis.

Managers too often find themselves so captured by the crisis of the day that they've lost the ability to see beyond the parts to a view of the whole. "Long-term management approaches should include biological values, as well as economic stability, with incentives to retain skilled stewards intimate with local landscapes. Biological values should be identified, articulated, and monitored. Patience and childlike inquire, rather than instant gratification and answer, should dominate the process. We must be able to act in our own lifetimes while thinking at the pace of plants and mountains" (11).

The loss of agricultural lands to urban development has reached near epidemic proportions in the United States. In the Rocky Mountain region alone, 1.6 million acres of pasturelands were lost per year in the decade from 1987 to 1997 (12). The loss of these lands is not only devastating to agricultural enterprises but also to wildlife habitat, open space, and rural communities. Ever so slowly agricultural interests and environmentalists are beginning to recognize that it is time to lay aside the historical conflicts that have restrained true progress in favor of building consensus to assure that the best decisions are made for the long-term benefit of the land, people, and communities.

The division of the western landscape into 35 acre or smaller housing development parcels is wreaking havoc on the ecosystem. Wildlife migratory pathways are interrupted, noxious weeds proliferate, and watersheds are devastated. And as if to add injury to insult, development rarely pays its way in terms of generating sufficient income to allow local governments to meet the demands of growth. For example, in Custer County, Colorado for every dollar the county receives in taxes from agricultural land and open space, it only costs 54 cents to provide services. On the other hand, for every dollar generated by taxing residential development, it cost the county \$1.16 to provide services (13). Given these scenarios, the value of grazing agriculture, as a cost effective protector of open space and ecosystem integrity cannot be overlooked. "Regardless of previous grazing impacts, critical habitats and open space have been protected for generations by private landowners. Sustainable ranching must include strategies that mitigate grazing impacts on wildlife, but must also strive to keep private landowners on the land. The risk of losing prime wildlife habitat to development is a far greater concern than historical or current grazing practices" (14).

Grazing agriculture is caught in a paradox. On the one hand, society is beginning to recognize the multiple values that originate from pastoral enterprises. On the other, society has not yet demonstrated a willingness to pay for the advantages of these benefits at a level that assures economic viability for pastoralists. However, there are those beginning to suggest that grazing agriculture generates more than traditional commodities (meat, wool, and hides) but also wildlife habitat, open space, and community stability to name a few. At the same time, agricultural and resource managers must increase their efforts to examine and deal with the environmental consequences of agricultural production practices. A statement of stewardship beliefs as articulated by the National Cattlemen's Beef Association is an initial step in addressing these issues (Table 2)

One of the more powerful tools for protecting agricultural lands from conversion to development is the use of conservation easements. These easements can take a variety of forms and can be extended for relatively short periods of time or in perpetuity. State governments, private foundations, community coalitions or individuals can purchase or donate the development rights on ecologically significant tracts of privately owned lands. While not appropriate in every situation, conservation easements lower the taxable value of the land and thus help to assure that these lands can transfer from one generation to the next, cash value is raised when the development rights are purchased, and the use of the resource as an agricultural venture is continued. In the long run, families that have intimate knowledge of these resources remain on the land, wildlife habitat is preserved, open space is maintained, and rural culture is sustained (15).

The time of preserving landscapes from human intervention is long past and we must consider the need to develop functional management strategies for dealing with resource allocation issues. "Humans are now inextricably involved in the management of virtually every inch of land on the planet. Even designating land as wilderness is, after all, a form of management" (16). However, determining the values and outcomes desired from a particular ecosystem will be fertile ground for conflict. Unfortunately, conflict usually results in lost time, diminished landscapes, and missed opportunities for meaningful action. Too often land and resource decisions become political power plays derived on the basis of a short-term need. "Ranching may exploit the earth, but it does so in memorable, important, and deserving ways", wrote geographer Paul Starrs (17). The answers to good management of animal agriculture will not come from government agencies or experts nor from blaming the forces of change, but from the creative energy of people empowered to act in their local communities.

**TABLE 2. Stewardship Beliefs of the National Cattlemen's Beef Association<sup>a</sup>**

**WHEREAS**, productive natural resources are vital for the well-being, not only of the individual farmer, rancher, or feeder, but also for the local, state and national economy and society as a whole. Healthy natural resources provide a healthy watershed and a renewable source of feed for domestic animals and wildlife.

**THEREFORE BE IT RESOLVED** that the National Cattlemen's Association promotes the prudent use of natural resources and offers the following Resource Stewardship recommendations. NCA further recognizes the value and benefit of periodic input and revision to keep the commitment to resource stewardship alive.

**BE IT FURTHER RESOLVED**, that NCA shall not be compelled to defend anyone in the beef cattle industry who has clearly acted to abuse grazing, water or air resources. To achieve these goals, the following environmental stewardship code is recognized by the industry:

- 1 Recognize the environment for its varying and distinct properties.
- 2 Manage for the whole resource, including climate, soil, topography, plant and animal communities.
- 3 Realize that natural resources are ever changing and management must adapt.
- 4 Recognize and appreciate the interdependence of ecosystems.
- 5 Recognize that management practices should be site- and situation-specific, and must be locally designed and applied.
- 6 Recognize that successful management is an ongoing, long-term process and commit to stewardship, economic success and business continuity.  
Strive to develop a management framework that involves family, employees, and business associates so that the entire team is committed to common goals.
- 8 Monitor and document for effective practices.
- 9 Never knowingly cause or permit abuses that result in permanent damage on public or private lands.
- 10 Develop ways to communicate and share the vast practical experience of other resource stewards.
- 11 Become involved in organizations that provide an effective way to educate and support individuals.
- 12 Select input from a variety of sources on a regular basis as a means to improve the art and science resource management.
- 13 Help develop public and private research projects to enhance the current body of knowledge.
- 14 Recognize that individual improvement is the basis for any change.
- 15 Communicate with diverse interests to resolve resource management issues.

<sup>a</sup> Adopted by the membership of the National Cattlemen's Association, 1/95.

## Animal Welfare

One of the obstacles to developing management systems that adequately address animal well-being lies in reaching agreement as to the very meaning of the term (18). Nonetheless, producers cannot afford to ignore the issues because it is contentious and unsettling.

Animal welfare concerns resulting from modern agricultural practices can be classified into three basic categories according to Rollin (19) – 1) production diseases such as liver abscesses in feedlot cattle that result from diets high in concentrates but low in roughages, 2) scale effects from large animal units that yield less individual animal attention than traditionally sized animal enterprises, and 3) physical and psychological deprivation due to prolonged confinement. Specific specie concerns are listed in Table 3.

**TABLE 3. Summary of animal welfare concerns relative to animal agriculture.**

Beef	Dairy	Veal	Sheep/Goats
Branding	Branding	Flooring systems	Tail docking
Castration	Castration	Diet	Shearing
Dehorning	Dehorning	Group housing	Slaughter protocols
Cancer eye	Tail docking	Behavioral deprivation	Transport protocols
Marketing non-ambulatory animals	Marketing non-ambulatory animals	White veal production	Handling protocols
Slaughter protocols	Calf management	Slaughter protocols	Feedlots
Handling protocols	Calf housing	Transport protocols	
Transport protocols	Stall systems		
Feedlots (space, sanitary conditions)	Management relative to mastitis/lameness		

Source: Adapted from Rollin, 1995.

Concerns about the treatment of animals are not likely to go away but rather to intensify. The livestock industry will be best served by assuring that producers maintain a strong record of sound husbandry practices, continuing to educate consumers and policy makers, and conducting research to improve facilities, management techniques, and animal handling. One of the most critical issues for producers is to clearly communicate within their respective enterprises and industries that there are expectations about providing quality care for animals under their management. Table 4 describes the Code of Ethics adopted by the Colorado Cattlemen's Association. Such a code provides a framework by which husbandry expectations can be communicated.

On a comparative basis, extensive animal management systems come closer to meeting the expectations of most mainstream animal welfare organizations than do intensive management systems such as confinement pork or poultry production. Consumers in the United States perceive that animals managed in a free-roaming system on pasture are considerably "happier" and better cared for than animals managed under more intensive management systems. Mench (20) suggests that the generalized ethic for animals includes these perspectives – animals have certain interests that need to be considered and respected, that animal pain and suffering should be minimized or avoided, animals cared for by humans deserve to have some quality of life that goes beyond avoidance of pain and suffering, the costs and benefits of animal use should be weighed in a context that includes the animal's interests, and that legal protection should be utilized to assure animal interests are adequately addressed. Clearly, these generalizations open the door to broad and conflicting interpretation.

Livestock producers thus find themselves in an environment where management decisions require consideration of more than productivity and economic issues but the need to deal with consequences related to the well being of the environment, animals and consumers.

### **Food Safety**

Food safety has historically been considered to be an issue that is best dealt with at the processing or consumer level. However, a growing desire by consumers to defer responsibility and an unrealistic expectation that risk can be held to zero has lead to more pressure on agricultural producers to provide abundant amounts of food that is absolutely defect free. In reality, as long as agricultural products (both plant and animal) are grown in natural environments, microorganisms, some of them pathogenic, will be part of the scene. Nonetheless, assurance of food safety is an issue that must be addressed at each step of production, processing, and preparation.

Pathogens can be introduced to the food chain through contaminated feed, incorrect manure management, or defective processing procedures. Failures in sanitation and food preparation/processing by packers, processors, food service operators, grocers, or consumers can also contribute to food borne illness. The extent of illness caused by food borne pathogens is not clearly known. Estimates of annual food borne illness cases in the U.S. range from six to 33 million episodes resulting in 6,000 to 9,000 deaths annually (21). Those most susceptible to food borne illness include the elderly, young children, and people with immune-suppressed conditions.



**TABLE 4. Colorado Cattlemen's Association Animal Welfare Code of Ethics**

Item	Policy
Statement of position	The multi-billion dollar livestock industry in Colorado is dependent upon the welfare of the animals under its stewardship. It is the policy of the Colorado Cattlemen's Association to promote among its members good stewardship towards animals under their care. It is further the policy of the CCA to cooperate with the Colorado Department of Agriculture, the Colorado Federation of Animal Welfare Agencies and other organizations, agencies and individuals that share legitimate concerns about the humane treatment of animals.
General considerations in livestock raising	<p>A. Livestock should be raised in conditions that meet their basic physical and behavioral needs.</p> <p>B. Handling facilities. Properly designed, well-kept facilities allow humane, efficient cattle movement. Facilities should be constantly evaluated to see if they could be modified to allow better and more humane animal handling.</p> <p>C. People with a good knowledge of working cattle and cattle behavior allow the best use of these facilities. Staff should be monitored to make sure they understand the best way to work cattle. Training should be available for those who need additional instruction in handling livestock. This applies especially to those who have not previously handled livestock.</p> <p>D. Inducements. Inducements of any sort (hot shot, whips, etc.) should be used as little as possible and should be used only to the extent that it is necessary to facilitate animal movement. They should never be used in a punitive or angry manner.</p> <p>E. Livestock should have access to professional veterinary care as required both to prevent and treat injuries and disease. Use of pharmaceuticals should be used based on an evaluation of the animal's need, not simply out of "habit."</p>
Transport of animals	Density of the loading of livestock should be based upon careful consideration of the class of livestock and the planned duration of the trip. Under no circumstances should the animals be crowded to the point of causing undue stress during the transport. Length of time in the vehicle should be based upon the class and condition of the livestock. In no case should the animals be in the vehicle long enough to cause them inordinate amounts of stress.
Livestock auctions	<p>A. Terminally sick or injured animals should be destroyed on the ranch and not be subjected to the additional stress of being shipped to auction (i.e., nonambulatory cattle, severe cases of bovine ocular neoplasia).</p> <p>B. It is essential that auction management continually monitor their facilities and staff to make certain that conditions that may foster animal abuse do not exist.</p>
Statement of duty	It is a livestock producer's duty to oppose inhumane treatment of livestock at any stage of the animal's life. Persons who willfully mistreat animals will not be tolerated in our business. We will provide any assistance necessary to proper officials during the investigation or prosecution of individuals who abuse livestock under their care.

In response to quality and food safety issues, quality assurance programs have been developed to assure that live animal production systems yield wholesome products. For example, 40 states in the U.S. have

beef quality assurance programs in place with about one-third of them in the process of implementing certification procedures to verify compliance with the program guidelines. These programs typically focus on the correct storage, administration, and recording of animal treatment protocols to avoid tissue residues, injection site blemishes, and marketing of animals prior to the correct withdrawal period. Training personnel and maintaining an effective record keeping system are critical elements of quality assurance efforts. These producer programs can have a significant impact on the ability of industries to reduce quality defects. For example, in 1991 just over one-fifth of all top butt subprimal cuts had injection site blemishes due to intramuscular injection protocols. Via a concentrated industry effort injection site blemishes had been reduced to 6 percent by 1997 (22).

The integration of environmental, animal health, and quality assurance management will be required for producers to be able to participate in select supplier marketing arrangements, production and marketing alliances, and other pre-harvest value-added initiatives. One of the most significant changes in the U.S. beef industry is the growth of branded and value-added products. As the industry moves away from commodity approaches to production and marketing, the development of supply assurance programs becomes of utmost importance. At a time when food production systems are undergoing increased scrutiny on a variety of fronts, the adoption of quality assurance programs, best management practices, and standard operating procedures provide evidence of the positive intent of food producers.

### **Economic Forces**

There are powerful economic forces that are causing structural change for rural industries. None can truly be considered as sudden or new occurrences. In fact, these economic realities have either been a long-standing fact of life or have been emerging in such a fashion that their existence should come as no surprise. These forces can be categorized as follows:

1. Most agricultural producers function within a commodity mindset and a commodity pricing structure.
2. Economy of scale is a significant advantage.
3. Structural changes are resulting in fewer and larger ranches, dairies, feed yards, packers, and processors.
4. Consumers are demanding products that meet their criteria for convenience, health, food safety, environmental impact, animal welfare, packaging, quality, and price.
5. Market chains are evolving to meet consumer demands.

Coping with these forces requires flexibility and a willingness to change. Before effective decisions can be formulated, it is important to recognize that I have assumed the following to be true:

1. Structural changes are not unique to animal agriculture.
2. It would be inappropriate to guarantee a living to those engaged in animal agriculture (or anyone else for that matter). Opportunity is the hallmark of the free market, not a guarantee of success.
3. Not all agricultural producers should be in the livestock business.
4. The impacts of animal agriculture are determined by the choices of human beings.

Historically, rural industries have been engaged in the production of commodities and as such have experienced the economic realities associated with being raw ingredient suppliers. These realities include cyclic commodity prices, pressure to become low-cost producers to attain profitability over time, and vulnerability to shifts in climatic and market conditions. A basic definition of a commodity industry is one in which average producers break even over time. The supply chains associated with commodity production typically put producers in the position of being price-takers as opposed to the more desirable position of being a price-setter.

Under commodity production and marketing systems where the rules of a free market are in place and there are a relatively large number of producers involved, prices are historically cyclic. High demand for the commodity associated with relatively low supply yields higher prices. Producers respond to these higher prices by increasing production. Eventually, the amount of commodity produced overwhelms the level of demand

and prices fall. As a result of falling prices, production falls and the cycle repeats itself. Under a commodity system, profitability is variable for producers (Table 1) with average producers finding profits attainable in periods of high price and more difficult to capture when prices are low.

**TABLE 5. Percent of profitable cow-calf producers (1995-1999)**

Year	1995	1996	1997	1998	1999
Profitable (%)	21	15	45	50	75
Breakeven (%)	43	40	33	40	20
Unprofitable (%)	36	45	22	10	5
450 lb. steer price (\$/cwt.)	78.24	69.10	88.93	87.50	92.21

Source: Adapted from Cattle-Fax, (23).

Individual producers lack the capacity to affect price in a commodity system as any individual decision is absorbed by the decisions of the masses. Producers are thus left with the following options to attain profitability in that enterprise over the long term.

The first option is to increase volume of production via increased numbers of animals and/or individual animal productivity. The task of improving production received the greatest attention in the recent past. Technological advancements and improved efficiency have resulted in levels of individual animal productivity that have allowed the U.S. beef industry, for example, to produce nearly 14 percent more beef in 1999 than in 1980 with nearly 5.5 million fewer cows in the national inventory. The U.S. dairy industry produces nearly 11 billion kilograms of milk more in 1998 with 1.7 million fewer cows than it did in 1980 (3).

Increasing volume of production may yield favorable results in the short term but may be an undesirable decision in the long term. Two consequences stand out. First, increasing the quantity of production is rarely free from cost. Secondly, if increased production is a widely adopted strategy then the price declines in a cyclic market may be more pronounced.

Lowering cost of production is the second option. In a cyclic commodity market, the low cost producer has the advantage. The low cost producer has the greatest number of opportunities to generate a profit while the high cost producer waits for cyclic peaks in price before profitability is attained.

Lowering cost of production is often the most attainable solution. However, this strategy has limitations if the efforts to lower production cost result in production quantities that fall beneath profitable levels. In an age of increasing regulation and rising pressures from consumers, activists, and society in general; producers will be hard pressed to remain profitable unless they are able to access more revenue from their efforts.

### **Economies of Scale**

The magnitude of the benefits that arise from large enterprises was made most evident to me by a conversation with a manager of large eastern seaboard farrow-to-finish hog enterprise. I had inquired as to the effects of increased environmental regulations on his business. His response was that increased regulation would deliver additional market share to the company because the costs associated with new regulation could be borne by the large organizations but not by the small to mid-sized farms. This is not an isolated example. Economies of scale are having a significant impact on the structure of agriculture and rural communities across the United States (24).

The benefits that arise from capturing economies of scale include opportunity to lower costs via the advantages of volume purchase power which lowers per unit costs of inputs, capability to access useful new technology, the ability to spread fixed costs over higher levels of production, and gaining access to markets as a result of scale. The advantages gained from economies of scale are manifested at nearly every level of the

food system. In the beef industry, ranchers with herds larger than 500 head have about one-half of the production costs in a weaned calf as compared to small herds with fewer than 50 head (25).

The national chain supermarket has replaced the locally owned grocery store on the corner of the neighborhood. In fact, just five retail companies account for approximately 50 percent of all grocery store sales. Packing and processing activities have consolidated into the hands of several relatively large companies. The largest players generally dominate the feedlot industry, and the same trend is occurring at the ranch level. The effects of scale at the ranch level are of course limited by the profit motivation of the enterprise. Many beef producers are relatively small and may not be entirely, if at all, motivated by a desire to generate profits.

The benefits from economies of scale have contributed to significant structural changes in nearly every agricultural industry. The consolidation of agricultural production into fewer and larger farms and ranches is evident in the beef industry (25). The average cow-calf enterprise in the United States has less than 50 head of breeding cattle. Herds with less than 50 cows account for almost 80 percent of the total enterprises with beef cattle but only approximately 30 percent of the total breeding herd. Meanwhile those herds with more than 100 breeding cattle account for nearly one-half of the national beef herd but less than 10 percent of the total herds (Table 2). At the packer level, economies of scale have driven consolidation that has resulted in 80 percent of the steer-heifer harvest by the four largest companies. At the feedlot level less than 15 percent of the feeding companies account for nearly 70 percent of all fed cattle marketings in the United States (3).

In the short run, increased consolidation in the production sector is driven by “survival of the fittest”. In this case the fittest are those enterprises that can function as low-cost producers. Increased consolidation also results when producers choose to exit production agriculture rather than adapt to the “new rules” of the game.

The effects of increased consolidation include lower production costs at the farm and ranch level, lower food prices for consumers, a more competitive position for U. S. agriculture in the global market, a requirement for producers to develop more flexibility and adaptability, and dramatic changes in the structure of rural communities.

**TABLE 6. Percent of beef cow inventory and number of herds by various sized categories**

Size (N of head)	Beef cows (%)	Herds with beef cows (%)
1-49	29.9	79.0
50-99	19.1	12.0
100-499	36.6	8.4
500-999	7.6	0.5
>999	6.8	0.1

Source: USDA, NASS, 1999.

Consolidation in the agricultural sector has been driven by consumer expectations for plentiful and relatively cheap foods. The net result for U.S. consumers has been that instead of paying 21 cents of each earned dollar for food, as was the case fifty years ago, they now pay 11 cents (24). The corporate superstores, be it Wal-Mart or Safeway, are part of the economic landscape because they meet a demand. They are there because consumers want to do business in an environment where access to a variety of brand names is readily available. Commodity production systems of the past are not capable of meeting consumer demands for a variety of value-added products that offer an assurance of quality and value.

### **Producer Alternatives**

These are challenging times for producers of food and fiber animals. Not only are the

expectations of consumers changing but there are significant structural changes occurring to the food production systems of the world. Sustainability of food production at levels sufficient to meet the needs of a growing population is in doubt. On the one hand, agricultural managers are pressured to focus on production goals and improvements in efficiency. These pressures have led to consolidation into larger production units that have inherent advantages from economies of scale and the ability to quickly adapt and utilize new technologies. But these very changes that contribute to increased productivity have many consumers questioning the resulting environmental, animal welfare, and food safety effects. As a result of these concerns, regulation and the cost of meeting new regulation has proliferated with a net effect of increasing loss of the small and mid-sized (and typically family owned) farms and ranches championed by consumer activists.

Wilson (26) and Alexander (27) suggest the following as important considerations to improve sustainability of ruminant animal production systems – acceptance of optimum versus maximum production levels, enterprise diversification to improve cash flow, participation in value-added activities, reduction of grain in ruminant animal diets, increased focus on improving pasture and forage quality, refinement of grazing system management, better use of preventative medicine, and balancing animal waste generation with sound land application practices. Which of these alternatives is practical can only be determined on an individual case basis. Irrespective of the situation, producers, researchers, and community leaders must evaluate the options and begin the process of examining creative solutions that meet the needs of consumers and society by keeping good stewards on the land via a healthy and profitable agriculture.

Producers of animal products have several alternatives in an environment of competitive forces. These alternatives should not be uniformly applied in all cases nor are they mutually exclusive to each other. Nonetheless, because the rules of the game have changed, choices will have to be made. The clearest choices seem to be:

1. Attain and maintain a position as a low cost producer.
2. Participate in the chain that adds value or creates branded products.
3. Diversify the economic activities of the ranch or farm.
4. Develop a source of off-ranch income.
5. Capture the remaining equity in the land base by selling to the highest bidder.

In most cases, determining and documenting production cost is a logical place to begin. Control of production cost is most typically focused on expenditures associated with supplemental feed, labor, and the purchase, maintenance, and operation of equipment.

Most economic analyses suggest that feed expenses account for about one-third of the variable costs associated with livestock production. Typically, labor costs are responsible for the next highest percent of variable costs in ranching. Equipment costs, especially those associated with the use of fossil fuels, are also a focus in most situations. Finally, debt load is another cost that should be critically evaluated. For the best managed of enterprises, cost controls are in place and little additional profitability can be generated from the cost side of the equation.

However, in almost every case, the costs associated with estate taxes have stacked the deck against our ability to sustain production agriculture in the future. The most significant policy decision for the future of agriculture would be estate law reform that reduces the burden of intergenerational transfer of agricultural lands. Without these changes, citizens of the United States can look forward to a future of being as dependent on foreign sources of food as they are for fossil fuels.

Once production costs are under control, managers can turn their attention to more complete participation in the production and marketing of value-added products. Commodity production systems put producers in the role of serving as raw ingredient suppliers – in essence, the bottom of the economic food chain. Furthermore, most independent producers lack the resources required to take full advantage of economies of scale. Therefore, the development and implementation of partnerships becomes necessary.

These partnerships can take a variety of forms ranging from contractual agreements to loosely knit alliances. Furthermore, these partnerships can focus on both traditional (livestock, etc.) and non-traditional (recreation, carbon sequestration, etc.) outputs. Some of the advantages of alignment include: opportunities to capture economies of scale in both the purchase of inputs and access to markets, the opportunity to capture higher prices by adding value to products, and establishment of customer loyalty via the delivery of branded products into the marketplace that consistently meet consumer expectations.

The tradeoffs (disadvantages) of participating in alliances include: acceptance of more market risk, loss of independent decision making as a result of agreeing to predetermined production and marketing specifications, and the costs of gaining access to the needed infrastructure to add value.

One of the challenges for producer cooperatives or alliances is acquiring the specialized expertise needed to fully participate in the value-added supply chain. Infrastructure issues that must be overcome include acquisition of human capital, financial backing, and processing capacity.

Often times, producers seek opportunities to build or purchase processing plants. This approach has rarely been successful. A more beneficial tactic has been to capture plant capacity via partnership or contractual agreements. Making the transition from being a supplier of raw ingredients to developing the ability to deliver value-added products to consumers requires a different mindset and appropriate skills.

Gaining access to processing and marketing skills has motivated the development of alliances that have become a hallmark of the last decade in the livestock industry. Efforts have ranged from large-scale approaches such as U.S. Premium Beef to more local efforts such as Yampa Valley Beef. Some of these alliances between primary producers, feeders, packers, wholesalers, retailers, and food service will succeed. Others will fail. However, their presence allows producers a route to participate in the creation of branded products.

The market place is diverse and as such demand niches create opportunities for a variety of approaches to capturing a share of the consumer's dollar. Creating brands that are attached to specific ranches (CO Bar Beef in Arizona; Ranchers Renaissance headquartered in Colorado), efforts to preserve open space and agricultural lands and livelihoods (Yampa Valley Beef in Colorado), or demand for organic-type products (3BR Beef in Texas or Coleman Beef in Colorado) have found at least moderate success.

The emergence of business agreements between various segments of the food industry to coordinate activities to allow the consistent delivery of value-added products to consumers should not be viewed as a passing fancy. Furthermore, the formation of alliances will extend beyond the mechanics of food production. Cooperative partnerships will tie other values to food products as well. Certification programs are likely to develop whereby ranches with a strong record of environmental stewardship are able to have access to participation in a branded product supply chain that is merchandised as an environmentally friendly product.

These changes will require significant adaptation by livestock producers. Furthermore, supply chain systems will have more stringent requirements in regards to product specifications and production system standards. Therefore, managers will have to become more focused on information utilization, risk strategies, and the business environment. Ranchers who desire the opportunity to participate in branded product approaches will value flexibility, creativity, and relationships at historically high levels. Access to these alliances will not be limited to only the largest producers. While the largest ranches are typically targeted in the early stages of alliance formation because of the volume they bring to the table, mid-sized and small-sized enterprises can gain access by joining forces. Cooperative agreements between smaller producers allow them the opportunity to gain access to market opportunities by acting large. Regardless of size, these structural changes often require that producers gain new skills, capture more information, and adapt their business practices.

Diversifying the economic activities of the ranch is another alternative. However, the alternatives and ultimate choice of enterprises are unique to each ranch and its resources. The options available to any

given ranch depend on geographic location, resource base, available facilities, as well as the manager's motivation to initiate new enterprises. An in-depth analysis of enterprise diversification is a topic beyond the scope of this essay. However, non-traditional enterprises may in fact offer opportunities that enhance cash flow and enhance the ability of the ranch to enhance utilization of capital resources. As producers evaluate opportunities, it is absolutely essential that a critical assessment of the financial ramifications, hidden costs, risks, and required skills be conducted.

Consideration of non-traditional enterprises requires that resource owners and managers appreciate the full range of products and/or services that can be offered. Understanding the perception of consumers as to the values originating from a particular resource facilitates the process of identifying unique enterprise opportunities. In short, it is an important exercise to look at ranch resources with a different perspective in the search for possible new enterprises.

Seeking off-ranch income opportunities is a common decision for at least one member of agricultural families. USDA data provides some insight into the dependence of ranch families on outside income by evaluating agricultural versus off-farm income. The reliance on income generated outside of farming is also scale related. As the gross sales from an agricultural enterprise increase, the percent of total income derived from off-farm source declines. This effect is particularly significant once gross sales of \$250,000 are exceeded. Sales classes of farms at less than the one-quarter of a million dollar sales derive more of total income from off-farm employment than from their agricultural enterprise. It is difficult to gauge the degree of unhappiness with these conditions among owners of small to mid-sized agricultural production enterprises. For many, particularly those with sales less than \$50,000, the farm or ranch was never intended to generate a significant level of family income. Rather, the goal of these enterprises may be to generate \$10,000 or more to maintain classification as a farm for tax purposes (28).

Finally, ranchers can choose to capture the value of their resources by selling. In some cases, this may well be the best decision from a financial perspective. However, from a longer-term view, a mass exodus of agricultural landowners would set off a chain reaction that would dramatically alter the landscape, community structure, and culture of the west. When ranchers leave the land they take with them a lifetime or more of working knowledge and intimate association with those resources. Not always but too often they are replaced with those who easily tire of the responsibility for stewardship of a working piece of land or who have only a short-term profit motive with little consideration for either the community or the landscape.

### **Cultural Considerations**

While all of these alternatives are largely financial decisions, it is important to recognize that for many ranchers, non-monetary factors play an important role in their decision-making processes. There are also cultural considerations that involve community and family commitments. Agriculture has as much to do with how people live on the land as making a living from it. Lynn Sherrod, who ranches, with her husband in the Elk River valley of Colorado, captures the essence of living on the land well. "There is something about getting your hands dirty with soil on your own land, gazing across hay meadows rippling in the breeze and seeing that some hay has been baled and is ready for winter, seeing a calf be born and struggle to its feet – instinctively seeking its mother's sustenance, realizing and understanding that daily this rhythm and pattern of life is repeated, reinforced, and reaffirmed for the future."

Agriculture will not be well served nor will it serve the rest of us well if we ignore these traditional values. Rather, what is required is a delicate balancing act that incorporates the central mission of generating long-term profits via superior business skills, a passion for excellence, and sustaining appropriate traditions. Without a sense of emotion the concepts of good stewardship and careful husbandry are not possible. Without an understanding of tradition we cannot build effective communities. Without stewardship, husbandry, and community the business of agriculture would be less worthy of the investment of our time, energy, and resources.

Paul Starrs' (17) concluded his book with the statement that "To know ranching's realm and ranchers themselves, to know cows and cowboys and their horses, to see the land and its people, watching the complicated interactions of grazers, their charges, and the terrain, is to absorb one of the astoundingly complex and rich stories of humanity. In the modern world no one is so close to the land as working ranchers – women and men who gunnysack-dry calves born at winter dawns, who laboriously move cattle up distant hill-sides toward the salt blocks placed there to encourage the animals to spend time on heights, away from creek bottoms, or who simply devote days on horseback, at a walk or a trot, looking over the status and prospect of land, plants, and animals. That is husbandry – nurturing – at its most basic. "

Thomas and Gripne (29) concur even in regards to public or government owned lands. "Ecological processes know no boundaries between public and private land – provided both share some broad similarities in function. The long-standing arrangement between grazers with privileges of livestock and the Forest Service cannot, and should not, be casually disregarded – ethically, ecologically, legally, and economically. We should recognize incentives that maintain our collective "open space", by enhancing the viability of farms and ranches."

However, we cannot assume that animal agriculture has no need for change. Nothing could be further from the truth. It is time to question our assumptions, take off our blinders, and engage in the process of searching for better approaches to the dilemmas that confront us. We will never be able to capture ranching or traditional animal agriculture in a freeze frame and hold it changeless against the tides of economic, political, and social dynamics. Such a notion has never been reality.

We will have to learn new skills and lay down those old perspectives that burden our ability to forge partnerships, build communities, and contribute to healthy and productive landscapes. Nothing good ever comes without the efforts of motivated people and creativity is the best salve to heal our wounds.

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