Range Livestock Production, Food, and the Future: A Perspective

Ranching and farming systems could soon drastically change because of rising world population, depletion of water supplies, agricultural land loss to urbanization, fossil fuel depletion, and concerns about food health

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There is a growing belief that the era of cheap food in the United States is ending and that major changes will eventually occur in how our food is produced, processed, and distributed.[1] Changes in the food production system in the United States will undoubtedly affect the rest of the world and the prospects for the human population. This is because the United States is the world's primary grain producer and has played a critical role in preventing famines when food shortages have occurred in other countries.[1] Changes in the world food outlook have important implications for range livestock producers.

Under present conditions, every 1 farmer in the United States feeds about 170 people, compared to 20 in 1900.[2] Yields of most crops have tripled, and in some cases, like corn, they have increased by fivefold. This remarkable achievement has allowed the US human population to triple while food costs as a percentage of family income have dropped from 30% to 10%. An abundance of cheap food indirectly helped the United States become the world's foremost industrial power in the 1920s, build the interstate highway system in the 1950s, develop the internet in the 1990s, and become a nation of affluent suburban homeowners.[3] However, there are now many concerns about future food production in the United States. They relate to its sustainability relative to energy use, its ethics in treatment of livestock, its impact on the environment, and its effects on food nutritional value and healthiness.[3,4] I will discuss the development of US food production from 1900 to the present and then relate my analysis to implications for range livestock producers.

Changes in Farming

In 1900, the typical American farmer grew a wide variety of crops and animal species.[3] Horses were a necessary animal on every farm because tractors were still in the developmental state. Next came cattle, chickens, and hogs. Corn was the primary crop followed by wheat, apples, hay, oats, and potatoes. Many farms also grew cherries, plums, grapes, peaches, and pears. Through this diversity, most farmers could feed not only their families but also their livestock and soil.[3] The fields were small (5–40 acres) and mostly fenced. The landscape across large farming areas was highly diverse and much different than today.

Tractors and other mechanization rapidly eliminated the need for horses during the 1920s. This increased the amount of land that could be devoted to producing food for humans by 30%, as feed was no longer needed for draft animals.[3] The tractor also allowed farming of lands not easily tilled with draft animals and increased the speed of tillage. The rapid expansion of supply in farm commodities due to mechanization caused real farm income to drop 75% between 1919 and the Depression in 1932.[2]

The spreading use of tractors during the 1920s resulted in the plowing of vast acreages of rangelands in the western Great Plains that were unsuited for sustained cultivation.[4] This would lead to the "dust bowl" of the 1930s.

In the 1930s, New Deal programs from the Roosevelt administration to combat the Depression restricted farm commodity production. These programs followed by World War II in the early 1940s temporarily rescued farmers and ranchers from the supply glut of the 1920s.[2,5,6] However, another round of farm commodity supply increases started in the early 1950s. This came from the "green revolution," which involved the development of specialized crop varieties highly responsive to inputs of fertilizer, pesticides, and irrigation.

The key feature in green revolution productivity was the heavy use of nitrogen fertilizer. The process of synthesizing nitrogen fertilizer was developed by the German scientist, Fritz Haber, in 1909.[3] However, nitrogen fertilizer received little use by American farmers until the 1950s green revolution. The Haber process of synthesizing nitrogen requires high inputs of fossil fuel, primarily natural gas. The soil fertility transformation from natural fertilizers (livestock manures) and legumes (green manures) to synthesized fertilizer caused the second big boost in farm production but further increased the reliance on cheap fossil fuel.

In response to an oversupply of farm commodities in 1956, the Eisenhower administration implemented the "soil bank" program that idled 30 million acres by 1960 (total farmland base = 380 million acres). Under this program, farmers were paid to retire cropland from production. It was moderately successful in containing crop surpluses but it did provide important conservation benefits (wildlife habitat and reduced soil erosion).

In the late 1950s, substantial amounts of marginal cropland in the drier western Great Plains were reseeded to perennial grasses and returned to grazing.[7] Profits from western ranching were exceptionally high in the early 1950s and early 1960s, but weakened during the late 1960s.[7] A rapidly rising human population with increased affluence (more beef consumption per capita) explains the generally favorable economic situation for western ranchers during the 1950s into the early 1960s.

The downward trend in farm commodity prices due to oversupply had a sharp reversal in the early 1970s.[2,5,6] Factors causing this reversal included inflationary macroeconomics policies by the US government, oil supply shocks, drought in the US farm belt, and climatic adversity in China, India, and Russia that depressed world grain production.

During the late 1960s and early 1970s, the Vietnam War coupled with the "War on Poverty" put a severe funding strain on the US government. Rather than raise taxes, the governments under Presidents Johnson and Nixon basically chose to fund them through printing the money. The expansion of the money supply relative to economic output created pressure for the US dollar to be devalued against other currencies.[8] At the Bretton Woods Conference in 1946, the major world trading partners established that the US dollar would be the basic monetary unit of exchange in international trade. Dollars could be exchanged for gold with the US government. The US government was able to increase the supply of dollars to cover its excessive spending during the late 1960s. However, a point was reached in 1971 when the United States could no longer meet foreign country redemption of dollars for gold. In August of 1971, President Nixon took the dollar off the gold standard, which set the stage for dollar devaluation against other currencies. This caused US exports, primarily farm products, to become more competitive on world markets. This also contributed to its primary import, oil, becoming much more expensive. Other factors in the increase in oil prices were "peak oil" in the United States, the Arab oil embargo, the beginnings of globalization, and currency speculation. Soaring food prices in 1972 and 1973 caused widespread protest by American consumers.[3] In response, then Secretary of Agriculture Earl Butz encouraged farmers to plant fence row to fence row and get big. He ended land idling programs. Most importantly, he implemented a new system of direct subsidy payments to farmers that encouraged them to maximize their production of primary grains (corn, wheat) regardless of supply. The combination of adverse weather, Russian grain purchases, and dollar devaluation caused US farm exports to surge from $7.3 billion in 1970 to $34.7 billion in 1979.[6] In this same period, prices for cattle and other livestock rose along with farm commodities, greatly benefiting western ranchers.

This favorable situation for US farmers and ranchers abruptly changed in the early 1980s due to different US economic policies under the Reagan administration, improved climatic conditions, and massive grain surpluses from the 1970s farm policies.[5] Low farm income and a crash in land values lead to massive bankruptcies of farmers and ranchers that peaked in 1985.[6]

Probably the most critical factor affecting conditions for farmers and ranchers in the 1980s and 1990s were the economic policies implemented early in the presidency of Ronald Reagan. The Reagan strategy involved restraining the money supply to control inflation, business deregulation, lower taxes, and loose immigration policy to lower labor costs.[2,5,6] The most drastic element of his program was using the Federal Reserve to restrict inflation by elevating interest rates. This greatly strengthened the US dollar and broke the upward inflationary spiral. It caused money to flow from natural resource assets (gold, oil, farmland) to financial assets (stocks and bonds).

During the l980s and 1990s, US farm products were expensive relative to those of other countries such as Canada, Argentina, and Australia, due to the strong dollar. World climatic conditions were quite favorable for food production. In this same period, new technology involving genetically engineered plants, coupled with market reforms in China and several other countries, resulted in a third big boost in world food production. A precipitous drop in oil prices due to overproduction improved energy efficiency, and deregulation contained food production costs.

In the early 1980s, there was growing concern that another "dust bowl" could occur as a result of the massive plow-out of rangelands in the western Great Plains in the 1970s. The Conservation Reserve Program was implemented as part of the 1985 farm bill. It was a land set-aside program that had dual objectives of controlling soil erosion and reducing farm commodity supplies. By 1995, about

35 million acres had been set aside at an annual cost of $1.8 billon per year. The Conservation Reserve Program was quite effective in controlling soil erosion and increasing wildlife habitat, but minimally effective in reducing the surplus of farm commodities. Prices of the primary farm food commodities—corn, soybean, wheat, rice—remained depressed throughout the 1980s, 1990s, and into the early 2000s. Basically, further increased yields from green revolution techniques and genetically engineered plants increased farm commodities faster than they could be used by the United States and the world human population.

Starting in the 1950s, the biggest dilemma was what to do with all the surplus corn. This matter was resolved by development of corn-based processed food and drink products for human consumption and by gradually changing livestock production systems in the United States.[3] A huge surplus of cheap corn made it cost-effective to produce pigs and chickens on a large scale under confined conditions using harvested feed. It also made it cost-effective to put a high amount of fat on finished beef from the feedlot. Massive supplies of cheap grains available as livestock feed starting in the 1950s caused the price of chicken and pork to gradually drop relative to beef. This is because pigs and chickens convert grain more efficiently into meat than cattle. The value of traditional livestock feed sources of range grass, pasture, and crop roughages were reduced by cheap corn. The desire by large meat packing corporations to control their supply chains and finished products was also an important factor in the development of confined animal meat production systems. This also led to meat packers demanding uniform cattle, which requires production systems based on feeding rather than grazing.

A New Era of Agriculture Begins

There are now compelling reasons to believe that the era of cheap and abundant food may be ending. They center around depletion of fossil fuels, limits to the green revolution, depletion of world water resources, losses of farmland to development, global warming, changed farm policies by the US government, the return of inflationary monetary policies, and continuing human population growth.[1] The most important of these factors centers around fossil fuel depletion, but they are all significant.

Human Population Increase

The world human population is now increasing at about 1.2% per year.[1] Fortunately, the rate of growth has been slowing down. There is hope that the present world population of 6.5 billion will stabilize at 9–10 billion by 2050.[1] However, unless there is some kind of major breakthrough in energy, it seems almost certain world food prices will rise in response to more people. The real question is by how much? There is deep concern that food shortages and famine could soon occur in some Asian and African countries.[1]

World grain harvests have more than tripled since 1950, keeping up with human population until 2000.[1,4] However, in 7 of the last 8 years, world grain production has fallen short of consumption.[1] World carryover stocks of grain are at their lowest level in 34 years.[1] This situation is now being greatly accentuated by increased grain demand to produce ethanol for cars.

Water Problems

Several countries of the world have growing water shortage problems.[1] These problems center around drops in water tables due to excessive withdrawals from irrigation, loss of glaciers, and loss of irrigation water to industry/urban users. China, Pakistan, and India, which collectively account for 40% of the world's human population, are all experiencing falling grain production due to gradual water depletion.

The irrigation problem in these countries is being further compounded by global warming that may or may not be caused by human activities. The glaciers and snowpacks that are the upper water sources of the Ganges, Yellow, Yangtze, Indus, and Mekong River are melting.[1] These rivers play a critical role in irrigating lands that feed millions of people.

In the United States, irrigated land accounts for only 20% of the grain harvest, but in India, it accounts for about 60%, and in China, near 80%.[1] Losses of irrigated land from ground water depletion and more erratic river flows are being compounded by appropriation of water from farmers for urban and industrial growth. This problem is most acute in India and China but is occurring in several other countries including the United States.

In the United States, groundwater depletion impacts on grain production have been most severe in the southern Great Plains where the vast Ogallala aquifer is shrinking.[1] This is gradually forcing many farmers in Texas, New Mexico, Oklahoma, Kansas, Colorado, and Nebraska to either return their lands to rangeland pastures or adopt low-yield dryland farming. Rapidly growing US cities, such as Denver, Los Angeles, Albuquerque, El Paso, and San Diego, are increasingly meeting their water demand through appropriation of farmland irrigation water.

Energy: The Biggest Challenge

The biggest current threat to human progress may be the approach of "peak oil."[1,4,9] Various books and several television documentary programs have addressed this subject during the past 2 years. The US Government Accounting Office (GAO) 2007 report warns that "peak oil" will occur sometime within the next 32 years and could be occurring now.[9] During the last 3 years, world oil production has stalled at 85 million barrels per day, which may be the peak.[1,9] Once the peak occurs, the world will have to rapidly switch to alternative energy sources.

There is no present energy source that can compare to oil in terms of energy output per unit of input and ease of handling.[4] As examples, domestically produced oil has an energy output to input ratio of near 20, compared to 10 for natural gas, 9 for coal, 4 for nuclear power, 2.1–2.6 for wood, 0.8–1.7 for ethanol from sugar cane, and 0.7–1.3 for ethanol from corn.[10,11] Noncarbon renewable energy sources like wind, solar, hydropower, geothermal, and tidal can vary from 2 to 15 depending on their location and the technologies needed to develop them. In other words, as peak oil is reached and other energy sources are gradually substituted for oil, their net energy yields will be mostly lower. This will make it quite challenging to maintain, let alone increase, the energy supply for a growing human population.[1,4,9,12] Travel and production of goods and food will probably become much more expensive than when oil was plentiful and other world economies, like China and India, were not rapidly increasing their oil use.

Few big oil discoveries have occurred since the North Sea and Prudhoe fields of the 1970s.[4,9,12] Presently, the world is extracting and using five–six barrels of oil for every barrel that is discovered.[13] Since its 1970 oil production peak, the United States has steadily increased its imports of oil to the present level of 66%.[9] Once world oil production peaks, initial declines near 2% per year can be expected based on what has happened in various countries that have already reached peak oil.[4,12,13] In the United States, oil production has on average decreased about 1.3% per year from the peak in 1970 (9.6 million barrels per day) to 2004 (5.4 million barrels per day).[9,12] However, between the 1970 peak and 1975, it dropped 10% or 2% per year.[9] Within 5 years after peak oil, a global oil shortage of 10–15% could easily occur due to reduced supply coupled with increasing world oil demand. This could completely disrupt the world economy.[9,14] If peak oil occurs within 5 years, the 2007 GAO report points out that the consequences would be dire due to a lack of global preparedness. Because the United States is the largest consumer of oil and so dependent on oil for transportation of people, goods, and food, it would be especially vulnerable.[9,14]

Agriculture and Energy

Since 1940, the productivity of US farmland and US oil consumption have both grown at a rate near 2% per year.[3] All aspects of US food production are fossil fuel intensive, from tractors and other machinery, to fertilizer, pesticides, herbicides, crop transport, food processing and packaging, and cooking.[1,4,14,15] The production of a typical food item at the point of consumption has involved energy inputs of one hundred to several hundred times its food energy.[4] In terms of energy efficiency, modern industrial agriculture is the least efficient type of food production in human history.[1,4,15] The globalization of world food production systems during the last 20 years has accentuated the use of fossil fuel inputs. This is because of the replacement of subsistence cultivation with industrially grown monocrops for export in many developing countries and food transport over longer distances.[1,14,15]

The big driver of the run-ups in world grain prices in 2006 and 2007 has been the crop-based fuel ethanol program in the United States.[1] This program has been around since 1978 but was abbreviated due to the low prices of oil and gas. When oil rose above $50 a barrel in 2005, it become cost-effective to convert grain into ethanol.[1] This caused heavy investment in distilleries and drove up demand for corn. As oil prices shot up further in 2006 and reached $100 per barrel in early 2008, the economics of corn to ethanol became favorable even without the government subsidy of $0.51 a gallon. Once ethanol plants now under construction are completed, grain used for ethanol could double. The key point here is that as much as 40% of the corn crop in the United States might soon be used in ethanol production if oil prices remain above $60 per barrel. Several other countries, including China, France, Spain, and Germany, are now converting part of their grain crop to ethanol. Poor crop production is occurring in some Asian and African countries, and some farmers are converting from wheat to corn. This could cause further rises in grain prices and make food much more expensive throughout the world.

Since 2006, higher grain prices have adversely impacted range cattle prices because of the squeeze of feedlot profit margins. The feedlot operators have passed part of these costs on to the ranchers by lowering the prices they are willing to pay for cattle going from grass to the feedlot and greatly reducing the number of days-on-feed. Meat imports have moderated the impact of higher grain prices on pork, poultry, and beef in the grocery store. The increase in grain prices expected 5–10 years from now could change meat production systems in the United States away from grain back to forage. This is because food prices that are twice or more than those right now will greatly affect the capability of consumers to buy meat. Pending world food shortages could eventually necessitate that most of the US grain crop be fed directly to humans rather than to livestock or used for ethanol production. The raising of livestock for meat under confined conditions with grain-based diets is feasible only under conditions of cheap grains and cheap meat transport. Once peak oil is reached, it could become a major challenge to avoid massive starvation.[1,4,13–15] Keep in mind that the world went from 1.7 billion people in 1900 to 6.5 billion people today on a pillar of abundant, cheap fossil fuel. Once the fossil fuel is withdrawn from the equation, there is doubt that the present world human population can be adequately fed. Water depletion, loss of farmland, and global warming could exacerbate problems from peak oil.

Under these conditions, most of our meat could again be produced like it was all through history until the last 50 years.[3] Pigs and chickens could again be primarily raised by small households and farmers on a variety of feeds they can scavenge. Most cattle may spend their entire lives consuming range grasses and other roughages that only their digestive systems can efficiently utilize. Meat of all kinds could be very expensive, but that from range ruminants would likely be cheaper than that from chickens and pigs.

After peak oil, it is believed by some energy experts that the present system of large industrialized farms will devolve back into small farms where humans and draft animals again become the primary energy sources for cultivation, planting, and harvesting.[14,15] They question that large numbers of people can be supported in big cities on imported food in an energy-deficient world. Without cheap energy, they believe that by necessity, people will return to the land and big corporate farms will dissolve into small farms depending mainly on human and animal labor.

Concerns About Confined Animal Meat Production

The present system of confined animal meat production confronts other serious challenges beyond those relating to energy.[3,16] The treatment of confined pigs, chickens, and feedlot cattle as discussed in some detail by Pollan[3] seems dubious or not humane to many people. Rather than go into detail on this matter, I will summarize that animal treatment concerns have generated a demand for meat from animals grown under natural (range pasture) conditions. Some people are willing to pay a premium for so-called "humanely" produced meat. Pollan also interestingly makes the case that meat from grass-fed animals is more healthy than that from corn-fed animals.[3] In other words, the nutritional profile (and taste) of beef, chicken, pork, eggs, and milk is different when based on range forage or pasture compared to grains. Specifically, there is preliminary evidence that meat, milk, and eggs from pastured animals contain higher levels of the essential omega-3 fatty acids that play a positive role in human health. Health problems assigned to beef consumption may be due to the animal's grain-based diet, while conversely, the grass-fed animal's meat may be nutritionally advantageous. A beef steak from a grass-fed steer may be healthier than a filet from a farmed salmon on grain.[3] The real point I want to make is that more people are becoming believers in the health benefits of grass-fed meat and are willing to pay a 30–50% premium for it.[3] Concerns about diseases from meat of confined animals and environmental damage from confined meat animal production systems are also contributing to this demand. So far, this is a small niche market. There is hope but also doubt that it will grow. The primary question is whether or not most consumers will be resistant to paying a premium for "organic" beef as prices go up for gas, other foods, and health care.

Is the Present System of Food Distribution Sustainable?

There is growing belief that the present system of food transport and distribution in the United States is unsustainable and puts the country at risk.[4,13–15] This concern is based on the long distances most of our food is transported and the heavy reliance on imported oil that fuels this transport. The food production system in most of the United States is geared to produce the big farm commodity crops (corn, soybeans, wheat, rice, potatoes), while the fruits and vegetables come mostly from California, Florida, and Latin American countries.[1,3,6,15] If anything disrupts the flow of oil to the United States, food supply problems in the big cities could become critical.[13–15] Once peak oil is reached, the costs of transporting food will probably rise quickly. The whole Wal-Mart economy based on massive globalization could crumble. Locally produced foods and goods sold in local markets and small shops might come back.

Inflationary Monetary Policies

The US government is drifting back into inflationary monetary policies.[1,8,17–19] The high debt and trade deficit levels coupled with the house price collapse in the US economy have put the Federal Reserve Bank under great pressure to keep interest rates low. Eventually, the dollar could be severely devalued against other currencies (particularly the Euro) and gold.[8,18,19] The government is again fighting wars and expanding social programs without raising taxes.[19] The inflation rate at both the producer level and consumer level started rising in 2007.[19] The devaluation of the dollar associated with these policies, at some point, may stimulate US meat exports, discourage meat imports, and boost cattle prices.

Closing Thoughts

Western range livestock producers have been through a 25-year period of financially tough times due primarily to high supplies of cheap grain. Cheap oil has been the underpinning of the green revolution and abundance of grain. Meat production systems in the United States were reorganized to utilize this cheap grain supply by feeding it to large concentrations of confined domestic animals. This system has provided the consumer with an abundance of cheap meat. However, animal treatment ethics, meat nutritional value, and environmental degradation have been points of controversy. During the era of cheap grain, the historic, natural livestock foods of range grass, pasture, and crop roughages were devalued. Both privately and publicly owned rangeland came to be viewed by political leaders and the public as disposable resources because it was thought that our meat could be efficiently produced with harvested feed or imported. The era of cheap oil and cheap grain may now be ending. Conversion of grains into ethanol for cars is accelerating price run-ups on grains. Government policies that favor eventual devaluation of the US dollar are now being implemented, which could make US meat more competitive in foreign markets. Under these conditions, it seems likely that range livestock production profitability in the long term will improve assuming ranchers can contain costs, particularly for energy and supplemental feed. I believe range operators using low-input systems that minimize costs tied to fossil fuel are the ones most likely to benefit from the new trends.[20–22] The capability to supply local markets with humanely produced meat from natural grass is paying out well for some ranchers, but presently this market is uncertain and has many risks.

While I introduce the possibility that range livestock production profitability could improve sometime in the future, I recognize that I leave many important questions unanswered. These questions include

1) How can ranchers take advantage of a shift to a grass-finished market?
2) How can ranchers reduce energy costs?
3) How should grazing regulation on federal lands be changed?
4) What do these changes mean for part-time or absentee ranchers?

I hope this article stimulates thought on these questions.

There are many political and corporate leaders who believe new technologies can solve all challenges relating to peak oil, climatic change, water depletion, and human population growth. However, the GAO (2007) report strongly questions that the new technologies relating to energy could adequately eliminate the adverse impacts if peak oil came within the next 5–7 years.[9] Basically, there is a complete lack of preparedness for this "worst case" scenario.

As a rational hedge against the possibility of technological lag or failure, I most strongly believe everything possible should be done to conserve and enhance our rangelands and farmlands so they will meet the basic needs of a world with ever more people (70 million per year), but with shrinking energy, water, and agricultural land resources. There are many sound ways that energy, water, and agricultural land resources can be conserved and enhanced to meet human population needs without severely compromising our economy.[1,5,13–15] Therefore, I am an optimist about the future. However, I am in agreement with Brown (2008)[1] and the GAO report (2007)[9] that it is critical we not delay preparation and implementation of these measures.

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