Applied Environmental Science

Global Climate Change and Environmental Stewardship by Ruminant Livestock Producers

Student Reference

Developed and written by
Agricultural Education, University of Missouri
in cooperation with
The United States Environmental Protection Agency,
The National Council for Agricultural Education, and
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Introduction

Maintaining a clean environment while conserving the Earth's natural resources should be important to all Americans. To accomplish this; however, we must begin to grapple with difficult issues such as water pollution, toxic waste spills, tropical forest destruction, and global climate change, to name a few. Action should be taken to address these issues. After all, the damage we do to our planet today will stay with us long into the future. Agriculturalists can play an important part in preventing and repairing damage to our environment. By becoming good environmental stewards, agriculturalists can preserve their land for future generations.

The purpose of these materials, which supplement the Air Quality unit of the Applied Environmental Science Instructional Materials, is to look at one particular environmental issue - global climate change - what causes it, what are the consequences, and what actions can be taken to improve the current situation. In particular, this unit takes a detailed look at methane, one of the major greenhouse gases, and the contribution ruminant livestock make to the greenhouse effect through emissions of methane. In addition, an overview of profitable management techniques livestock producers can use to reduce ruminant livestock methane emissions is provided.

"*Global Climate Change and Environmental Stewardship by Ruminant Livestock Producers*" consists of three lessons:

1. Understanding the Greenhouse Effect
2. Methane and Its Sources
3. Reducing Methane Emissions from Ruminant Livestock

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Global Climate Change: A Growing Environmental Problem

One of the environmental threats our planet faces today is the potential for long-term changes in the Earth's climate and temperature patterns known as **global climate change**. Scientists estimate that as a result of global climate change, the Earth's average temperature could increase as much as six and one-half degrees Fahrenheit by the year 2100. While this may not sound like much of an increase, if the temperature increase approaches the six and one-half degree mark, the Earth will be a much different place than we know it today. To gain an appreciation of how different the Earth could be, consider that during the last ice age**,** when our planet was on average only nine degrees Fahrenheit cooler, the area that is now New York City was under 1,000 feet of ice. To prevent this sort of disruption to the many natural and human systems that everyone on our planet depends on, we must all work to control global climate change.

Determining the potential causes of global climate change has been a long-term process that has involved the work of thousands of scientists around the world. An important step in this process was made in 1995 when over 2,500 scientists from around the world agreed for the first time that emissions of **greenhouse gases** from human activities have influenced the global climate. As a result, the question is no longer whether humans are altering the world's climate, but where, when, and by how much. The great importance of this scientific conclusion is that we now know that in order to prevent the onset of catastrophic changes to the Earth's climate, humans must reduce their emissions of greenhouse gases.

Consequences of Global Climate Change

Although climate change may result in some benefits such as extended growing seasons or more moderate temperatures in some areas, the overall effects are likely to be harmful. Sea-level rise, as a result of climate change, could lead to the loss of many coastal wetlands, and entire island nations could disappear. Changes in the quality and availability of water resources could occur and worsen conflicts over water use. Healthy forests could be greatly reduced as the range of tree species shifts. Additionally, humans could suffer from increases in the spread of infectious diseases, heat-related deaths, and air pollution.

Global climate change could potentially cause sea levels to rise as oceans warm and expand and as a result of ice cap and snow cover melting. The Intergovernmental Panel on Climate Change projects a sea level increase of six inches to more than three feet by the year 2100. Because half the U.S. population lives within 50 miles of the coastline, this would be disastrous. Large areas of Florida and Louisiana could be submerged, while many beaches along the East Coast would disappear. Even worse, many small-island nations with no high ground to retreat to could disappear altogether.

The worldwide redistribution of disease vectors - the animals, insects, microorganisms and plants that transmit diseases - which is already upon us could increase due to global climate change. Many tropical diseases such as dengue fever, yellow fever, and malaria are beginning to be seen at higher latitudes and altitudes as warming occurs. This warming could potentially result in a greater number of people being exposed to these deadly diseases.

Many ecosystems could have a difficult time adjusting to the rapid rate of climate change if the world does not reduce greenhouse gas emissions. Animals and plants that are excellent competitors under stable environmental conditions often cannot survive when their habitat is altered by rapid change. Instead, parasite species such as weeds, rodents, insects, bacteria and viruses will quickly reproduce and colonize disturbed environments. The recent population explosion of termites, cockroaches and mosquitoes in New Orleans and rodents in southern Africa are examples of this type of problem.

There are also likely to be significant economic and social costs as agriculture is forced to make painful adjustments in response to climate changes. Droughts, floods and storms could become more severe, and entire agricultural regions could become disrupted as rainfall and temperature patterns shift. It is unknown whether farmers and governments will be able to adopt new techniques and management approaches that can deal with the negative impacts of climate change. It is also hard to predict how relationships between crops, pests, weeds, and livestock will evolve. The result could be an inability to provide adequate food resources to a growing world population. This could lead not only to higher food prices, but also to increased conflict throughout the world as people compete for resources in a very different global environment.

Table 1. Natural Sources of Carbon Dioxide and Methane

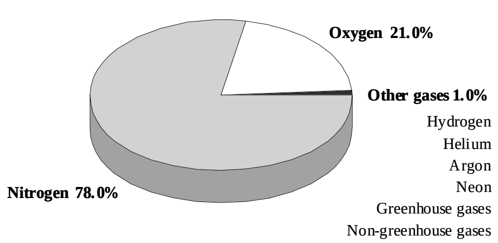
Source	Emission
Volcanic eruptions	Carbon Dioxide (CO_2)
Natural fires	
Wetlands	Methane (CH_4)
Termites	
Oceans	
Fresh waters	
Hydrates	

Source: Anthropogenic Methane Emissions in the U.S.: Estimates for 1990

The Earth's Atmosphere and the Greenhouse Effect

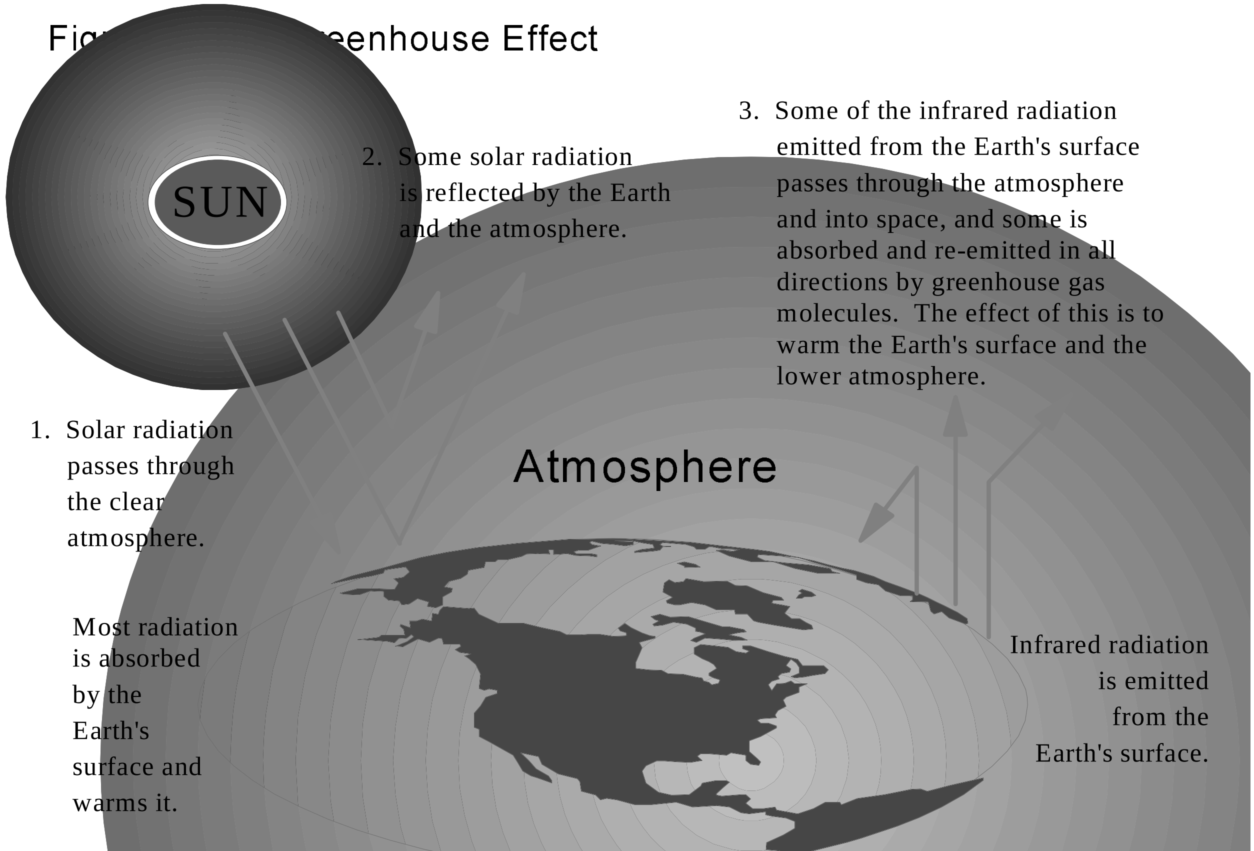
In order to understand why global climate change is occurring it helps to understand what occurs in the Earth's atmosphere. The Earth's atmosphere consists mainly of nitrogen and oxygen, with small amounts of hydrogen, helium, argon, neon, and other gases (see Figure 1). Some of the other gases, such as carbon dioxide (CO_2) and methane (CH_4), are major greenhouse gases. A greenhouse gas is a gas that traps **infrared energy** (heat) in the atmosphere. Table 1 lists the natural **sources** of carbon dioxide and methane. Other gases include nitrogen oxides, nitrous oxide, and CFCs.

Figure 1. Components of the Atmosphere



Even though greenhouse gases represent only a small portion of the gases in the Earth's atmosphere, they play an important role in the Earth's climate. By trapping heat in the atmosphere instead of letting it escape into space, these gases warm our planet. This natural warming phenomenon is known as the **greenhouse effect** and is very beneficial. Without the greenhouse effect, the Earth would be on average 60°F colder and unable to support plant and animal life as we know it. Figure 2 illustrates the greenhouse effect and shows how greenhouse gases act like a blanket to trap heat in the atmosphere.

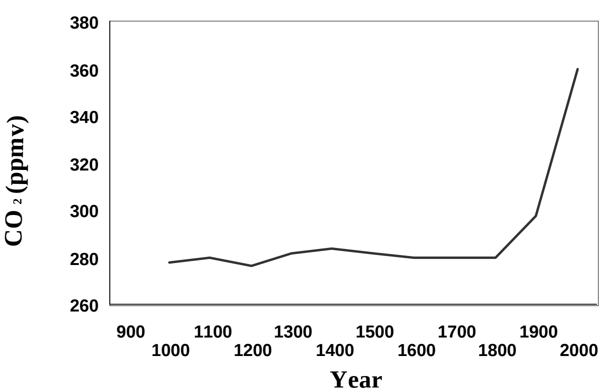
During the past century, greenhouse gas concentrations in the atmosphere have been rising sharply. This is due largely to the increased production of these gases from human-related, or **anthropogenic,** sources such as the burning of fossil fuels like oil and coal. Figure 3 shows how the concentration of CO_2 in the atmosphere remained fairly constant for hundreds of years



Source: U.S. Department of State 1992

until the late 1800s when it began to increase rapidly. This rapidly increasing concentration of CO_2 in the atmosphere coincides with the beginning of the industrial revolution when humans were expanding their use of fossil fuels. As human activities have increased the concentration of greenhouse gases in the atmosphere, the natural greenhouse effect has been amplified, leading to rising global temperatures and global climate change.

Figure 3. CO_2 Concentration Over Time



Source: Intergovernmental Panel on Climate Change, 1994

The largest sources of anthropogenic greenhouse gases are listed in Table 2. They include the burning of coal, oil, and natural gas, and activities such as raising cattle, growing rice, and cutting down trees for agriculture and development. While all of these activities are needed, an effort must be made to minimize the quantity of greenhouse gases emitted from these sources. If action is not taken, scientists believe that the atmospheric level of greenhouse gases could triple by the year 2100 resulting in irreversible global climate change.

Water vapor is also an important greenhouse gas that needs to be considered. While human activities do not directly add large amounts of water vapor to the atmosphere, warmer air, which results from human emissions of greenhouse gases, holds more water vapor. Because of the increased amount of water vapor in the atmosphere, global warming could be further enhanced. This indirect effect is called a positive feedback and could play a large role in future climate change.

Table 2. Major Anthropogenic Sources of Greenhouse Gases

Source	Emission(s)
Fossil fuel combustion: *coal, natural gas, petroleum*	CO_2, CH_4, N_2O
Fuel production and processing: *coal mining, oil, and natural gas systems*	CO_2, CH_4
Transportation	CO_2, CH_4
Industrial processes	CO_2, N_2O, CH_4
Landfills	CH_4
Wastewater treatment	CH_4
Waste incineration	N_2O
Land use change	CO_2
Biomass burning	CO_2, CH_4
Agricultural activities: *digestive processes of domesticated ruminant livestock, manure management, rice cultivation, agricultural waste burning, agricultural soil management, fertilizer use*	CO_2, CH_4, N_2O
CO_2 = Carbon Dioxide N_2O = Nitrous Oxide CH_4 = Methane	

Source: Anthropogenic Methane Emissions in the U.S.: Estimates for 1990

Conclusion

Global climate change is a growing environmental problem that threatens not only our environment but perhaps the very way we live on Earth. A 1995 assessment by 2,500 scientists determined that human activities are contributing to this problem through the emission of greenhouse gases. There is general agreement that the overall effect of global climate change could be harmful to the environment and humans, leading to many environmental problems. At the root of global climate change is the greenhouse effect which helps keep the earth warm by trapping heat at the earth’s surface. The problem; however, is that humans have amplified the natural greenhouse effect, causing the earth's surface to warm too much, therefore altering the natural climate.

Greenhouse gases are released into the atmosphere from both natural and anthropogenic (human-caused) sources. The amount of greenhouse gases released through human activity has increased dramatically in recent years. This is leading to excessive atmospheric concentrations of greenhouse gases, amplification of the natural greenhouse effect, and global climate change. Efforts are underway to reduce emissions from anthropogenic sources to prevent global warming and protect the Earth's natural climate system.

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What Is Methane?

Methane (CH_4) is one of the primary greenhouse gases found in the Earth's atmosphere. It is the principal component of natural gas and often serves as an energy source in homes, cars, and power plants. Methane is produced by the decomposition of organic matter in the absence of oxygen. This process is known as **anaerobic decomposition**. Examples of where this occurs are rice production, wetlands, manure lagoons, and in the digestive process of ruminant animals.

Reducing methane emissions from anthropogenic sources can be a very effective means of lowering the methane concentration in the atmosphere and, in the near term, slowing global climate change. Reducing methane emissions is important because:

- ❖ Methane is second only to carbon dioxide in its contribution to the greenhouse effect.
- ❖ Methane concentrations in the atmosphere are rising and have more than doubled over the last two centuries.
- ❖ Methane is a very potent greenhouse gas -- 21 times more effective at trapping heat in the atmosphere than carbon dioxide on a kilogram per kilogram basis.
- ❖ Methane has a relatively short atmospheric life compared to other greenhouse gases, so reducing methane provides relatively rapid benefits.
- ❖ Most anthropogenic methane emissions are controllable through cost-effective reduction technologies that are currently available.

Sources and Sinks of Methane

Methane is released into the atmosphere from both natural and anthropogenic **sources**. Methane emissions from natural sources make up approximately 30% of the total global methane emissions. The major natural sources of methane and the estimated amounts released by these sources each year are shown in Table 3.

Table 3. Natural Sources of Methane Emissions

Source	**Estimated Amount** (million metric tons/year)
Wetlands	115
Termites	20
Oceans and fresh water	15
Gas hydrates	5
TOTAL	155

Source: Anthropogenic Methane Emissions in the U.S.: Estimates for 1990

Methane from anthropogenic sources accounts for the remaining 70% of emissions. Table 4 lists these sources and the estimated amounts they release each year.

The concentration of methane in the atmosphere is regulated by the balance between sources and sinks. A **sink** is something that absorbs, destroys, or removes gases from the atmosphere. When sources of greenhouse gases exceed sinks, methane concentration in the atmosphere increases and contributes to an amplified greenhouse effect. In recent years, the concentration of methane in the atmosphere has been increasing at a rate of about one percent per year. This increase is largely attributed to increased emissions from anthropogenic sources.

The primary sink for methane is the atmosphere itself which contains free hydroxyl (OH) ions. Once released into the atmosphere, methane undergoes a chemical reaction in the troposphere (lower region of the atmosphere),

Table 4. Anthropogenic Sources of Methane

Emissions

Source	**Estimated Amount** (million metric tons/year)
Domesticated livestock	80
Rice farming	60
Natural gas, petroleum processing and use	50
Coal mining	40
Biomass burning	40
Landfills	30
Livestock manure	25
Wastewater treatment	25
TOTAL	350

Source: Anthropogenic Methane Emissions in the U.S.: Estimates for 1990

combining with hydroxyl ions to form water vapor and carbon dioxide. A secondary sink is the soil which contains bacteria that absorb methane and oxidize it. Because the emission of methane exceeds its removal by sinks, concentrations are increasing, enhancing the natural greenhouse effect and contributing to global climate change.

Agricultural Sources of Methane

Over half of the world's anthropogenic methane emissions are produced by agricultural activities. The primary sources of agricultural methane include domesticated ruminant livestock, rice cultivation, and the handling and processing of livestock manure. In addition, about half of the emissions from biomass burning are attributed to agriculture.

Rice is produced using shallow flood irrigation. This flooding process allows for anaerobic decomposition of organic matter, which produces methane. The methane is released into the atmosphere through the stems of growing rice plants.

Liquid manure management systems used by many swine and dairy farmers also produce large amounts of methane. These systems use anaerobic decomposition to break down the organic material in the manure. This decomposition process produces and releases methane into the atmosphere.

Because of an increasing population pressure on land, farmers in many regions of the world convert forest land into crop land by burning. Savannah and range land biomass are often burned to improve forage production for livestock. Also, in many parts of the world, agricultural residues are burned for cooking fuel. This biomass burning produces methane emissions as a result of incomplete combustion.

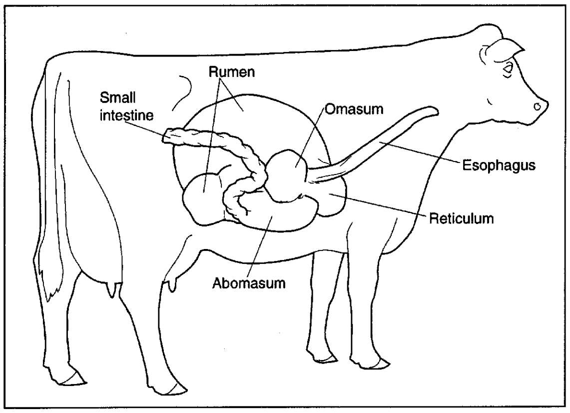
The greatest agricultural source of methane, however, is domesticated **ruminant livestock,** such as cattle, sheep and goats. Methane from this source is produced by bacteria in the animal's digestive system that break down fibrous foods. The animal releases the methane gas into the atmosphere mainly through its mouth and nostrils.

How Do Ruminant Animals Produce Methane?

Ruminant livestock such as cattle have a unique digestive system that allows them to eat coarse plant material that humans and other animals cannot digest. This is very useful for humans because it allows us to obtain food from land that is not suitable for crop production by having livestock harvest the forage and convert it to milk or meat. The unique digestive system of a ruminant animal consists of a four-part stomach, which includes the rumen, reticulum, omasum, and abomasum (see Figure 4). The **rumen** is the first and largest compartment, making up about 80% of the total stomach volume, and is unique to ruminant animals. In the rumen**,** microbial organisms such as bacteria, protozoa, and fungi break down and ferment the plant material into products that the animal can use for energy.

Some of the most important products of this digestive process (called **enteric fermentation**) are organic acids. These acids are absorbed into

Figure 4. Digestive System of a Ruminant Animal



the animal's bloodstream to provide energy to support maintenance and production. **Maintenance functions** are those bodily processes that allow the animal to survive. They include respiration, blood circulation, skeletal support, and body temperature maintenance. **Production functions** include growth of body tissue (meat), lactation (milk), work (draft power) and reproduction.

A by-product of a ruminant animal's digestive process is methane, produced by microorganisms in the rumen called **methanogens.** The animal releases methane into the atmosphere by exhaling or belching the gas through its mouth and nostrils. Methane produced by cattle is actually a loss of feed energy from the diet and represents inefficient utilization of the feed. Ruminant nutrition researchers are seeking ways to conserve some of the feed energy wasted as methane, that can reach as high as seven percent of the total energy content of the diet.

Scientists involved in ruminant nutrition research have for many years been interested in how cattle energy requirements can be met through various diets. This research has produced a great deal of information describing the amount of methane produced by individual animals. They have found that many factors influence methane production in ruminant animals, including:

- the physical and chemical characteristics of the feed;
- the feeding level and schedule;
- other dietary components such as feed additives that promote growth and production efficiency; and
- the activity and health of the animal.

The amount of methane an animal produces is influenced most by feed intake levels and digestibility of the feed. Focusing on methane production in ruminant nutrition studies, may enable researchers to find ways to improve the efficiency of livestock production and protect the environment at the same time.

Conclusion

Methane is one of the primary greenhouse gases in the Earth's atmosphere and is second only to carbon dioxide in its contribution to the greenhouse effect. The concentration of methane in the atmosphere has more than doubled in the last 200 years, which is why it is important to research and develop strategies to reduce emissions of methane.

The major source of anthropogenic methane results as a by-product of a ruminant animal's normal digestive process and represents a loss of dietary energy. Methane production from ruminant animals is influenced by two main factors: quantity of feed intake and digestibility of the feed. Animal nutrition researchers are looking for ways to reduce methane emissions from ruminants in order to improve livestock production and help the environment.

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Reducing Methane Emissions Through Increased Productivity

The most promising and cost-effective way to reduce methane emissions from cattle is to improve the efficiency of livestock production. A more efficient animal will have lower methane emissions relative to the amount of milk or meat it produces. This means that for every pound of meat or milk produced by an animal, less methane is emitted. Though highly productive livestock usually emit more methane per head than less productive livestock, they also produce more milk or meat. As a result, the ratio of methane emissions to milk or meat production is lower than with cattle that are not highly productive. In other words, less methane is emitted on a per unit of product basis. On a national or global scale, these productivity gains will have two effects. First, the overall demand for animal products can be met with fewer but more efficient animals. Second, total methane emissions will decrease.

The United States dairy industry has in fact already demonstrated this point. If we look at the 30-year period from 1960 - 1990, milk production increased significantly while the population of dairy animals and total methane emissions decreased. As shown in Table 5, the industry produced 10 million tons more milk with 7.4 million fewer animals in 1990 than in 1960. As an additional benefit, 170,000 fewer tons of methane were emitted in 1990 than in 1960.

The beef industry has also made significant productivity improvements in recent years. However, there is still room for improvement and even greater opportunities exist to reduce methane emissions from beef cattle than with dairy cattle. There are two main reasons for this. First, in the United States, the beef cattle population is much larger than the dairy cattle population. Second, the beef industry has a large number of operations with low production efficiencies, especially in the cow-calf sector of the industry which is the largest sector. Within this sector, it is generally the smaller-scale operations with fewer than 100 cows that have the greatest opportunity to reduce emissions through increased production efficiency.

Table 5. Productivity Gains and Methane Reduction in the U.S. Dairy Industry

	1960	**1990**
Milk / cow / year	3196 kg	7000 Kg
Methane / cow / year	76.1 kg	114.6 kg
Methane / kg milk	24 grams	17 grams
Dairy cows	17.5 million	10.1 million
Total milk produced by dairy cattle	55.9 million tons	65.6 million tons
Total methane produced from dairy cattle	1.33 million metric tons	1.16 million metric tons

The most promising opportunities for increasing productivity and reducing methane emissions from the beef industry are those that improve reproductive performance in cow-calf operations. As the percentage of successful pregnancies increases and weaned calf weights rise, a smaller but more efficient cow population will be needed to supply the number of calves to satisfy the market demand. With fewer animals needed, less methane will be emitted.

Management Practices to Improve Productivity

Numerous management practices can be used to improve productivity in cattle operations. A few of these practices are:

Controlled Grazing

One of the best ways for cow-calf and stocker managers to improve the productivity of their operations is to implement a well-planned **controlled grazing** system. This can result in greater production of higher quality forage than with traditional grazing practices. With the development of new fencing and watering technologies, farmers and ranchers can now take advantage of the economic benefits associated with this highly productive grazing system while protecting the environment.

In many parts of the country, beef cattle are raised using a continuous stocking approach despite the numerous economic and environmental drawbacks of this technique. Continuous stocking is a management system where cattle have uninterrupted use of a unit of grazing land throughout the grazing season. This system of grazing often fails to maximize the productive potential of the land resulting in wasted forage, decreased pasture productivity, and lower liveweight gains per acre of land.

Controlled grazing, a more productive grazing system, requires a pasture to be subdivided into individual grazing units called paddocks. The individual paddocks are alternately grazed and rested throughout the grazing season. The paddocks are grazed to keep plants in a "vegetative" stage, the stage just before seed production. The size and number of paddocks depends upon pasture productivity, stocking rate, and the desired residency period of the livestock in each paddock. Because it is easier to maintain an effective balance between forage demand and supply with controlled grazing, this system can promote higher forage yields, more uniform levels of forage quality, and improved harvest efficiencies.

Because controlled grazing leads to more productive cows and greater liveweight gains per acre, producers can benefit from increased profits while reducing methane emissions per pound of beef produced. An additional benefit of controlled grazing is the increased ability of the pastures to act as a sink for carbon dioxide, the major greenhouse gas. As pasture quality improves with controlled grazing, carbon builds up in the soil and plant biomass, reducing the total amount of carbon dioxide in the atmosphere.

Disease Control and Herd Health

Another way to improve livestock productivity is by controlling disease and improving herd health. A healthy animal is a more efficient animal that produces less methane per unit of product. Producers can control diseases and maintain herd health by the appropriate use of antibiotics, vaccines, and other health maintenance products (e.g., dewormers). These products can increase profitability and production efficiency.

Disease control includes proper timing and appropriate use of vaccines as a disease prevention measure. Once an animal is sick, selective use of antibiotics is beneficial. Vaccines, antibiotics, and associated veterinary costs are expensive, but they pay off in increased productivity and improved herd health.

A health maintenance plan is very important to maximize animal productivity. One of the most important parts of health maintenance is regular deworming of animals. Internal parasites disturb the normal functioning of the animal's system, especially the digestive tract. An animal infected with parasites (e.g., ticks, worms) requires more feed per unit of weight gain than a parasite-free animal. In other words, the maintenance energy requirement increases if an animal has parasites. The greater the maintenance requirements, the slower the rate of weight gain.

Good managers recognize health problems quickly and isolate and treat sick animals to prevent the problem from spreading throughout the herd. A good health maintenance program will increase profits and decrease total methane emissions.

Strategic Supplementation

Better nutrition, through strategic supplementation of diets, reduces methane emissions per unit of product by enhancing weight gain, milk production, and reproductive performance. Targeted mineral and protein supplements should be used to correct deficiencies in the diet of fed and grazing animals and make improvements in animal performance. When animals receive low-protein diets or graze on poorquality pastures (especially in semi-arid grazing areas), supplements should be used.

Examples of possible supplements include industry by-products such as molasses, sugar beet pulp, grape pomace, brewery waste, and distillers grains. Supplements such as these can reduce overall methane emissions by improving the nutritional quality of the diet and digestibility of the feed, thereby improving production efficiency. Though supplements can add to production costs, increases in feed digestibility and productivity can make this alternative both profitable and environmentally sound.

Production-Enhancing Agents

Certain chemical agents can act directly to improve productivity in livestock and as a result, methane emissions per unit of product will be reduced. A number of pharmaceutical products have been developed to enhance beef and/or milk production.

Bovine Somatotropin (bST) is a naturally-occurring hormone produced by the cow's pituitary gland. Through modern technology, it is now possible to produce large quantities of this hormone in laboratories. This artificially-produced hormone, bST, can be injected into dairy cows, where it increases milk production by approximately 12% per lactation. This improved milk production will result in reduced methane emissions per unit of milk produced.

Another method of improving productivity with beef cattle is through the use of anabolic steroids. Steroid implants are a proven technique for improving feed conversion efficiency and increasing the growth of lean tissues. Hormone-based growth stimulants can increase feed conversion efficiency by 5-10% over non-growth stimulant production.

Ionophores, such as Rumensin and Monensin, are commonly used to supplement the diets of fed cattle. An ionophore can enhance animal performance and improve weight gain. Methane production is suppressed indirectly because the rate of liveweight gain is increased without increasing feed consumption.

Genetic Improvements

Yet another way to increase livestock productivity is to bring genetic traits into the herd that enhance desirable characteristics. If heritable traits can be identified and enhanced to increase the level of production in animals, then overall methane emissions will decrease.

Feed conversion efficiency is one example of an inherited trait that can lead to lower methane emissions. Genetic traits can be bred into animals that allow them to convert grains and roughage into meat, milk, and other products more efficiently.

Improved genetics combined with good management can also increase reproductive efficiency of brood cows. This can result in higher birth rates and calf weaning weights and shorter intervals between calvings. Because increased reproductive efficiency decreases the size of the brood herd needed to produce a given number of calves, methane emission per unit of meat produced is reduced.

Another genetic improvement to select for is increased growth rates of calves. Feeder cattle with greater rates of gain take fewer days to reach slaughter weight. Overall methane emissions are reduced since the animal's lifetime is shortened and the total amount of feed it consumes is reduced.

Improved genetics can increase biological efficiency and reduce methane emissions per unit of product because fewer but more efficient animals can satisfy the consumer demand for livestock products. Research on genetic improvements is valuable because it can help producers improve the profitability of their operations while decreasing overall methane emissions.

Profitability and Environmental Stewardship

The management practices identified here focused on improving efficiency and productivity to reduce methane emissions on a per unit of product basis. However, as with any enterprise, the cost of improving productivity must be offset by increased revenue resulting from the improvement. The most profitable practices may not always be the ones that work best for an individual producer. Each producer should adopt the set of practices that best matches his/her available resources, including forages, equipment, labor, and cost of feed supplements. Because of this, no firm set of guidelines or practices can define what is economically best for all producers. In general terms, however, producers can increase the efficiency and profitability of their operations through better genetics, improved pasture management, a good herd health program, and strategic feed supplementation.

Environmental stewardship occurs when an individual recognizes a personal obligation to maintain or improve the environment. Cattle producers are fortunate to be able to respond to the issue of global climate change by being good environmental stewards while also improving their operation's profitability and maintaining their lifestyles. In addition to reducing emissions of methane and other greenhouse gases, cattle producers can simultaneously improve the soil, water, and wildlife habitat through the use of good management practices. A well-managed livestock operation not only makes a profit for the producer it provides valuable consumer products, and protects the environment.

Conclusion

When producers improve livestock production efficiency, less methane is released per unit of product (milk, meat). At a national or global level, this results in lower total emissions because fewer but more efficient animals are able to meet consumer demand. Although methane emissions from livestock cannot be totally eliminated, good management practices can reduce overall methane emissions while providing more animal products (meat and milk) for consumers.

There are numerous methods that producers can use to increase the productivity of their herds. Techniques include improved grazing management, genetic improvements, strategic supplementation, use of production-enhancing agents, and better disease control and herd health. Proper use of these methods can also help producers increase profits, reduce methane emissions from ruminant animal production, and protect the global climate.

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Key Words

Anaerobic decomposition - The breaking down of organic matter in the absence of oxygen.

Anthropogenic - Related to human activity.

Carbon dioxide (CO_2) - A gas released in an animal's normal respiration process and in the combustion of fossil fuels. A molecule of this gas contains one carbon atom and two oxygen atoms.

Controlled grazing - A grazing system that subdivides a pasture into multiple paddocks which are alternately grazed and rested.

Enteric fermentation -The digestive process in ruminant animals in which microorganisms break down feed into organic acids, methane, and other products.

Global climate change - Long-term changes in the Earth's climate and temperature patterns.

Greenhouse effect - Trapping of heat energy within the Earth's atmosphere by a layer of greenhouse gases.

Greenhouse gases - Gases that trap infrared energy in the atmosphere. Major greenhouse gases include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20).

Infrared energy - Heat.

Maintenance functions - Bodily processes such as respiration and blood circulation required to keep an animal alive.

Methane (CH_4*)* - Natural gas, biogas, or swamp gas. A molecule of this gas contains four hydrogen atoms and one carbon atom. A potent greenhouse gas.

Methanogens - Bacteria that produce methane.

Production functions - Production functions include growth of body tissue (meat), lactation (milk), work (draft power) and reproduction.

Ruminant livestock - An animal with a stomach divided into four compartments.

Rumen - The first of a four-part stomach in a ruminant animal where fermentation takes place.

Sinks - Things that absorb, destroy, or remove gases from the atmosphere.

Sources - Things that release greenhouse gases into the atmosphere.