Nature, the Ultimate Recycler

Hydrologic Cycle

Nature recycles everything. The hydrologic cycle is the name given to the process used by nature to recycle water. Water evaporates and exists for a time as water vapor in the air. It returns to the earth's surface as precipitation. A portion of the precipitation evaporates from the surface and re-enters the atmosphere as vapor and continues the cycle. A portion runs off into streams and rivers which find their way the ocean. The portion that soaks into the soil is either taken up by plant roots and is expelled as water vapor from the plant leaves (transpiration) or it percolates below the root zone where it eventually finds its way to an aquifer or it emerges as a spring.

Water is a part of the biological process within every cell of every plant and animal on earth. Not only is water essential for life to exist on a cellular level, it also serves to regulate global temperature by distributing heat via ocean currents. One need only watch the pictures being returned by the NASA rovers on Mars to imagine what the earth would look like if we lost our water the way Mars apparently did.

Nitrogen Cycle

Another natural cycle and one of great importance to farmers is the nitrogen cycle. Seventy-eight percent of earth's atmosphere is comprised of nitrogen gas. To help one grasp the enormity of the quantity of nitrogen contained in the atmosphere, consider this. Some estimate the quantity of nitrogen in the atmosphere to be sufficient to supply nearly 6,000 pounds of nitrogen per square foot of surface area on the earth.

Green plants need nitrogen. Nitrogen enters into many processes within the plant and is essential for the formation of proteins. The irony is green plants cannot use nitrogen gas as a source of nitrogen for biological processes. Plants use nitrogen primarily in two forms, the nitrate ion (NO_3^-) and the ammonium ion (NH_4^+).

A small amount of nitrogen is converted to plant-available forms in thunderstorms. The intense heat of a lightening bolt combines nitrogen gas with oxygen gas and water (rain) in the atmosphere to form a weak nitric acid. Nitric acid converts to nitrate in soil and can be taken up with soil water and utilized by plants. Thunderstorms contribute a few pounds of plant-available nitrogen per acre per year.

Legume plants (e.g. beans, peas, alfalfa) can be colonized by specialized bacteria which cause the plant to form nodules on the roots. The bacteria live and reproduce within these nodules and feed on plant sugars. As a part of their metabolism they take in nitrogen gas from the soil air and convert it to ammonium which is utilized by the plant as a source of nitrogen. The conversion of nitrogen gas to ammonium is called nitrogen fixation. Farmers routinely inoculate legume seed with these bacteria to make certain that the symbiotic relationship between plant and bacteria will occur in their legume crops.

When any green plant dies, bacteria break the tissues down into organic matter in the soil. The organic matter is further broken down into elemental compounds. The organic forms of nitrogen incorporated into the organic matter cannot be used by plants until they are converted to the ammonium form (mineralized) by bacteria.

People have also learned to fix nitrogen into forms that can be used by plants. The process involves combining nitrogen gas from the atmosphere with methane gas (natural gas) in an anhydrous ammonia plant. Methane contains one carbon atom and four hydrogen atoms (CH_4). The hydrogen atoms are stripped from the methane and combined with nitrogen from the air to form anhydrous ammonia (NH_3). The carbon atom from the methane is combined with oxygen from the air to make carbon dioxide (CO_2). Therefore, all anhydrous plants produce both anhydrous ammonia and carbon dioxide. All other forms of commercial nitrogen fertilizer start with anhydrous ammonia as the source of nitrogen.

When anhydrous ammonia is injected into the soil, it combines with water to form ammonium (NH_4^+) which is held by the negatively charged clay and organic matter particles in the soil. Plants can take up the ammonium from the soil by exchanging a hydrogen ion (H^+) through a process called cation (pronounced kat-i-on) exchange.

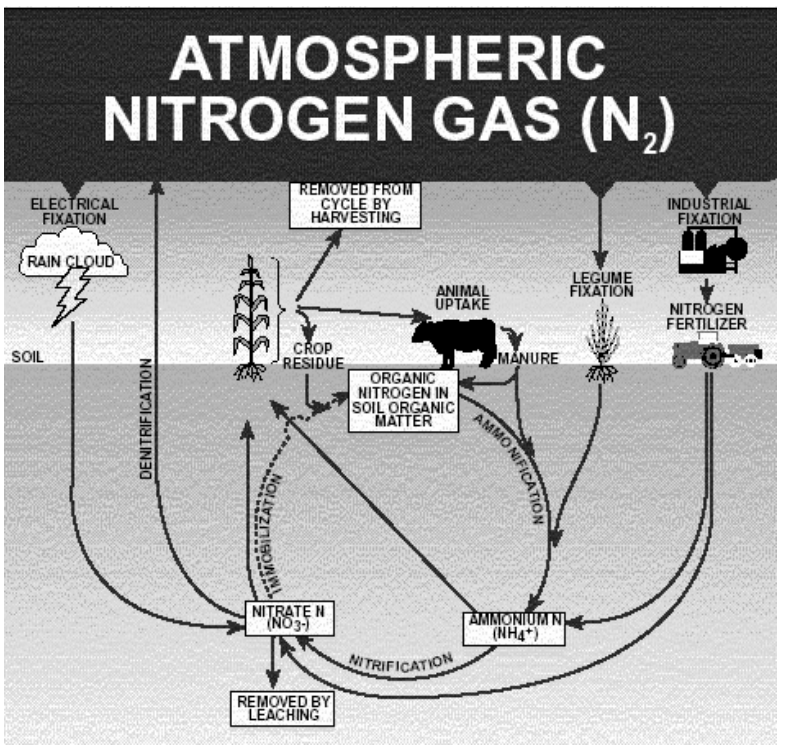
The nitrogen cycle continues when other bacteria in the soil convert ammonium ions to nitrate ions (NO_3^-) through a process called nitrification. While ammonium is held in the cation exchange complex, nitrate, having a negative charge, is not held on the soil particles. Nitrate nitrogen in the soil is dissolved in the soil water. Like ammonium, nitrate can be taken up and utilized by plants.

When soils become saturated with water and oxygen is limited, bacteria in the soil utilize the nitrate as an oxygen source, thus converting nitrate ions to nitrogen gas which leaves the soil and re-enters the atmosphere.

Nitrate also has the potential to move downward with the soil water. It may emerge as a contaminate in springs which feed creeks and rivers or continue downward until it enters and becomes mixed with the groundwater. The federal EPA has set limits on the nitrate content of public water supplies because of the potential negative effects of ingesting too much nitrate, especially by babies and people with other health problems.

Carbon Cycle

Another cycle which affects us all is the carbon cycle. Green plants combine carbon from carbon dioxide (CO_2) gas from the air with water taken from the soil to produce simple sugars in a process called photosynthesis. Excess oxygen (O_2) is expelled from the plant as a waste product of photosynthesis. The simple sugars undergo further processing in the plant and are converted into more complex carbohydrates which make up plant tissues and are stored in the seed as an energy source for the germinating embryo. All processes need a source of energy. Plants contain a chemical called chlorophyl which is able to harness the energy from sunlight to drive the photosynthesis reaction.



Nitrogen Cycle

Plant tissues containing carbohydrates are consumed by animals where they are digested and broken down into simpler sugars and then absorbed into the blood stream. At the cellular level, sugars are combined with oxygen from the blood to provide energy for cell metabolism. Carbon dioxide is a waste product of metabolism within animal cells. This carbon dioxide is removed by the blood where it is carried back to the lungs and exhaled by the animal back into the atmosphere.

Carbon that remains tied up in plant residues, the organic matter in the soil or other stable forms is said to be sequestered. Coal and petroleum are examples of extremely stable carbon compounds that were once plant matter. Limestone is another example of extremely stable carbon sequestration by nature. Limestone is made up of the calcium carbonate that was once a part of the bodies of aquatic creatures. When these creatures died, the calcium carbonate in their bodies accumulated and we mine them today as limestone from areas that once were covered by shallow seas (eastern Nebraska).

Presumably, prior to the rise of modern man, the carbon cycle attained an equilibrium state where a balance existed between the carbon dioxide in the air and the carbon sequestered in various solid forms on the earth. However, the level of carbon dioxide has measurably increased in the atmosphere during the last few hundred years mainly due to the burning of fossil fuels (coal and petroleum) during the industrial age.

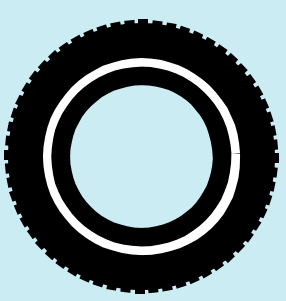
The destruction of forests has had an effect on the level of carbon dioxide as well, in part due to the reduction in the rate of photosynthesis when rain forests are cleared and converted to cultivated land. Carbon dioxide in the atmosphere traps heat energy that would otherwise be radiated out into space by the earth in much the same way the glass roof of a greenhouse traps heat within the greenhouse. This greenhouse effect has many implications for global climate and is an area of much study today. There may come a time when farmers are paid to adopt farming practices that sequester more carbon in the soil in the form of organic matter. This is a matter for debate by politicians and world leaders.

Cycles are a miraculous part of nature. They literally make life on earth possible. When one considers the complexity of cycles, the numbers of species of bacteria necessary to make it all work and delicate balance that must exist, it can boggle the mind. (TD)

Scrap Tire Collection Announced

Extension has been notified about an opportunity for individuals to get rid of scrap tires that may have accumulated around your place. This program is funded through a grant from the Nebraska Department of Environmental Quality and hosted by officials from Sanitary Improvement District Number 6.

Tires (without the wheels) will be accepted May 15 and 16 from 9 a.m. to 9 p.m. at the Shoemakers south parking lot 48th and West O Street, Lincoln. Three hundred and fifty tons of tires will be accepted in this recycling effort on a first-come, first-served basis. Please have a count of the number of tires you are dropping off.



Sorry, this opportunity is open to individuals only — the grant specially prohibits tire dealers.

For more information, call (402) 476-3590. (TD)

Guidelines for Farm Debt

Debt is a part of every farmer's life. In fact, most agricultural producers now find debt is necessary to the success of their operations. Credit should be seen as a resource by producers because when managed carefully, it can do wonders to enhance the profitability of the operation. But in the end, debt is debt. When too much of it is accrued, trouble strikes. Here are four financial ratios that can help to assess exactly how much is too much.

The debt to asset ratio is the ratio of total farm liabilities to total farm assets. Guidelines based on farm record studies indicate that total debt less than 40 percent of the total value of assets is acceptable. Debt between 40–70 percent is questionable and debt over 70 percent of the value of assets is in the danger zone.

The rate of return on assets (ROA) reflects the productivity of farm assets. So long as the ROA is greater than the interest rate, the borrowed funds are aiding in the profitability of the operation. For example, an operation with an ROA of 12 percent and borrowing money at nine percent, is using credit profitably and can benefit from a high level of debt.

Interest expense ratios measure the percent of gross revenue being spent for interest. In most cases, 10 percent or less is optimal. Up to 20 percent is cause for concern, and any higher than 20 percent is dangerous.

The term debt coverage ratio indicates the ability of the business to cover all term debt and capital lease payments. It is the ratio of funds available to service term debt to the amount of existing term debt payments. Any ratio greater than one to one indicates the business has reserve capacity to service term debt and capital lease payments.

Remember these ratios are only guidelines based on the facts, every ranch or farm is unique. (TD)