AS-954 (Revised)

Livestock AND Water

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Water is an important but often overlooked nutrient for livestock.

Water makes up more than 98 percent of all molecules in the body and is necessary for regulation of body temperature, growth, reproduction, lactation, digestion, lubrication of joints and eyesight, and as a cleansing agent.

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JUNE 2008

Water Intake

Before discussing water quality, knowing how much water animals require is important. Water requirements are influenced by several factors, including rate of gain, pregnancy, lactation, activity, type of diet, feed intake and environmental temperature. These requirements are met by water consumed from wells, ponds, fountains, etc., as well as moisture found in feedstuffs.

Table 1 lists estimated water intakes for lactating beef cows, dry beef cows and bulls. Table 2 lists estimated water intakes for growing and finishing beef cattle. Water requirements of cattle also can be estimated based on ambient temperatures and feed intake (Table 3). Table 4 lists the water requirements for sheep. Table 5 lists recommended water intakes for dairy cattle. Table 6 lists the water requirements for swine. Table 7 lists the water requirements for horses.

Limiting water intake can depress animal performance more quickly and drastically than any other nutrient deficiency. Domesticated animals can live about 60 days without food, but only seven days without water. Hearing and sight are impaired without water.

Signs of dehydration

Signs of dehydration or lack of water are tightening of the skin, loss of weight, and drying of mucous membranes and eyes. In cattle, the eyes will appear sunken and dull. Dehydration in lactating dairy animals results in near cessation of milk production.

One way to check for dehydration in the horse is by skin folds. Pull the skin over the shoulder and hold a moment. Release and count the seconds until the fold disappears. On a dehydrated horse, the skin will stand for several seconds.

Table 1. Estimated daily water intakes (gallons per head per day) for lactating beef cows, bred cows, dry cows and bulls.

Month	Monthly Average Temp	Lactating Cows	Dry Cows, Bred Cows and Heifers	Bulls
	(F)	gallons per head per day		
January	36	11.0	6.0	7.0
February	40	11.5	6.0	8.0
March	50	12.5	6.5	8.6
April	64	15.5	8.0	10.5
May	73	17.0	9.0	12.0
June	78	17.5	10.0	13.0
July	90	16.5	14.5	19.0
August	88	16.5	14.0	18.0
September	78	17.5	10.0	13.0
October	68	16.5	8.5	11.5
November	52	13.0	6.5	9.0
December	38	11.0	6.0	7.5

Adapted from GPE-1400, Water Requirements for Beef Cattle.

Table 2. Water requirements of growing and finishing beef cattle (gallons per head per day).

		Growing Cattle			Finishing Cattle			
Month	Avg. Temp.	400 lb	600 lb	800 lb	600 lb	800 lb	1,000 lb	1,200 lb
	(F)	gallons per head per day						
January	36	3.5	5.0	6.0	5.5	7.0	8.5	9.5
February	40	4.0	5.5	6.5	6.0	7.5	9.0	10.0
March	50	4.5	6.0	7.0	6.5	8.0	9.5	10.5
April	64	5.5	7.0	8.5	8.0	9.5	11.0	12.5
May	73	6.0	8.0	9.5	9.0	11.0	13.0	14.5
June	78	6.5	8.5	10.0	9.5	12.0	14.0	16.0
July	90	9.5	13.0	15.0	14.5	17.5	20.5	23.0
August	88	9.0	12.0	14.0	14.0	17.0	20.0	22.5
September	78	6.5	8.5	10.0	9.5	12.0	14.0	16.0
October	68	5.5	7.5	9.0	8.5	10.0	12.0	14.0
November	52	4.5	6.0	7.0	6.5	8.0	10.0	10.5
December	38	4.0	5.0	6.0	6.0	7.0	8.5	9.5

Adapted from GPE-1400, Water Requirements for Beef Cattle.

Table 3. Water consumption estimates for beef cattle based on thermal environment and dry-matter (DM) intake.

Thermal Environment	Water Requirements
>95 F	8 to 15 pounds of water per pound of DM intake
77 to 95 F	4 to 10 pounds of water per pound of DM intake
59 to 77 F	3 to 5 pounds of water per pound of DM intake (young and lactating animals require 10% to 50% more water.)
29 to 59 F	2 to 4 pounds of water per pound of DM intake
Less than 29 F	2 to 3 pounds water per pound of DM intake (increases of 50% to 100% occur with a rise in ambient temperature following a period of very cold temperatures; e.g., a rise from -5 to 30 F.)

Adapted from Effect of Environment on Nutrient Requirements of Domestic Animals, 1981, NRC.

Table 4. Daily water requirements of sheep.

Class of Animal	Gallons/Day
Rams	2
Dry Ewes	2
Ewes with Lambs	3
5- to 20-pound Lambs	0.1 to 0.3
Feeder Lambs	1.5

Adapted from MWPS-3, Sheep Housing and Equipment Handbook.

Weather conditions may affect water intake and lead to problems such as urinary calculi (waterbelly). Cold weather may reduce water intake, which reduces water flow through the bladder and kidneys. This reduced water flow allows kidney stones to form. When desirable weather returns, water intake increases and urinary calculi problems are seen, primarily in males, because the stones have become too big to pass through the urethra. Any factor that reduces water intake can be a contributing factor to urinary calculi. Hard water does not cause urinary calculi problems, but it may be a factor if the hardness affects water palatability.

Temperature

Avoid watering systems that allow the water to get too hot or to freeze. Drinkable water is usually between 40 and 65 F. Steers that have access to cool drinking water will gain 0.3 to 0.4 pound more per day than those drinking warm water. Occasionally check waterers with heaters to detect a "runaway" (a heating element that is not working properly). Dip a thermometer into the water, but do not allow it to rest on the bottom. Touching the heated bottom of the pan can result in recording a higher temperature than the actual water temperature. Check the temperature during several cold days. Water temperatures of at least 40 F should minimize mechanical problems and maintain animal performance.

Table 5. Water consumption of dairy cattle.[a]

Class of Cattle	Age or Condition	Gallons Per Day[b]
	Drinking Water Only	
Holstein Calves	1 month	1.3 to 2.0
Holstein Calves	2 months	1.5 to 2.4
Holstein Calves	3 months	2.1 to 2.8
Holstein Calves	4 months	3.0 to 3.5
Holstein Heifers	5 months	3.8 to 4.6
Holstein Heifers	15 to 18 months	5.9 to 7.1
Holstein Heifers	18 to 24 months	7.3 to 9.6
Jersey Cows	30 lbs milk/day	13.0 to 15.5
Guernsey Cows	30 lbs milk/day	13.8 to 16.0
Ayrshire, Brown Swiss, and Holstein Cows	30 lbs milk/day	14.5 to 17.0
Ayrshire, Brown Swiss, and Holstein Cows	50 lbs milk/day	24.0 to 27.0
Dry Cows	Pregnant, 6 to 9 months	9.0 to 13.0
	Water Intake From Feed and Drinking Water	
Milk Cows	4.5 to 5.0 lbs/lb milk produced daily	

[a] Adapted from Dairy Reference Manual, Pennsylvania State University.

[b] Consumption at air temperatures of 50 to 80 F; intake depends upon water content of the forage ration. Higher levels apply to an all-hay ration. One gallon of water weighs 8.34 pounds. A cubic foot of water weighs 62.4 pounds.

Table 6. Water intake for various classes of swine.

Class	Gallons/Day
25 lb Pig	0.5
60 lb Pig	1.5
100 lb Pig	1.75
200 lb Pig	2.5
Gestating Sows	4.5
Sow Plus Litter	6.0
Nonpregnant Gilts	3.2
Pregnant Gilts	5.5

Table 7. Water requirements of various classes of horses.

	Estimated Class Water Consumption (gal/day)
Maintenance, 1,100 lbs, thermoneutral environment	6-8 gallons
Maintenance, 1,100 lbs, warm environment	8-15 gallons
Lactating Mare, 1,100 lbs	10-15 gallons
Working Horse, 1,100 lbs, moderate work	10-12 gallons
Working Horse, 1,100 lbs, moderate work, warm environment	12-18 gallons
Weanling, 650 lbs, thermoneutral environment	6-8 gallons

Adapted from Lawrence (1998).

Insulate waterers to reduce problems with water freezing and keep electric costs down in North Dakota winters. Make sure the insulation inside the waterer is still in good condition. Conserve heat by caulking the base of the automatic waterer and seal the access door with weatherproof tape. Reducing wind exposure on the waterer with a windbreak also can reduce electrical costs.

Extra external insulation may be added to some automatic waterers. Surround the external surface with 2 inches or more of plastic foam. Place ½-inch plywood over the plastic foam. Put galvanized steel on the top part of the plastic foam-plywood pieces and angle iron on the vertical edges. Wrap this external insulation with some ⅛-inch steel cable to keep it in place.

Stray voltage in a self-heating trough can reduce water consumption and thus reduce feed intake. Shut off the electricity to automatic waterers and check the inside for rodent nests or other malfunctions that may be causing the stray current. Make sure the connections are dry and the waterer has a clean, tight ground. Remember to use caution when working with electrical connections.

Access

Cows given free access to water will produce more milk and more butterfat than cows allowed to drink only twice a day. The same animal will consume different levels of water at different physiological states. For example, a pregnant or lactating animal will consume more than a nonpregnant, nonlactating animal.

In some cases, regulating access to water may be necessary. Horses that are hot from strenuous exercise should not have free access to water. Unlimited access to water by hot horses can lead to colic, laminitis and/or exertional rhabdomyolysis (tying up). They should be allowed only a few sips every three to five minutes until they cool down.

If swine on a high-energy diet are deprived of water (such as can occur during power outages) and then are allowed free access to water (power is restored), they may die from salt poisoning. Salt poisoning also is known as cerebral edema. Swine should be given access to water sparingly until fully rehydrated. Prognosis for swine making a full recovery from salt poisoning is very guarded.

Nutrients in diet

Increasing the salt concentration or the protein level of the diet stimulates increased water intake in all species because of the increase in urine volume necessary for excretion of salt and urea. Studies with poultry have shown an increase in water consumption due to increases in fat, protein, salt or potassium in the diet. Feeds high in crude fiber, such as roughages, will require more water for ingestion than feeds low in crude fiber, such as barley and corn.

Never limit water intake for animals that are consuming rations or supplements limit-fed using high-salt concentrations.

Stress

Reduced water consumption can be a sign of sickness or other stressors. Special considerations may be needed for valuable animals. Newly arrived animals may refuse water at first due to differences in palatability, so water intake in newly received cattle should be monitored carefully to make sure the animals exhibit no signs of dehydration. Allowing animals to become accustomed to the new water supply gradually by mixing water from old and new sources often is not practical or even possible. Mixing small amounts of molasses with water sources can hide differences in taste.

Have water available during low-activity times during the day. Consumption of water and feed can be reduced when the animals are involved in a lot of activity that diverts their attention. Allowing waterers to run over for the first few days may help cattle acclimate to drinking from fountains or new water sources since the sound of running water will draw animals to the waterer. In addition, waterers should be placed in the fence line since newly received cattle tend to pace back and forth along the fence.

Composition of water

Water quality and quantity may affect feed consumption and animal health. Low-quality water normally will result in reduced water and feed consumption. Absolutely pure water is not found in nature. Actually, deionized-distilled (pure) water is undesirable for livestock. Certain salts and gases in solution make water more palatable if not present in excess.

Substances that may reduce palatability of water include various salts. Salts may be toxic at high levels. Substances that are toxic without much effect on palatability include nitrates and fluorine, as well as salts of various heavy metals. Other materials that may affect palatability or toxicity include pathogenic microorganisms, hydrocarbons, oily substances, pesticides and many industrial chemicals that sometimes pollute water supplies.

Contamination of water sources can occur when a hose is placed where it can become submerged when filling an animal watering tank. If the tank fills over the outlet of the hose, and the hose or faucet has automatic back siphoning, the entire water system may become contaminated by impurities or poisonous solutions with the loss of water pressure.

Cleanliness

All water troughs should be cleaned frequently. Livestock never should be forced to drink dirty or contaminated water. Stale water can cause reduced water consumption. Even when clean water is available, animals may continue to consume dirty water if it is available.

Dirty water is a host for disease organisms. Disease can spread rapidly if animals drink from the same trough, so sick animals should be isolated from the trough and the trough cleaned and disinfected. A good disinfectant is a dilute bleach solution after the trough has been cleaned thoroughly. Sprinkling baking soda into the fountain periodically may reduce algae growth. Tip tanks sometimes are installed in larger dairy free-stall barns to simplify cleaning.

Have an elevated base around automatic waterers. Make the base wide enough so animals can put their front legs on it easily when they are drinking, but not their hind legs. Animals normally will not place only their hind legs on this base and, therefore, will not defecate in the water. Placement and height of the base are the keys to avoiding fecal contamination. Make the surface rough so animals will not slip.

Water Quality

If uncertain about water quality, it should be tested. The following chemical properties should be considered when evaluating the quality of water for livestock:

Salinity

Salinity refers to salt dissolved in water and is expressed as parts per million (ppm) or as milligrams per liter (mg/L). The State Health Laboratory (Bismarck) and the NDSU Veterinary Diagnostic Laboratory (Fargo) conduct salinity tests. The expression "total dissolved solids" (TDS) often is used to denote the level of water salinity. TDS is a nonspecific indicator of water quality. TDS levels should not be used as the only measure of water quality. Specific water components should be measured to determine suitability for specific applications.

Salts commonly present include carbonate, bicarbonates, sulfates, nitrates, chlorides, phosphates and fluorides. Highly mineralized waters (high solids) do not have much effect on health as long as specific ions, such as sulfate, have no objectionable effects, and as long as normal amounts of water are consumed. One gram of sulfate per liter (1,000 ppm) may result in scours. High levels of sulfate in the water also may reduce copper availability in the diet. In North Dakota, well water high in TDS is often high in sulfates. The limiting health concern is often sulfate because the acceptable sulfate level will be exceeded before TDS levels are high enough to be a concern.

Salts, such as sodium chloride, change the electrolyte balance and intracellular pressure in the body, producing a form of dehydration. Salts also place a strain on the kidneys. Excess fluoride causes degeneration of the teeth.

High salt concentrations that are less than toxic actually may cause an increase in water consumption. Animals may refuse to drink high-saline water for many days, followed by a period when they drink a large amount. Then they may become sick or die. The tolerance of animals to salts in water depends on factors such as water requirements, species, age, physiological condition, season of the year and salt content of the total diet, as well as the water. Animals have the ability to adapt to saline water. However, abrupt changes from water with low-salt to water with high-salt concentrations may cause harm while gradual changes do not.

Table 8 gives the level of mineral content that either makes the water taste too bad to drink or causes a detrimental effect on health. Whether the total quantity of dissolved salts or dissolved solids is made up of a single salt or a number of different salts appears to make little difference. Table 9 shows recommendations for various animal species in relation to dissolved solids content.

Table 8. Recommendations for livestock water use based on total dissolved solids (TDS).

TDS (ppm or mg/L)	Comments
Less than 3,000	Usually satisfactory for most livestock.
3,000-5,000	May not cause adverse effects to adult livestock. Growing/young livestock could be affected by looseness or poor feed conversion. At levels near 5,000 ppm, the water is unacceptable for poultry.
5,000-7,000	Should not be used for pregnant or lactating females. Usually a laxative and may result in reduced water intake.
7,000-10,000	Do not use for swine. Do not use for pregnant or lactating ruminants or horses.
10,000 or more	May cause brain damage or death.

Table 9. Recommended levels of dissolved solids for various animal species.

	Dissolved Solids (ppm)				
Species	**Excellent**	**Good**	**Fair**	**Poor**	**Limit**
Humans	0-800	800-1,600	1,600-2,500	2,500-4,000	5,000
Horses:					
– Working	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
– Others	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Cattle	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Sheep	0-1,000	1,000-3,000	3,000-6,000	6,000-10,000	15,000
Poultry and Chickens	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
Swine	(young pigs and market pigs appear to tolerate less than cattle)				

Sulfates

Consider diluting high-sulfate water with low-sulfate water. The sulfate recommendation for calves is less than 500 ppm (167 ppm sulfur as sulfate). For adult cattle, the recommendation is less than 1,000 ppm (333 ppm sulfur as sulfate). Caution is required in evaluating sulfate levels in water because of interactions with copper and molybdenum and the inhibiting effect compounds such as sodium fluoride have on sulfate absorption for the digestive tract. In addition, high levels of sulfates also may contribute to an increased incidence of polioencephelomalacia (PEM), a brain disorder found in cattle. If copper deficiency problems are suspected, water sources should be analyzed for sulfates to determine if high sulfate levels are contributing to the problem.

Other minerals

Water hardness is caused by calcium and magnesium. Softening the water through exchange of calcium and magnesium with sodium may cause problems if water is already high in salinity.

When a significant amount of calcium is in water, it should be considered as a part of the total mineral intake. However, many mineral salts are relatively insoluble and pass through the body without being absorbed. Even in hard water, the amount of mineral ingested from the water is not likely to be substantial.

Nitrates

Water may be a source of toxic levels of nitrate for livestock. Water may become contaminated by fertilizer, animal wastes or decaying organic matter. Shallow wells with poor casings are susceptible to contamination. Marginally toxic levels of nitrate in water and feed together may cause nitrate toxicity in animals. Remember to consider both sources of nitrate. For more information regarding nitrates and nitrate poisoning, refer to "Nitrate Poisoning of Livestock" (V-839 Revised).

pH

Water pH denotes either alkalinity or acidity. High-saline water is not the same as alkaline water. A pH of 7 would be neutral; a number higher than 7 indicates alkalinity; below 7 designates acidity. Most North Dakota waters are mildly alkaline with a pH value between 7 and 8. Acidic water (pH below 7) is not common in most of North Dakota; however, some reports indicate acidic water in the western part of the state in proximity to lignite coal veins. Various degrees of alkalinity have been reported in the state. High alkalinity may cause digestive upsets, laxative action, poor feed conversion, and reduced water and/or feed intake.

Cyanobacteria

Green scum that builds up in livestock drinking troughs and tanks is cyanobacteria (sometimes called blue-green algae). It cannot grow without sunlight and usually is seen in stagnant water during dry, hot weather. Some cyanobacteria are toxic.

Numerous dead rodents and other small animals near the water source may indicate cyanobacteria poisoning. Signs of cyanobacteria poisoning in livestock are diarrhea, lack of coordination, labored breathing and death. During recovery, unpigmented skin may slough off. Contact your veterinarian for more information and assistance.

For additional information on algae poisoning refer to NDSU Extension Service publication V-1136, "Cyanobacteria (Blue-Green Algae) Poisoning."

Other microbiological properties

Many water sources contain microorganisms. Most microorganisms are quite harmless, but some do cause animal health problems.

Coliform counts below 50 per milliliter of water are safe for all cattle. Possible contaminants include bacteria, parasites and viruses.

Microorganisms can enter a well that has improper surface protection. A well is situated improperly if it receives drainage from livestock pens or a manure storage structure. Cracked well casings also may allow bacteria to enter the water supply. Cracks in cisterns can allow access to microorganisms. Contamination might occur from a heavy spring rainfall. Protect the surface of wells from contamination by rodents.

Other chemicals

Many other chemicals, some of which could be detrimental to livestock production, may be found in water. Safe levels of herbicides and pesticides in water for animals have not been determined.

Herbicides and pesticides can enter a ground water or surface water supply from runoff, drift and accidental spills. Provide adequate drainage around the water supply. Wells should be on elevated ground to prevent surface runoff in to the well. Fish are much more sensitive to pesticides than other livestock.

Table 10 lists the safe levels of potentially toxic nutrients and contaminants in water for cattle. These should be analyzed only when you have good reason to suspect their presence at excessive levels.

Table 10. Safe levels of potentially toxic nutrients and contaminants in water for livestock.

Element	Short Exposure	Chronic Exposure
Arsenic	1 mg/L	1 mg/L
Barium	<10mg/L	No recommendation
Fluoride	2 mg/L	2 mg/L
Molybdenum	0.3 mg/L	0.3 mg/L
Nitrate	500 mg/L	500 mg/L
Nitrite	100 mg/L	100 mg/L
pH	Acceptable ranges (a low of 5.5 to 6.5 and a high of 7.5 to 9.0) are excessively conservative from a strictly animal health standpoint. Sufficient experimental and/or clinical data is not available to offer a specific alternative.	
Selenium	0.1 mg/L	0.1 mg/L
Sodium	4,000 mg/L	1,000 mg/L
Sulfate	1,800 mg/L	1,000 mg/L

Adapted from Raisbeck et al. (2007)

Summary

Water is an important, but often overlooked, nutrient.

Water intake in livestock is affected by many factors, including environmental conditions, productivity and size.

Water quality is determined by many different factors.

Water testing should be conducted to determine suitability for various classes of livestock and to ensure optimum productivity of your herd or flock.

For more information on this and other topics, see: www.ag.ndsu.edu

2M-7-99; 500-7-04; 2M-6-08