Water, the Most Important Essential Nutrient

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“Nuff Said!”

988 lbs., 223 Days of Age: Green Grass, **Clean Water**, Blue Sky, Precisely Arranged Nucleotides
**Cow-Calf Breakeven**

**Pasture**  **Hay**  **Supplements**  **Water**  **Bulls/Breeding**  **Cow**  
**Depreciation**  **Supplies**  **Fuel/Lubricants**  **Machinery/Equipment**  **Repairs**  
**Veterinary**  **Hired Labor**  **Transportation**  **Family Living Expense**  
**Insurance**  **Taxes**  **Machinery/Equipment**  **Depreciation**  **Utilities**  
**Land Ownership Costs**  **Fencing**  **Miscellaneous**  **Marketing**  **etc.**

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### Annual Cow Cost

#### Calf Weaning Weight X Weaning %

- **Age at Weaning**  x  **Daily Gain Birth to Weaning**
  - Cow Milking Ability
  - Pasture Quality/Quantity
  - Health
  - Creep Feed
  - Growth Stimulants
  - Genetic Propensity for Growth

- **Cows/Heifers Failing to Wean a Calf**
- **Cows/Heifers Failing to Conceive**
- **Cows/Heifers Conceiving Late**
- **Cows/Heifers Lost Calves- Gestation**
- **Cows/Heifers Lost Calves-Birth to Weaning**
Example:
$700 Annual Cow Cost
550 lb. Calf Weaning Weight
85% of Cows Wean a Calf (.85)
$700 ÷ (550 x .85) = $1.4973/lb. Breakeven
550 lbs. x $1.4973 = $823.52/calf to Breakeven
Calf Market Value: $1.50/lb.
Calf Market Value: 550 lbs. x $1.50 = $825.00/calf
Profit/Loss ($825.00 - $823.52) = +$1.48/cow
Not Much Profit, but as the Sage of the West Would Say:
“Nobody Ever Went Broke Making a Profit”
What Makes Water So Special?

1. Most Universal Solvent.
2. High Thermal Conductivity.
4. 99% of Body Molecules.
5. 70% of Body Mass.
6. Involved in Most Nutrient Digestion, Absorption, and Metabolic Reactions.
7. Cushions and Shock Absorption.
Major Nutrient Groups:

- Carbohydrates
- Proteins
- Lipids
- Minerals
- Vitamins
- Water
Water/Dry Matter Relationship

Water \leftrightarrow \text{Dry Matter}(4:1)

- Dry Matter Intake and Water Intake Are Closely Linked.
- If Water Intake is Restricted, Dry Matter Intake Will Be Proportionately Reduced.
- If Dry Matter Intake is High, Water Requirement Will Be Proportionately Increased.

Water Requirement

- Drinking Water
- Water From the Feed
- Water From Nutrient Metabolism
How Do Animals Deal With a Water Deficiency?

• **Like Any Other Nutrient Deficiency:**
  1. Try To Increase Digestion and/or Absorption.
  2. Conserve the Nutrient, Decrease Excretion.
  3. Alter Nutrient Metabolism.
  4. Partition the Use of Limited Nutrient Supply:
• **The Hierarchy of Nutrient Partitioning:**
  1. Maintenance
  2. Development
  3. Growth
  4. Lactation
  5. Reproduction
  6. Fattening

• **All of These Adjustments Cost Energy!!**
Factors Affecting Water Requirement

Water Intake

- Rule of Thumb: 5 to 10% of Body Weight
- Lactation
- Physical Exertion: Expiration, Panting, Sweating
- Health Issues
- Distance Traveled: 800 foot rule

Water Characteristics
- Temperature: Cool Not Cold (40 to 65°F)
- Dissolved Solids: Cattle Most Tolerant, Sulfates Worst
- Environmental Contaminants: Manure, Urine, Algae, etc.

Diet Characteristics
- Water Content
- Fiber Characteristics
- Mineral Composition
- Toxic Components

Have It Tested for Quality
The Importance of Water Quality

Sources of Drinking Water

- Sources of Drinking Water Not as Important as Water Quality: Physical and Chemical Characteristics
Senior Research Projects
Senior Research Projects:
## Distance to Drinking Water

### Effects of Distance From Drinking Water on Hay Intake of Dry, Pregnant Beef Cows

<table>
<thead>
<tr>
<th>No. of Cows</th>
<th>Distance From Drinking Water, ft.</th>
<th>Water Intake, gal.</th>
<th>No. of Times Drinking</th>
<th>Dry Matter Intake, lbs./day</th>
<th>Water: Dry Matter Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>660</td>
<td>13.7</td>
<td>6</td>
<td>28.4</td>
<td>4.00</td>
</tr>
<tr>
<td>4</td>
<td>1320</td>
<td>12.8</td>
<td>3</td>
<td>26.8</td>
<td>3.96</td>
</tr>
<tr>
<td>4</td>
<td>2640</td>
<td>9.8</td>
<td>2</td>
<td>20.5</td>
<td>3.97</td>
</tr>
</tbody>
</table>
Dissolved Solids in Drinking Water

- Effects of Water Quality (dissolved solids) Drinking Water and Hay Intake by Dry, Pregnant Beef Cows (ave daily temp., 58°F):

<table>
<thead>
<tr>
<th>No. of Cows</th>
<th>Water Source</th>
<th>Dissolved Solids, ppm</th>
<th>Water Intake, gal/hd/d</th>
<th>Hay DM Intake, lbs/hd/d</th>
<th>Water:DM Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Deep Well</td>
<td>1500</td>
<td>12.75</td>
<td>28.00</td>
<td>3.78</td>
</tr>
<tr>
<td>6</td>
<td>Dugout Pond</td>
<td>2500</td>
<td>13.12</td>
<td>28.31</td>
<td>3.85</td>
</tr>
<tr>
<td>6</td>
<td>Waste Ditch</td>
<td>8115</td>
<td>10.67</td>
<td>24.40</td>
<td>3.63</td>
</tr>
</tbody>
</table>
### Temperature of Drinking Water

- **Effect of Air and Water Temperature on Drinking Water and Hay Intake by Dry, Pregnant Beef Cows:**

<table>
<thead>
<tr>
<th>No. of Cows</th>
<th>Average Daily Air Temp, °F</th>
<th>Water Source</th>
<th>Water Temp., °F</th>
<th>Water Intake, gal/hd/d</th>
<th>Hay DM Intake, lbs/hd/d</th>
<th>Water: DM Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>30</td>
<td>Heated Trough</td>
<td>51</td>
<td>14.92</td>
<td>31.35</td>
<td>3.95</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>Unheated Trough</td>
<td>33</td>
<td>12.76</td>
<td>27.22</td>
<td>3.89</td>
</tr>
<tr>
<td>6</td>
<td>79</td>
<td>DeepWell (1500 ppm)</td>
<td>49</td>
<td>16.84</td>
<td>27.23</td>
<td>5.11</td>
</tr>
<tr>
<td>6</td>
<td>79</td>
<td>Dugout Pond (2500 ppm)</td>
<td>72</td>
<td>14.67</td>
<td>25.17</td>
<td>4.83</td>
</tr>
</tbody>
</table>
Drinking Water Restriction

- Effect of Drinking Water (deep well) Restriction on Intake and Digestibility of Hay by Dry, Pregnant Beef Cows:

<table>
<thead>
<tr>
<th>No. of Cows</th>
<th>Water Intake Allowance</th>
<th>Average Air Temp °F</th>
<th>Water Intake, gal/hd/d</th>
<th>Hay DM Intake, lbs/hd/d</th>
<th>Water: DM Ratio</th>
<th>DM Digested, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Ad-libitum</td>
<td>52</td>
<td>13.38</td>
<td>28.40</td>
<td>3.91</td>
<td>62.21</td>
</tr>
<tr>
<td>6</td>
<td>80% of Ad-libitum</td>
<td>52</td>
<td>10.70</td>
<td>24.62</td>
<td>3.61</td>
<td>59.82</td>
</tr>
</tbody>
</table>
The Use of Salt to Limit the Intake of Supplements is a Common Practice and Allows the Convenience of Free-Choice Access.

A Mixture of 67% Protein Supplement and 33% Salt will Usually Result in a Free-Choice Intake of About 5.0 lbs./day for a 1200 lb. Cow.

<table>
<thead>
<tr>
<th>No. of Cows</th>
<th>Treatment</th>
<th>Forage DMI, lbs./day</th>
<th>Water Intake, gal/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Salt Meal</td>
<td>23.75</td>
<td>17.12</td>
</tr>
<tr>
<td>8</td>
<td>Pair Fed</td>
<td>22.17</td>
<td>11.82</td>
</tr>
</tbody>
</table>
• The Following Tables Shows the Effect of Water Quality on Cow and Calf Performance:

<table>
<thead>
<tr>
<th>Item</th>
<th>High-Sulfate Surface Water, 7325 mg/L</th>
<th>High-Quality Well Water, 926 mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf Weaning Weight, lbs.</td>
<td>450</td>
<td>496</td>
</tr>
<tr>
<td>Cow Weaning Percentage, %</td>
<td>83</td>
<td>91</td>
</tr>
</tbody>
</table>
Beef Cattle Water Requirements

**Daily Water Intake, L/day**

**Dry Matter Intake, kg/day**

**Solar Radiation, W/m²**

**Temperature-Humidity Index**

\[
\text{DWI} = -7.31 + 1.00 \times \text{DMI} + 0.04 \times \text{SR} + 0.3 \times \text{THI}
\]

<table>
<thead>
<tr>
<th>Animal</th>
<th>40°F</th>
<th>60°F</th>
<th>70°F</th>
<th>80°F</th>
<th>90°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 lb. Calf, gallons/day</td>
<td>5.3</td>
<td>6.6</td>
<td>7.8</td>
<td>8.9</td>
<td>12.7</td>
</tr>
<tr>
<td>Lactating Cows, gallons/day</td>
<td>11.4</td>
<td>14.5</td>
<td>16.9</td>
<td>17.9</td>
<td>16.2</td>
</tr>
<tr>
<td>Winter, Dry Cows, gallons/day</td>
<td>6.7</td>
<td>8.3</td>
<td>9.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Estimating Water Requirements

### Water Requirements:

<table>
<thead>
<tr>
<th>Species</th>
<th>Weight, lbs.</th>
<th>% body weight</th>
<th>Water:DM</th>
<th>Hot weather adjustment</th>
<th>Lactation adjustment medium</th>
<th>Lactation adjustment high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cows, dry</td>
<td>1200</td>
<td>2.0</td>
<td>3.0</td>
<td>+1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Beef cows, lactating</td>
<td>1200</td>
<td>2.5</td>
<td>3.0</td>
<td>+1.0</td>
<td>+1.0</td>
<td>+1.5</td>
</tr>
<tr>
<td>Beef yearlings</td>
<td>800</td>
<td>2.5</td>
<td>3.0</td>
<td>+1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Beef feedlot</td>
<td>900</td>
<td>3.0</td>
<td>3.0</td>
<td>+1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Dairy cows</td>
<td>1400</td>
<td>3.5</td>
<td>3.0</td>
<td>+1.0</td>
<td>+1.5</td>
<td>+2.0</td>
</tr>
<tr>
<td>Horses</td>
<td>1100</td>
<td>2.0</td>
<td>2.8</td>
<td>+1.0</td>
<td>+1.0</td>
<td>+1.5</td>
</tr>
<tr>
<td>Sheep and Goats</td>
<td>150</td>
<td>4.0</td>
<td>2.5</td>
<td>+1.0</td>
<td>+.50</td>
<td>+1.0</td>
</tr>
<tr>
<td>Swine</td>
<td>300</td>
<td>3.5</td>
<td>3.0</td>
<td>+1.5</td>
<td>+.50</td>
<td>+1.0</td>
</tr>
<tr>
<td>Turkeys</td>
<td>25</td>
<td>4.5</td>
<td>2.5</td>
<td>+1.0</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Chickens</td>
<td>5</td>
<td>5.0</td>
<td>2.5</td>
<td>+1.0</td>
<td>---</td>
<td>20</td>
</tr>
</tbody>
</table>
Estimating Water Requirements

- **Example Calculations:**
  - 1200 lb. Beef Cows, Medium Milk Production, Temperate Climate.
  - 1200 x .025 (2.5%) = 30 lbs. DM Intake/cow/day
  - 30 lbs. DM x 4.0 lbs. water(3.0 +1.0)/lb. DM Intake = 120 lbs. water/cow/day.
  - 120 lbs. water ÷ 8.3 lbs./gallon = **14.5 gallons/cow/day**
  - Of course this does not include drinking water for **her calf**.
  - Nor does it consider water she may obtain from **her diet**.

- **Maintenance**
- **Lactation Adjustment**

- 120 lbs. Water ÷ 1200 lb. Cow X 100 = 10% of Body Weight
Estimating Water Requirements

• Example Calculations:
  
  • In the example of the Lactating Beef Cow above, if she was consuming **Dry Feed like Hay**, she would probably require about **14.5 gallons of Drinking Water/day**.
  
  • However if she was **Grazing Succulent Pasture Forage** that contained **25% Dry Matter and 75% Water**, much of her water requirement would come from the Pasture Forage.
    
    • 30 lbs. DM/day ÷ .25(25% DM) = 120 lbs. Pasture Forage
    
    • 120 lbs. Pasture Forage – 30 lbs. DM = 90 lbs. of Water from the Pasture Forage or (90 ÷ 8.3) **10.8 gallons of Water from the Diet**.
    
    • 14.5 – 10.8 = **3.7 gallons of Drinking Water/day**
• Example Calculation:
  • 1500 lb. lactating dairy cow, high production, hot weather
  • 1500 x .035 = 52.5 lbs. DM/cow/day
  • 52.5 lbs. DM x 6.0 (3.0+1.0+2.0) = 315 lbs. water/day

  \[
  \frac{315 \text{ lbs. water}}{8.3 \text{ lbs/gallon}} = 37.9 \text{ gallons water/cow/day.}
  \]
  • Some water would come from the diet.
• The First Question is: How Much of this Forage Will the Cattle Consume?

• What Factors Affect Forage Intake?

- Body Size
- G.I. Tract Capacity
- Lactation
- Environmental Factors

- Animal Genetic Factors
- NDF Content
- NDF Characteristics
- Animal Health Issues

- Forage Dry Matter Intake

- Forage Plant Characteristics

- Contaminants
- Coarseness, Toughness
- Secondary Compounds

- Processing
- Pubescence

- Animal Genetic Factors
- NDF Content
- Animal Health Issues

- G.I. Tract Capacity
- NDF Characteristics
- Processing

- Lactation
- Secondary Compounds
- Pubescence

- Environmental Factors
- Contaminants
- Coarseness, Toughness
The Latest Version of “Nutrient Requirements of Beef Cattle” suggests the following Equation to Estimate the Dry Matter Intake of Beef Cows:

\[
\frac{(\text{Body Weight, kg})^{0.75} \times (0.04997 \times \text{NEm, Mcal/kg DM}^2 + 0.04631))}{\text{NEm}}
\]

Example: 1200 lb. Beef Cow

Consuming Hay Containing .52 Mcal NEm/lb. DM

Metric Conversions: 1200 lbs. ÷ 2.2 = 545.45 kg

.52 Mcal NEm/lb. x 2.2 lbs/kg = 1.144 Mcal/kg

Calculation:

\[
\frac{(545.45^{0.75}) \times (0.04997 \times 1.144^2 + 0.04631))}{1.144} = 11.02 \text{ kg DM/day}
\]

Metric Conversion: 11.02 kg/day x 2.2 lbs./kg = 24.25 lbs. DM/day

This Intake can Now be Adjusted for Things Like Lactation, etc.

Equations Such as These are Accurate and Valuable.

But It’s Easy to Get Bogged Down in the Calculations and Conversions