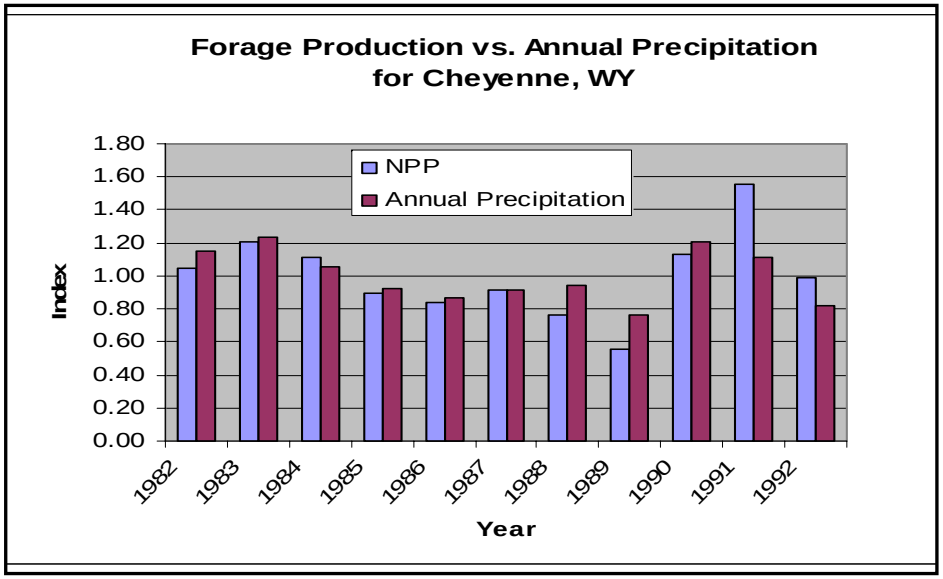


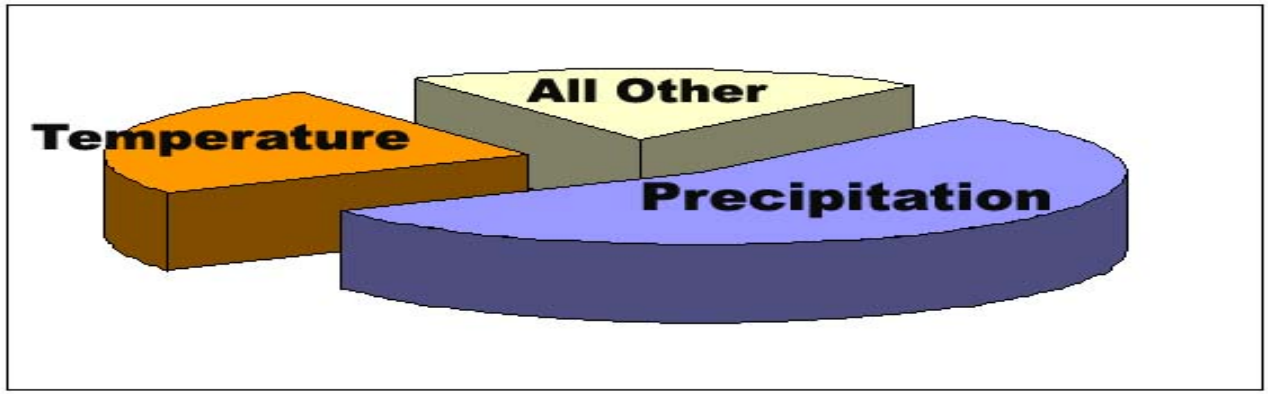
Theory Behind the Drought Management Calculator

The theory behind the DMC is based on the concept that average annual precipitation produces an average annual forage yield. Is this true? Yes and no.

> Yes – annual precipitation is highly correlated with annual forage production (r equal to or greater than 0 .5 or 50%)
> No – precipitation in some months in either the calendar year or the water year is not very important with respect to forage production

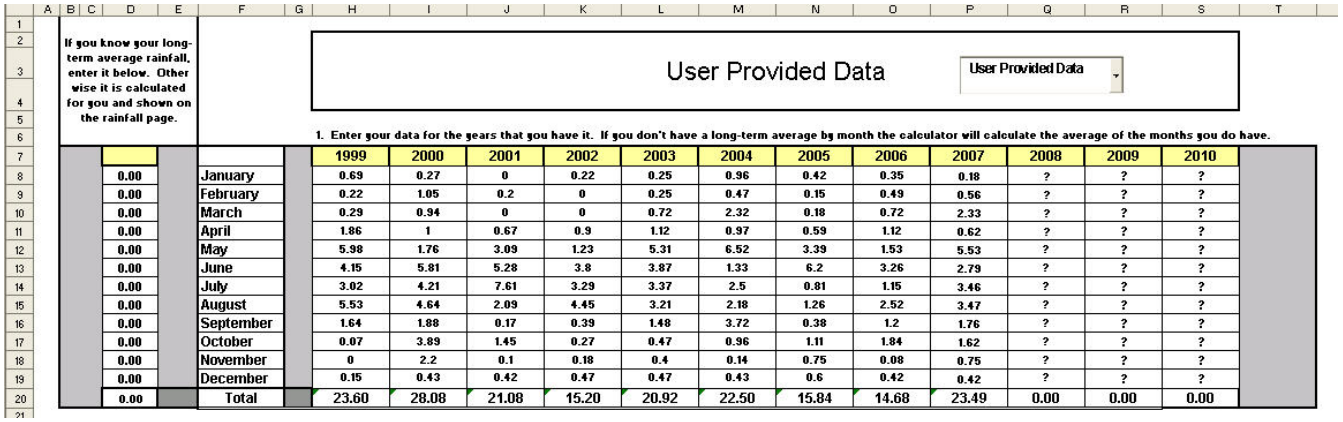
Because of this we use a system that assigns a value or coefficient to the precipitation for any given month. By doing this we can improve the correlation between annual forage production and annual precipitation (r equal to or greater than .65 or 65%)..

Environmental factors affecting forage growth potential.



Theory Behind the Drought Management Calculator

The reason this correlation between precipitation and forage growth potential isn't higher is because other environmental factors also impact forage growth – most notably, temperature. Timing and intensity of any given precipitation event, especially during the growing season, also have a profound effect on forage growth potential and are not captured in a single monthly figure. The DMC was designed for simplicity, but even with greater complexity an increase in absolute accuracy is not a given. The DMC is a qualitative tool with an overall accuracy around 75%.



If you know your long-term average rainfall, enter it below. Other wise it is calculated for you and shown on the rainfall page.

User Provided Data — User Provided Data

1. Enter your data for the years that you have it. If you don't have a long-term average by month the calculator will calculate the average of the months you do have.

		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0.00	January	0.69	0.27	0	0.22	0.25	0.96	0.42	0.35	0.18	?	?	?
0.00	February	0.22	1.05	0.2	0	0.25	0.47	0.15	0.49	0.56	?	?	?
0.00	March	0.29	0.94	0	0	0.72	2.32	0.18	0.72	2.33	?	?	?
0.00	April	1.86	1	0.67	0.9	1.12	0.97	0.59	1.12	0.62	?	?	?
0.00	May	5.98	1.76	3.09	1.23	5.31	6.52	3.39	1.53	5.53	?	?	?
0.00	June	4.15	5.81	5.28	3.8	3.87	1.33	6.2	3.26	2.79	?	?	?
0.00	July	3.02	4.21	7.61	3.29	3.37	2.5	0.81	1.15	3.46	?	?	?
0.00	August	5.53	4.64	2.09	4.45	3.21	2.18	1.26	2.52	3.47	?	?	?
0.00	September	1.64	1.88	0.17	0.39	1.48	3.72	0.38	1.2	1.76	?	?	?
0.00	October	0.07	3.89	1.45	0.27	0.47	0.96	1.11	1.84	1.62	?	?	?
0.00	November	0	2.2	0.1	0.18	0.4	0.14	0.75	0.08	0.75	?	?	?
0.00	December	0.15	0.43	0.42	0.47	0.47	0.43	0.6	0.42	0.42	?	?	?
0.00	Total	23.60	28.08	21.08	15.20	20.92	22.50	15.84	14.68	23.49	0.00	0.00	0.00

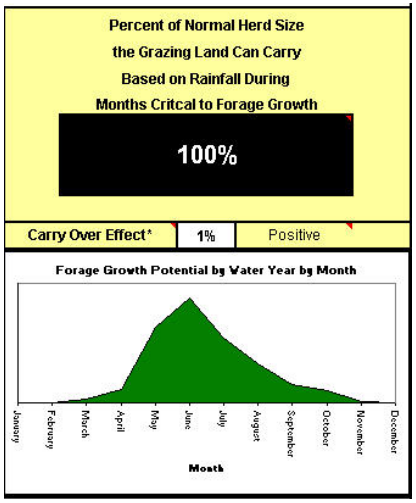
Theory Behind the Drought Management Calculator

Why use monthly precipitation? We use monthly precipitation because it is an easy value for everyone to find. The next phase of development of the calculator will use monthly precipitation *and* temperature. Until then we use just the precipitation values.

How do we assign a relative importance to monthly precipitation? We have three tools that we use together to help us determine what value a month should receive.

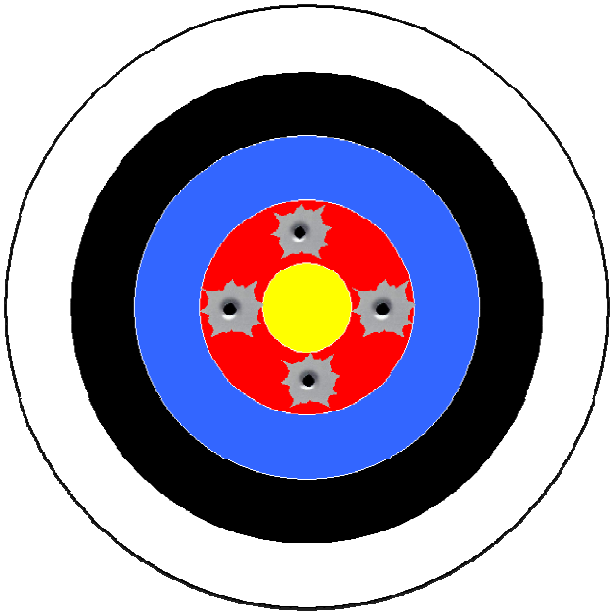
- ✓NRCS's ecological site descriptions that include plant growth curves,
- ✓Long-term monthly precipitation values, and
- ✓Results from a complex scientific forage growth model*

* If we have research data from a region showing annual forage production over a long time period (at least 10 and preferably 20 years) we use that data and specially designed statistical analysis tools instead of the forage growth model.



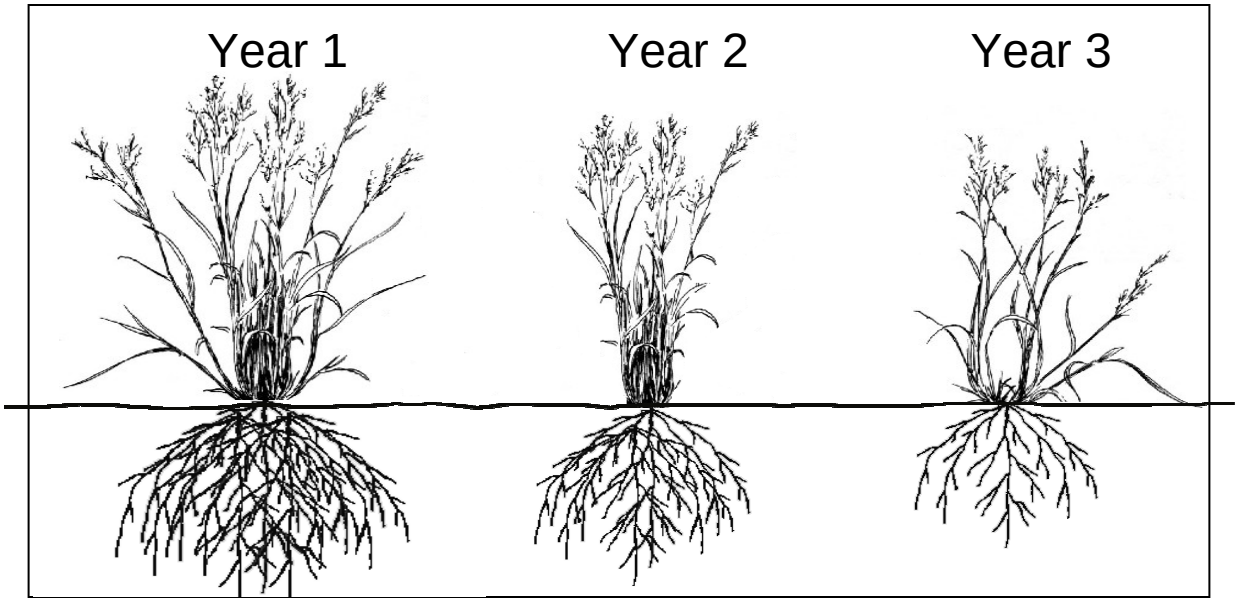
Theory Behind the Drought Management Calculator

Why forage growth potential? Relating back to the original theory concerning average precipitation and average forage yield, we feel that ranchers know intuitively what “average” forage looks like. Ask a rancher what the forage looks like and you’ll get a response like this, “Oh, it’s a little better (or worse) than average”. By using the ranchers knowledge and our calculator we avoid having to take into consideration aspects of soils, slope, species composition, etc. If we wanted to get down to pounds per acre the DMC would require far more data inputs and probably become no more accurate while becoming far more difficult to use. As an aside, when using research station data, we have found the best correlations occur when we compare precipitation to peak standing crop.



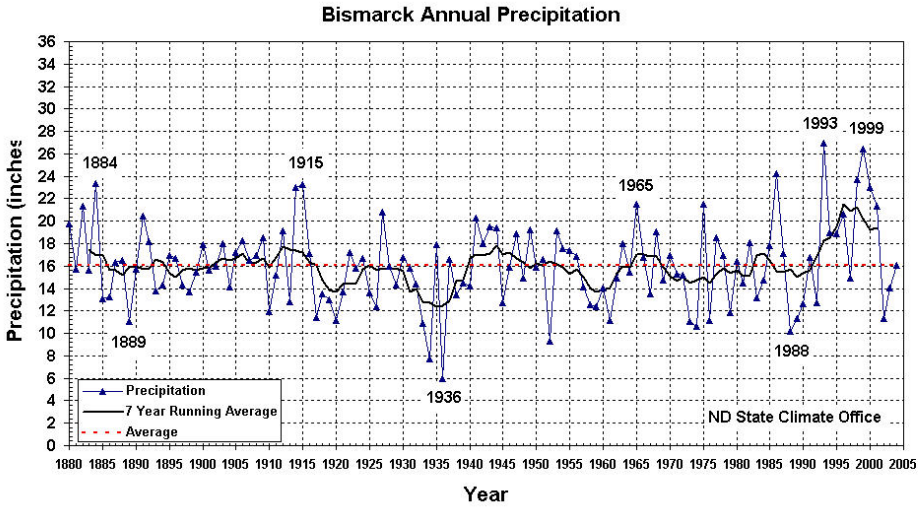
Theory Behind the Drought Management Calculator

Accuracy (model efficiency) vs. Correlation – For purposes of prediction we use accuracy instead of correlation and that, frankly, makes life a whole lot easier. With accuracy, if we are 10% above or below the actual forage growth potential it's still 90% accurate. That is not true of correlation, but it's accuracy ranchers are interested in – not correlation. A big "whew!" for us. We do strive to have as high a correlation as possible with our relationship between precipitation and forage growth potential because we know that with a high correlation we have a greater probability of achieving high efficiency of prediction.



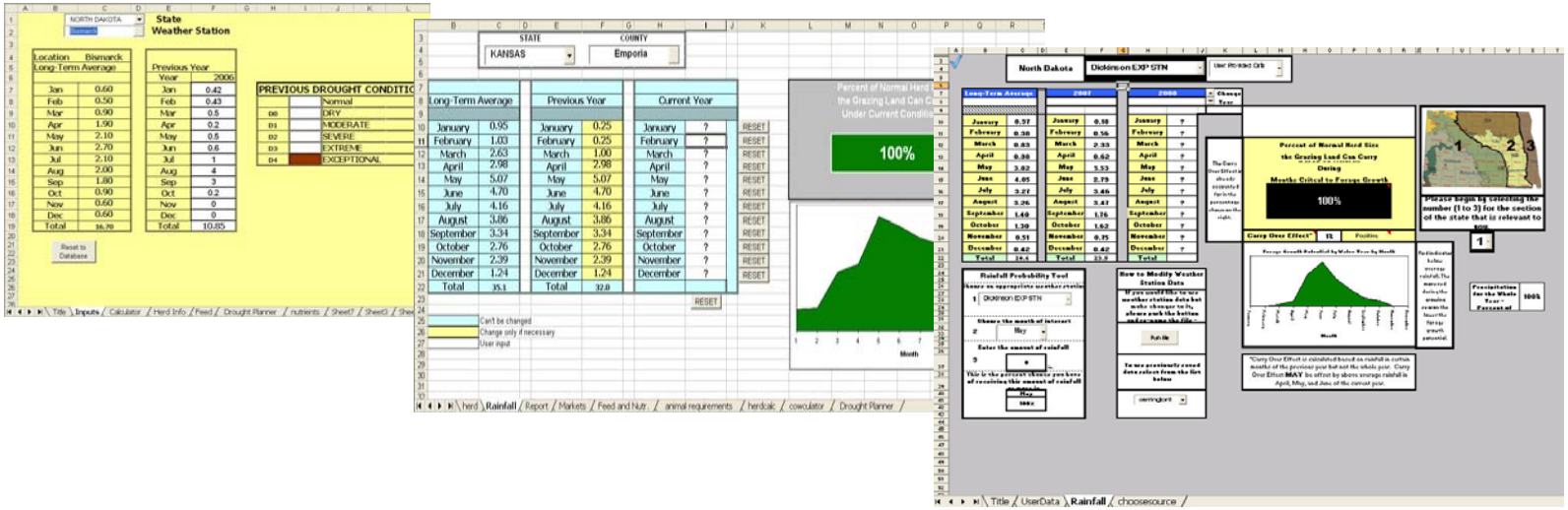
Theory Behind the Drought Management Calculator

Carry-Over Potential – One of the hardest estimates for us to calculate is carry-over effect. The DMC does calculate negative and positive carry-over effect but it is really only the negative that concerns us. The literature is full of studies that claim a poor previous season (precipitation) will result in lower forage growth in the following season even if precipitation is normal (average). Opposing findings are equally as prevalent that state a poor season has no bearing on the next season. Who's right? Unfortunately, both! The only time when we can say unequivocally that previous season conditions will have a detrimental effect on current season is when drought has been severe and has occurred over a number of years resulting in a reduction in root bio-mass. We use our forage growth model to examine consequences of severe previous season drought (one year only) on coming season forage growth potential. To be honest the correlation is not all that great (less that 50%), but it is a starting point for consideration and the DMC ignores the carry-over effect after a certain point because eventually in-season conditions dominate the current forage growth potential.



Theory Behind the Drought Management Calculator

Forecast vs. Long-term and Short-term Mean – When forecasting the weather a crystal ball would be handy. Since we don't have access to a crystal ball we use the next to the next best thing – a short-term average. The graph above shows the difference between long-term average and the 7-year running average. The running average paces the annual precipitation track whereas the long-term average is static. At this time we use a short-term average for the DMC. Our average begins with 1999 and doesn't drop off years. This is a compromise based on the design of the calculator and will be viewed for improvement in the future. Why not NOAA long- and short- term forecasts? Two reasons, the DMC is not designed to grab the value from the web and make the necessary updating correction, and because studies have shown that even the long-term average is more accurate than the current 30 day, 60 day, and longer forecasts in predicting the future. This will change and these NOAA forecasts will get better. Future DMC should take this into account.



Theory Behind the Drought Management Calculator

Credit Where Credit is Due – The original concept for the DMC belongs to Mr. Arnold Norman, NRCS-ITC, Fort Worth, TX. Although some aspects of the DMC have changed as the research and development have unfolded, without Arnold's insight and inspiration it's doubtful that development of the DMC would have progressed as well and as rapidly as it has.

The DMC has come a long way but it has a long way to go too. Suggestions, critiques, bugs, and other forms of evaluation are always welcome. Please direct these to Gale Dunn at:

gale.dunn@ars.usda.gov

Thanks,

gale