MEASURING DROUGHT

Droughts bring with them reduced availability of forage, decreased growth rates in animals, and less efficient livestock and poultry production. A practical definition of droughts is when precipitation and other water resources fall below expectations and this is not met by a decreased demand for water.

Low water resources can also be “caused” by increased demand, such as an increase in population or industry. As such, droughts can affect any part of the United States. Droughts usually occur insidiously and may go undetected for many months or years until a serious crisis situation has arisen.

Determining whether a drought is occurring is difficult because of the insidious onset and the patchy availability of water even in severely drought-stricken areas. Several indices of drought have been developed. Droughts have been classified according to their greatest impact.

Percentage of Normal Precipitation

The percentage of normal precipitation is one of the most commonly used drought indices. It is determined by dividing the actual precipitation in a given time period (e.g., a month) by the average precipitation for the last 30 years in the same time period. This value is then multiplied by 100% to give the percent value. Although the percentage of normal precipitation gives an easily understandable value, it can be biased because rainfall is not normally distributed over the years. Therefore the percentage of normal value can underestimate and overestimate the severity of the drought. As such the percentage of normal precipitation generally is not very useful in agriculture, which depends on meaningful long-term assessments of water availability.

Standardized Precipitation Index

A more accurate index of drought than the percentage of normal precipitation is the Standardized Precipitation Index. This is calculated by dividing the difference in precipitation from what is normal for a given time period by the standard deviation for this measurement.

Palmer Index

In an attempt to provide a more meaningful measure of water availability for agriculture, the Palmer Index was developed and has been modified over the years. The Palmer Index ranges from 6 (severe) to +6 (no) drought conditions. It takes into account precipitation, ambient temperatures, available water content of soil, evaporation, soil recharge, runoff, and moisture loss from the surface layer of the soil. The Palmer Index is used in such states as Colorado, Idaho, and Utah, where it is applicable to assess water availability over large, homogeneous ecosystems.

Surface Water Supply Index

A drought index that can be used to assess conditions on a smaller scale than the Palmer Index is the Surface Water Supply Index, which takes into account mountain snow pack, stream flow, precipitation, and reservoir capacity. The data on each of these water sources are weighted for the environment to which they are applied.

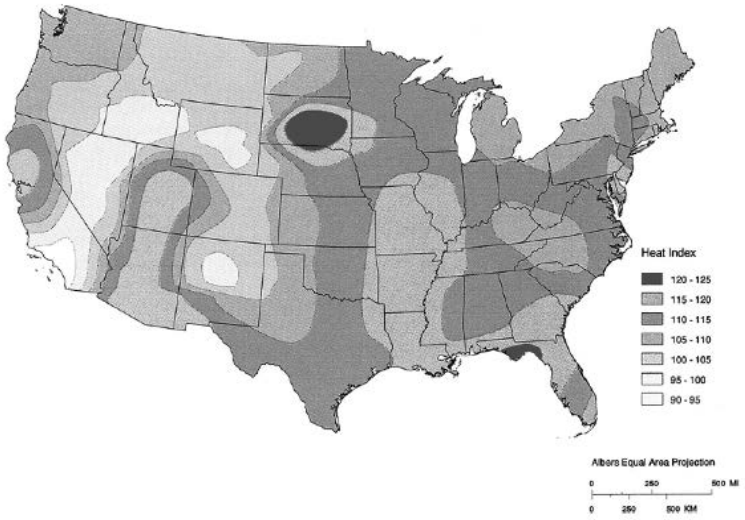

FIG. 9-1 Severity and regional extent of extreme summer heat in the United States. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.)

Crop Moisture Index

Satellites and Geographic Information Systems can also be used to monitor the Crop Moisture Index. This index is derived from weekly readings of crop conditions. It is useful for short-term predictions of water availability over large geographic areas.

Probability and Frequency

The U.S. Army Corps of Engineers is preparing a National Drought Atlas based on measurements from 1659 stream flow stations in all 50 states and U.S. territories with at least 20 years of records of unregulated flow. The goal will be to provide information on the magnitude and frequency of minimum precipitation and stream flow in the United States.

Table 9-1 Exposure of regions of the United States to droughts over the last 100 years

Region	Area affected by severe or extreme drought conditions in last 100 years*		
	Any area	More than 50%	Entire region
United States	100	1	0
Great Plains	93	16	0
Missouri	90	17	0
Pacific Northwest	86	23	0
South Atlantic, Gulf	79	9	0
Upper Mississippi	77	19	1
Great Lakes	73	9	0
Great Basin	71	19	1
Mid Atlantic	69	12	0
Ohio	67	16	3
Souris-Red-Rainey	66	19	0
Arkansas, White-Red	65	14	0
Rio Grande	58	15	2
Lower Colorado	56	16	3
New England	56	8	0
Lower Mississippi	56	4	0
California	53	14	3
Upper Colorado	50	27	8
Texas Gulf	49	22	7
Tennessee	31	21	5

Data from Cody Knutson, Drought Mitigation Center, Lincoln, Nebraska.
*The values in the table are the number of years in the last 100 years that a region was affected by drought. For example, in the last 100 years over 50% of the Upper Mississippi region suffered severe or extreme drought conditions for a total of 19 years.

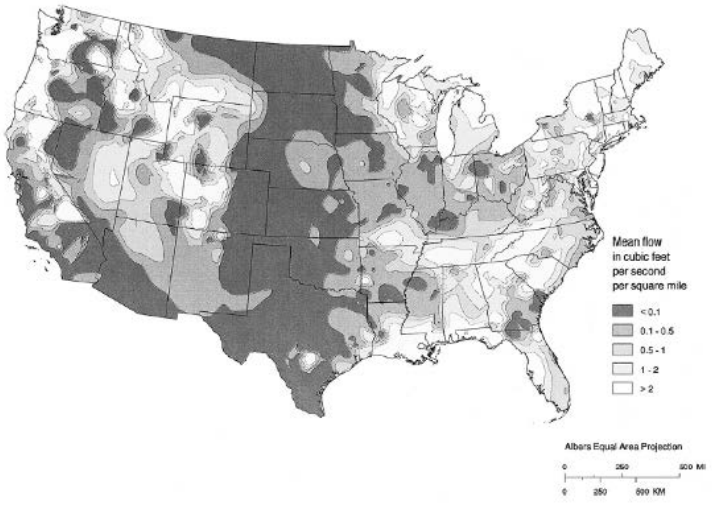

FIG. 9-2 Areas of drought vulnerability as measured by July to January mean flow with a chance of not being exceeded. The lower the mean flow, the greater the risk of drought. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy,* Washington, DC, 1997, FEMA.)

Table 9-2 Types of droughts

Type	Definition
Meteorologic	Departure (low) of actual precipitation from expected average or normal amount based on monthly, seasonal, or annual time scales
Hydrologic	Shortfalls of water in stream flows, reservoirs, and lake and ground water levels
Agricultural	Soil moisture deficiency relative to water demand for plant life (crops)
Socioeconomic	Demand of water exceeding the supply as a result of weather-related supply shortfall (water management drought)

The impact of droughts can be reduced in livestock operations by selling nonpregnant and otherwise nonproductive animals (old animals, animals with chronic mastitis, or otherwise debilitated animals). The stocking density of cattle on pastures should be reevaluated to allow for a margin of safety that prevents overgrazing. Overgrazing pastures leads to long-term damage to pasture vegetation, decreased weight gains, weight loss, and an increased propensity for animals to ingest toxic plants, which they would otherwise not eat.