

Using seasonal rainfall probabilities to predict drought risk

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Management strategies for perennial pastures should take account of the likelihood of drought. Drought is defined in this context as a period when rainfall is markedly lower than usual, resulting in plant death or unusually low production. Differences in average annual rainfall between regions of Australia's high rainfall zone can give a crude measure of drought risk. However, the severity, length and seasonal timing of drought, which also have management implications, are not accounted for by annual rainfall measures.

This analysis was undertaken to produce a simple pasture management tool that can be used to compare drought risk between locations.

Methods

Monthly rainfall records were compared for Armidale (NSW) and Ararat (Vic). Both cities lie within regions of intensive livestock production supported by temperate pastures. Armidale records were for 134 years to January 1997, while those for Ararat covered 132 years, also to January 1997. Data were sorted in ascending order for each site, then separated into rainfall probability categories. Data for different months were treated independently. Predictions from this technique assume that future rainfall will cover a similar range to that of the past 130 years.

Results and discussion

Armidale has an annual average rainfall of 790

mm, while that for Ararat is 616 mm. Another measure of likely rainfall is given by the median. This amount is exceeded in 50% of records. When considering a large number of measurements, the likelihood of receiving monthly rainfall less than the median is 50%, or one in each two events (Figure 1).

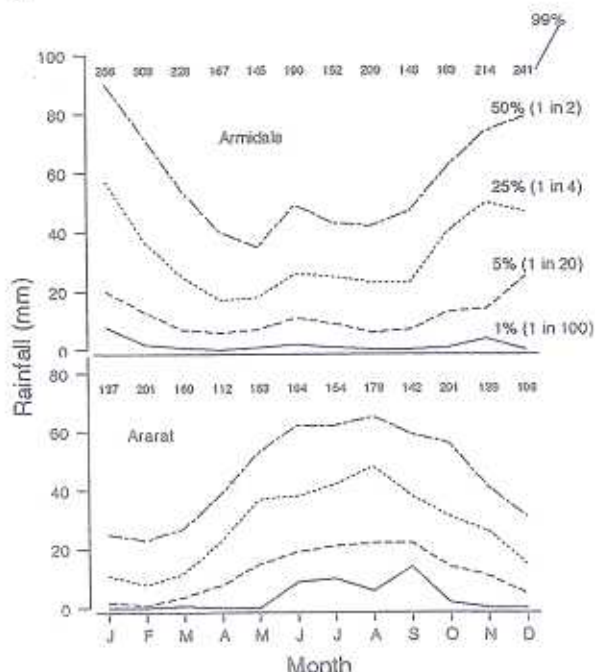


Figure 1. Comparison of rainfall probabilities for two sites.

The 25%, 5% and 1% probability lines in Figure 1 show the rainfall that will be received in drier than average months. For example, for any month in the year, rainfall less than the 25% line can be expected for 1 year in 4 on average. The numbers labelled '99%' are the monthly values that have been exceeded in only one in 100 measurements.

Records of monthly variability give more information about drought risk than do either monthly averages or annual average rainfall. Rainfall variability is shown by the distance between the probability lines. Spring, summer and autumn variability is greater for Armidale than at Ararat. Where probability lines are widely spaced, there is an increased chance that rainfall will differ markedly from the median. In that case it would not be unexpected for rainfall to be well below the median for several successive months.

Based on past records, monthly drought probabilities are independent of each other. If rainfall is of a certain probability in one month, the likely rainfall in the following month(s) cannot be estimated any more closely than is given by the

range shown in Figure 1. Because the probabilities are independent, the likelihood that rainfall will be less than the 1% line for two successive months is $0.01 \times 0.01 = 0.0001 = 0.01\%$.

Monthly drought risk is shown by how many times in 100 that rainfall of less than a chosen amount is expected. At Armidale for example, Figure 1 shows that less than 5 mm can be expected in any month, for one in 100 measurements (January excepted). In contrast, Ararat rainfall during any winter month will not be less than 5 mm/month, even for a 1 in 100 drought. However, dry summers there are the rule rather than the exception.

Both Armidale and Ararat can expect frequent droughts (Figure 1). Although Armidale's average rainfall is higher, this is due to occasional large rainfall events. Armidale has a greater risk of low rainfall in winter and spring because of this variability. Rainfall is one determinant of soil moisture content. Drought risk also depends on soil moisture reserves, soil water holding capacity and evapotranspiration rates.