Predicting cereal crop yields for rainfall analysis in semi-arid dryland farming areas

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A method of expressing rainfall in terms of yield of grain has been developed. By applying to past rainfall records, this can be used to determine the long-term economic prospects of growing wheat at any location for which long-term monthly rainfall values are available. By applying to the current cropping season's rainfall. the method could be used to determine the need for local or general grain handling facilities or transport to seaboard.

Marked improvements in technology, particularly in the capacity of machinery to give a 20 to 30-fold increase in cultivating capacity per unit time and increasing awareness of the effects of good and poor land use. mean that there is less erosion risk, and better economics. in growing wheat at Wentworth in a 250 mm rainfall in the 1980's than at Wagga or Wyalong with a 500 mm rainfall. in the 1930's. However, there is need for a method of determining the limit beyond which regular cropping should not be permitted, in respect of both economics and wise land use.

Two methods of estimating crop yields from monthly rainfall values have been developed. A study of crop yields in relation to rainfall over the crop year in hundreds of individual cases on light-textured soils has shown that yields, in bags per acre. are equivalent to 0.7 times the total March- October rainfall, in inches, for the crop year in question for yields in excess of 5 bags per acre (1.0 t pha).

This simple relationship predicts high at low rainfall levels and a more detailed monthly-multiplier equation is used for such years. A combination of both methods, in which the lowest value is used for any crop rainfall year, gives improved correlation especially at lower levels of crop rainfall.

The special monthly-multiplier equation is based on the use of fractional multipliers for each month for the pre-crop spring, summer, autumn and early winter with penalties for rainfall less than 25 mm or more than 50 mm in any month. and bonus values for rainfall in excess of 25 mm in August. September and October immediately preceding harvest. The multipliers_ and bonus and penalties values have been refined to their present state by detailed examination of rainfall events, or other causes for those years in which predicted yields were well removed from the actual.

The multipliers ranged from 0.1 in the pre-crop spring months to 0.75 for May. June and July with the multipliers in March and April being increased in the event of a heavy rain suitable for sowing during those months. Monthly rainfalls less than 25 mm are depreciated to come to -10 for a rain-less month. With two months in succession less than 10 mm, the penalty for the second month is increased by 50%, for the 3rd month 100%, and so on.

The correlation coefficient has been found to range between 0.7 and 0.8, but if it is determined using nought as the point of origin. the correlation coefficient (r^2) is between 0.90 and 0.96 for most analyses.

The technique of estimating yields from monthly rainfalls can be used in several ways. By converting rainfalls to yields for the periods for which past rainfall records are available. the estimated yields can be then converted to nett returns and used to give a year by year picture of the economics of cropping in any location for which long-term records are available. These financial values can, in turn, be used to establish isopleths representing the percentage of years better than break even.

The technique can also be used to obtain a forward indication of yields for the current season. Given a predicted yield as at the end of August it is then possible to use median or other suitable decile values for September and October to gain an assessment of likely yields. These could reasonably be used to plan grain handling and transport logistics.