Chapter 5
Agricultural Drought Management Strategies to Alleviate Impacts: Examples from the Arid and Subhumid Regions of the Indian Subcontinent

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INTRODUCTION

Drought, though not considered a disaster by many, is one of the natural calamities encountered by humans. Drought may begin at any time, last indefinitely, and attain many degrees of severity. Its beginning is subtle, its progress is insidious, and its effects can be devastating (World Meteorological Organization [WMO], 1975). Often, drought is associated with aridity, although in reality it is a climatic aberration that can occur in any part of the globe, including humid and per humid regions. It is a condition relative to some long-term average of balance between rainfall and evapotranspiration in a particular area (Wilhite and Glantz, 1985).

Droughts are not quick-onset disasters, like floods or typhoons, but are usually the eventual result of a set of weather sequences that require extensive periods of time to develop (Linsley et al., 1959). Thus, according to Wilhite (1982), drought is a "creeping phenomenon," the effects of which accumulate slowly over a considerable period of time. However, drought means different things to different people and no universally accepted definition has so far been developed (Sastri et al., 1982).

Droughts are classified in three main categories (Das, 1981): meteorological (rainfall substantially below climatological expectations); hydrological (surface and subsurface water [i.e., reservoirs, lakes, rivers, and groundwater] depleted); and agricultural (inadequate soil moisture to support the growth of plants and crops to maturity).

AGRICULTURAL DROUGHTS—GENERAL CONCEPTS

Agricultural drought is generally accepted to be a period of dryness caused by a precipitation shortfall during the crop growth period (Huda et al., 1986), resulting in a substantial reduction in yield. The impacts of drought depend not only on the duration and intensity but also on the crop, its stage of growth, and soil characteristics (e.g., water-holding capacity). Thus, agricultural drought is a crop-specific phenomenon.

D. A. Wilhite (ed.), *Drought Assessment, Management, and Planning: Theory and Case Studies*

In the *Technical Report on Drought and Agriculture*, the Commission for Agricultural Meteorology (CAgM), a working group of the World Meteorological Organization (WMO, 1975), gave a detailed account of the concept of agricultural drought and several meteorological indices used for detecting severity and impact. In the discussion that follows, the concept of agricultural drought is discussed in reference to the arid and subhumid regions of the Indian subcontinent.

CLASSIFICATION OF AGRICULTURAL DROUGHTS

Knowledge of the frequency and time of occurrence of agricultural droughts of varying intensity is of paramount importance in identifying crops best suited to a given region (Sastri et al., 1981). Some attempts have been made to classify agricultural drought using water availability periods and monthly rainfall deciles (George and Krishna, 1969; George and Kalyana Sundaram, 1969) for some parts of India and using an aridity index for the Indian arid region (Krishnan and Thanvi, 1971). However, these are general in nature and not crop-specific classifications.

Sastri et al. (1981b) developed a new method for classifying agricultural droughts based on a rational approach for pearl millet and wet season (kharif) pulses for the arid region of western India. The index of moisture adequacy (IMA), a ratio of actual to potential evapotranspiration during the crop growth period, is the basis for this classification. However, the drought or water stress period at different phenological phases of crop growth affects crop productivity differently. Ramana Rao et al. (1981) developed an integrated scheme of drought classification in which the values of IMA during the seedling, vegetative, and reproductive stages were considered. Water stress at these three stages was integrated with different combinations of drought intensity at different growth stages in order to assess the overall intensity of drought for the arid regions of India. More recently, Sastri and Patel (1984) developed another classification of agricultural droughts for rainfed rice, grown extensively in the subhumid tracts of central India.

Indices for Agricultural Drought Classification

Agricultural droughts have been classified according to degrees of water availability such as humid, moist, and submoist (Cocheme and Franquin, 1967). For the Indian arid region, Krishnan and Thanvi (1971) used the aridity index (IA) of Thornthwaite (1948). For studies of drought occurrence, this index is a ratio (%) of annual water deficit to the annual potential evapotranspiration.

For their crop-specific classification, Sastri et al. (1981b) and Ramana Rao et al. (1981) used the IMA, developed by Subrahmanyam and Subramaniam (1964). This index has also been referred to as the R-Index (Yao, 1969). The IMA is widely used for classifying agricultural droughts in many parts of the world.