

# *Definitions of Drylands and Dryland farming*

Dryland farming antedates history, but Hegde (1995) stated that the use of the term in its present form and meaning probably began in Utah, the United States of America, around 1863 and credits John A. Widstoe as being the pioneer of dryland farming research. According to Hegde, Widstoe defined dry farming as “the profitable production of useful crops without irrigation on lands that receive rainfall of less than 500 mm annually”, and said that the definition could be extended to include areas receiving up to 750 mm annual rainfall where its distribution was unfavourable. It is important to note that this definition is limited to land where crops are grown and does not include the management of other lands in dryland regions.

Mathews and Cole (1938) broadened the definition by suggesting that dry farming is concerned with all phases of land use under semi-arid conditions. Not only the question how to farm but also how much to farm and whether to farm or not must be taken into consideration. These questions raised by Mathews and Cole are critical regarding whether or not dryland agriculture can be sustained in the long term. However, they have not received the attention they deserve. Hargreaves (1957) defined dry farming as agriculture without irrigation in regions of scanty precipitation.

Oram (1980) made the distinction between rainfed farming and dryland agriculture explicit. He defined dryland agriculture as husbandry under conditions of moderate to severe moisture stress during a substantial part of the year, which requires special cultural techniques and crops and farming systems adapted for successful and stable agricultural production. Such conditions generally occur in regions classified as semi-arid or arid. Pastoral systems are an important part of dryland agriculture, and constitute the sole form of agricultural use in some areas, particularly in arid regions. Stewart and Burnett (1987) added that dryland farming emphasizes water conservation in all practices throughout the year. The Australian Centre for International Agricultural Research (2002) considers dryland cropping to occur in areas where the average water supply to the crop limits yield to less than 40 percent of full (not water-limited) potential. On this basis, it estimates that one-quarter of the world's cereal production is from dryland agriculture.

FAO (2000a) defined drylands as those regions classified climatically as arid, semi-arid, or dry subhumid, based on the length of the growing period for annual crops. The growing period begins when monthly precipitation exceeds half of the monthly potential evapotranspiration. The regions where the monthly rainfall never exceeds half of the potential evapotranspiration have zero growing days and are not included in the drylands. They are classified as hyperarid areas with no agricultural potential.

Arid regions have 1–59 growing days, semi-arid have 60–119 growing days, and dry subhumid regions have 120–179 growing days. Together, these regions make up 45 percent of the world's land area: 7 percent arid, 20 percent semi-arid, and 18 percent dry subhumid. The

distribution of these areas among the different regions of the world is presented in Figure 1 and in Table 1 in the main text of this book. The table does not include the hyperarid lands, which make up an additional 19 percent of the world's land area.

The classification system developed by FAO based on agro-ecological factors generally works well for assessing the potential of an area for growing crops, but there are notable exceptions. For example, in much of the Great Plains of the United States of America, one of the largest dryland cropping regions in the world, there is not a single month of the year when average precipitation exceeds half of the reference evapotranspiration. Based on the above classification system, this area is classified as hyperarid and considered non-agricultural. However, crops can be grown in this region because management practices have been developed that allow the accumulation of 100–200 mm of plant-available water in the soil during fallow periods to supplement precipitation received during the growing season. These cropping systems have a cropping intensity (the proportion of land planted to each crop during a year) of less than one, meaning that a crop is not harvested every year. Examples of such cropping systems are: wheat–fallow, resulting in one crop every two years; wheat–sorghum–fallow, resulting in two crops every three years; and wheat–sorghum–sorghum–fallow, resulting in three crops every four years. The average annual precipitation for the region where dryland farming is practised ranges from about 400 to 600 mm, but the amount for any given year for a specific location varies from about 50 percent of average annual amount to about 200 percent. The variation in yields is even greater, ranging from about 0 to 3 times the average yield. Drought conditions occur every year, but their extent and severity vary greatly.

Dryland areas such as the Great Plains may be better characterized by a climate aridity index. One such index proposed by the United Nations Conference on Desertification (UNESCO, 1977) defines bioclimatic zones by dividing the annual precipitation (P) by the annual potential evapotranspiration (PET). Climate zones are defined as hyperarid ( $P/PET < 0.03$ ), arid ( $0.03 < P/PET < 0.20$ ), semi-arid ( $0.20 < P/PET < 0.50$ ), and subhumid ( $0.50 < P/PET < 0.75$ ). This aridity index classifies the Great Plains as a semi-arid region where dryland farming is widely practised, whereas the growing-period system showed this large region as hyperarid. There is probably no classification system that can be universally applied and each area should be considered on its own merits. National and regional classifications that reflect local characteristics have also been developed to inform decision-making processes.

Bowden (1979) divided semi-arid lands into two broad physical-climatic regions: the tropical semi-arid territory close to the equator; and the steppe located in the mid-latitudes. Each region has peculiarities of climate, settlement and resource development that can vary as much internally as externally. In contrast to the frost-free, semi-arid tropics, the semi-arid mid-latitude lands are characterized by definite warm and cold seasons. Bowden used annual precipitation between 250 and 550 mm to define the steppe. In these conditions, crop production is marginal and the growing season is often shortened by unseasonal frost. The summer precipitation is mainly evaporated or transpired during the warm season, but winter rainfall and snow usually contribute to stored water in the soil profile. The dominant vegetation under native conditions was grass, and ploughing of grassland was difficult without strong draught animals and the steel plough. Therefore, almost none of the world's steppe land was farmed extensively 150 years ago, except beside streams where shallow groundwater was available. Mechanization has led to greatly expanded agricultural production in the semi-arid areas of North America and Eurasia.