Crop production throughout the world is dependent on soil water availability either directly through precipitation captured in the soil profile or indirectly as soil water recharge applied via irrigation. Increasing water use efficiency (WUE) is critical to ensuring that we continue to produce the food, feed, fuel, and fiber needed to sustain the world’s increasing populations. Optimizing the factors that affect WUE will enhance the stability of crop production across a range of climates; however, the ever-increasing problem of climatic change increases the urgency with which we should view this issue and begin to understand the implications of the interactions between soil management factors and WUE. The increasing variability in both temperature and precipitation throughout the world raises the question of how to enhance WUE under current cropping systems. This goal has to be coupled with the sobering fact that the soils of the world continue to be degraded, and many of the critical properties that are linked to WUE of cropping systems are being negatively impacted. Increasing our ability to efficiently increase food and feed production given changes in climate and soil will require that we better understand the interactions between the soil and crop production. Wallace (2000) summarized the need to increase WUE by more effectively using water resources for plant production. The challenge for us and future generations will be to provide a stable and secure food supply and the efficient use of our natural resources—soil, water, and air.

Hatfield et al. (2001) reviewed the literature on WUE and soil management to highlight many of the options for increasing WUE through improvements in soil management. Among these options were soil management practices that affected water availability and nutrient management practices that increased the nutrient availability to the crop. They summarized the potential impacts as a relationship shown in Fig. 10|1. Soil management practices related to nutrients or water availability could change the WUE by ± 15 to 25% compared to the baseline. These changes in WUE offer potential for how we can cope with changing climate and will be explored in the remainder of this chapter. It is important to begin this discussion by first defining WUE and the principal variables that affect WUE. There have been several different forms of relationship used to characterize WUE, and these have been summarized by Tanner and Sinclair (1983). Water use efficiency is described in mathematical form as