Climate variability creates enormous problems with agricultural production and in natural resource management. Preparedness is needed. Climate forecast information could help farmers to stabilize yield through management of agroclimatic resources as well as other inputs (Gommes 1997). However, effectiveness of climate related preparations for enhanced agricultural production and protection can be improved through close collaboration among the relevant agencies and organizations, National Extension Services, National Agrometeorological Services and farming communities (Weiss et al. 2000). Although there may be other constraints before a forecast can be factored into decision-making, it is often these stakeholders that need additional information to offset risk as much as possible (Ziervogel and Downing 2004). Many farmers involved in participatory decision making processes have shown interest in using climate information and try to implement their own management practices. Farmers have built a strong knowledge base from practical experiences (Balasubramanian et al. 1998) gained over generations and this knowledge has to be valued for potential gain in farming. Stigter et al. (2005) stressed the use of traditional methods and indigenous technologies for coping with climate variability.

Crop production in industrialized societies is primarily monoculture. These monocultures are input-intensive, depending on agrochemicals (fertilizer and pesticides) for high productivity. Plants in this system feed at the same level in the soil and draw the same nutrients. Pests associated with the crop tend to build up with favorable climatic conditions, necessitating the intensive use of pesticides to manage them. Biomass accumulation in monocultures is exponential in pattern. This pattern is modified by plant density.

Hansen (2002) argued that agricultural decision makers would realize the potential benefits of climate information only if farmers are prepared for viable decision options. Effective forecast applications impose intensive demands on coping skills, as they are implemented through adjustments of possibly many interrelated...
decisions. Coping decisions that are realistic and adoptable by farmers need to be investigated for associated risks (Ingram et al. 2002). Ideally, to get optimal preparations, farmers and researchers exchange information, most often through intermediaries, that is useful for each other in a participatory co-learning approach to properly understand decision options through discussions supported by economic analyses.

Farmers in general, and specifically dry-land farmers, take cropping decisions mainly influenced by the input costs and perceived risks of economic loss, because of crop failures resulting from climate variability. Although farmers possess good understanding about their crops and give primary importance to economic returns, risk aversion is their boon to achieve higher production, even during a good rainfall season. Seasonal rainfall forecasts are required to take technical decisions on options like (a) choice of cropping system: single or double crop, (b) crop maturity type, (c) optimum plant population, (d) when to sow a first crop or a second crop, (e) decisions on application of fertilizers and their quantity and (f) taking into account the likely effect of seasonal climate on crop yields. The following paragraphs and boxes list some preparedness strategies for dealing with climatic variability as adopted in agricultural production. The specific examples come from India (Box III.2.3), Australia (Box III.2.4) and the USA (Box III.2.5).

**Box III.2.3**

In the Anantapur region of Andhra Pradesh, India, cost of seed is a large fraction of the cost of cultivation of rainfed groundnut, ranging from 20 to 35% depending on the seed rate used. Hence, it is important to determine the seed rate for the climate variability of the region. The seed rate used by the farmers is about half the recommended rate. On the basis of a survey of six districts around the Anantapur region, scientists have suggested that a major contributory factor to the low yield is lower plant density practised by the farmers (Singh and Nageswara Rao 2004). However, Singh’s (1997) synthesis of field experiments at seven locations in different parts of India showed that increasing plant density from 15 to 30 per square meter generally increased average yields only between 3 and 10%. It is therefore necessary to determine the change in yield with change in plant density for the different types of rainfall patterns that occur over the region. It was found that in about 38% of the years, the yield at the higher plant density is higher by over 150 kg/ha\(^{-1}\), which is about the level required to compensate for the additional cost of seed. Such an enhancement of yield with enhanced plant density only occurs for years with good rainfall and hence good levels of yield. Hence, only if skillful prediction of good rainfall years was possible, it appears appropriate to prepare for enhanced seed rate beyond what the farmers now use.