# Climate and human impacts on wheat production and land use in the Loess Plateau region, China

Elisabeth Simelton

**Abstract**

China produces 20 % of the worldwide supply of grain. Continuous crop failures, which may result from changes in climate, could have tremendous implications for grain supply and food prices globally. Furthermore present land use change may increase the pressure on marginal land. China expresses as a matter of policy that conservation agriculture will play an important role for climate change adaptation and mitigation as well as for sustainable development. A better understanding of what has influenced agricultural yields in the past provides a wider basis for decision-making about future strategies.

The main aim of this thesis is to evaluate the impact of climate change and variability on winter wheat production between 1955 and 2004 in China. The geographic region in focus is the semi-arid Loess Plateau in northern China, represented by the Shaanxi province. The analysis includes non-climatological effects and the impact of land use policy. The data consists of observed meteorological, crop and remote sensing data. Two crop models and a water balance model were used.

The results of the water balance model show that actual evapotranspiration has decreased by 20 mm per decade in China's main wheat region since the 1960s in response to less annual precipitation and increasing annual mean temperatures. Shorter duration of sunshine and reduced wind speed also occurred. Observed grain yields have increased at a fairly constant rate of 500 kg $ha^{-1}$ per decade in Shaanxi. It is estimated that the climatic impact was -25 kg $ha^{-1}$ per decade between 1995 and 2004, which suggests that the technical impact dominates the total observed trend. Climate change thus played a minor role over 50 years, however, the climate impact increased considerably during the recent 12 years. Simulations show that water availability, represented by precipitation and soil moisture, is the main limiting factor for the wheat yield, particularly during spring. Five measures for improving the water use efficiency of rainfed wheat production were evaluated. Wheat straw mulch increases the probability of a higher yield compared with the conventional practice through efficient water use. A short-term study indicates that recent reforestation policies may have played an important role for revegetation in north Shaanxi between 2000 and 2004.

The results imply that the area suitable for rainfed winter wheat in China may diminish due to limited water resources in the north wheat belt and above optimal temperatures in the east and south. However, improved land use efficiency and yields on marginal land is possible by making small changes in management, and the present policies might have a capacity to bring about these changes.

**Keywords:** climate change and variability, climate impact, grain yield, winter wheat management, soil moisture, rainfed, semi-arid, Loess Plateau, China