6.1 Intensification vs. Extensification

When use of a practice, technology, or policy option was modeled, we defined two generic ways in which it could occur. Intensification involves exercising the option on land areas currently used in production of the relevant commodity(s) — creating more product with the same land area in the same location. For purposes of our analysis, we defined intensification to include the displacement of one commodity by another within existing land areas suitable for production of both commodities. Displacement in these models occurs when the technology or policy option causes a more favorable economic outcome relative to current land use. Extensification is the process of introducing production into land areas that were previously unused or used for less intensive purposes. In practice, to meet the demands for food imposed by an increasing population, extensification has often involved exploiting marginal lands with resultant degradation and/or desertification. These terms define the limits of a continuum of land use change resulting from outcomes driven by technology or policy options.

6.2 Geographical Equivalence and Use of Spatially Explicit Analysis

The term “geographical equivalence” in its simplest manifestation describes the ability to create an empirical model of a select location and identify all areas similar to that location. Geographical equivalence specifically relates to the observation-environment relationship and its spatial analogue. In many ways, the crudest forms of adaptation zones are those areas that are geographically equivalent to a location where a given technology appears well suited. However, geographical equivalence relates also to other characteristics that may not be fully part of a technology or policy-level adaptation zone.

Closely related to the idea of geographical equivalence is the term “adaptation zone.” In the case of new technology, this means geographically equivalent areas in which, as a first approximation, the technology might be adaptable. For example, a specific maize germplasm may have characteristics that loosely describe its adaptation zone (temperature, rainfall, and soil requirements). Geographical equivalence is the term used to describe a series of spatial tests relating other important characteristics to the initial adaptation zone. Perhaps the germplasm is not tolerant of a certain disease — a disease that has its own set of characteristics for which geographic equivalence might be identified. In these studies, we distinguished between the terms adaptation and adoption. Adaptation was a first-order approximation of areas of geographic equivalence to which new technology may be adapted. The precision of this estimate is dependent on the extensiveness of the analysis of geographic equivalence. We used the term adoption to mean the actual use of new technology, both in terms of the location and the extent of utilization. We recognized that the analysis of adaptation in ex ante analysis would be different from actual adoption as a result of factors that were not completely represented in our models.

Geographic equivalence was used in these studies as a fundamental part of establishing an objective method for determining spatial sampling frames that required spatially explicit analysis to assess the impact of new technology or policy. Objectively defined sampling frames provide a very important tool to improve the efficiency of research on impact assessment. Knowing how often and where to sample to acquire representative data avoids either over or under investing in detailed research. A spatial sampling frame not only sets up the rigorous examination of predictive data but also sets in place an understanding of how far (and how representative) results can be applied. We exercised two different spatial sampling mechanisms in our case studies.