

Executive Summary

As rising populations and incomes increase pressure on land and other resources around the world, agricultural productivity plays an increasingly important role in improving food supplies and food security. Agronomic studies and conventional wisdom have long recognized that land quality affects agricultural productivity, but it has been difficult to disentangle land quality's effects from those of other factors, such as changes in input use. Advances in spatially referenced data and geographic information systems offer new insights on land quality's role in shaping patterns of agricultural productivity and food security.

First, econometric analysis using new data on soils and climate, and controlling for the effects of agricultural inputs and other measures of resource quality, confirms that differences in land quality contribute to significant differences in agricultural productivity among countries. Some of these differences can be mitigated (e.g., by increasing fertilizer use to reduce or reverse soil nutrient depletion in Sub-Saharan Africa), but others may not be reversible at reasonable economic or environmental cost.

Second, land degradation appears to generate productivity losses that are relatively small on a global scale (although their relative importance may increase if productivity growth continues to slow). New estimates of productivity losses are consistent with the lower range of previous estimates. For example, potential yield losses to erosion estimated in the soil science literature average 0.3 percent per year across regions and crops. These estimates focus on biophysical relationships in the absence of behavioral response; actual yield losses will be lower to the extent that farmers act to avoid or reduce these losses.

Third, farmers' responses to land degradation affect how potential impacts on yields may translate into actual impacts on agricultural productivity. Econometric and simulation analyses show how differences in land tenure and other factors that affect farmers' planning horizons combine with differences in land quality to influence farmers' decisions to adopt practices that reduce erosion and nutrient depletion. Actual losses under optimal practices will typically be lower than potential losses derived from agronomic studies. Actual losses under optimal practices are difficult to estimate but are generally less

than 0.1 percent per year in the north-central United States.

These findings do not imply that degradation-induced yield losses are unimportant—just that they have historically been masked by yield growth (which has averaged over 2 percent per year in recent decades for the world as a whole) spurred by improvements in technology and increases in input use. Degradation-induced yield losses may become more significant in relation to yield growth in the future, as yield growth rates are projected to fall below 1 percent per year over the next few decades. Land degradation's effects on productivity are likely to be more severe in some regions and local areas, due to a combination of resource factors (terrain, soils, and precipitation) and economic factors (poverty, tenure insecurity, and lack of infrastructure).

Finally, land degradation's impacts on productivity may affect food security in some areas both through losses in aggregate production (and thus higher food prices for all consumers) and through losses in income for those who derive their livelihoods from agricultural land or agricultural labor. Model results suggest that the number of people with nutritionally inadequate diets in low-income developing countries would decline by 5 percent if average annual yield losses to land degradation in those countries were reduced from 0.2 percent to 0.1 percent over the next decade. Such improvements would contribute to meeting the 1996 World Food Summit objective of halving the number of undernourished people in the developing world by 2015 but would not be sufficient to meet the Summit goal entirely.

These results suggest that when markets function well, private incentives to reduce land degradation are generally sufficient to address onfarm productivity losses. When markets function poorly (e.g., when property rights are insecure or credit is expensive or unavailable), private incentives to address productivity losses are diminished. In either case, private actions are unlikely to adequately address land degradation's other, and perhaps more significant, effects: offsite impacts on both economic performance and environmental quality. Priorities for further progress in understanding and addressing the links between resource quality, agricultural productivity, and food security include targeted improvements in data, analysis, technology development, and policy.