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Natural Resources, Agricultural Productivity, and Food Security

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Issue. Sustained growth in agricultural productivity is critical to improvements in food security for two reasons. First, growth in agricultural productivity translates into increased food supplies and lower food prices for consumers. And second, growth in agricultural productivity means higher incomes, and thus improved ability to purchase food and other basic necessities, for many food-insecure people who earn their livelihoods through agricultural production. Most changes in agricultural productivity over time (and differences across farms or countries) can be attributed to differences in the quantity of resources used in agricultural production, such as land, labor, and fertilizer. But agricultural productivity also depends critically on the quality of resources used, including the quality of natural resources such as land. Distinguishing the relative impacts of resource quantity and quality is important in determining appropriate policy measures to improve agricultural productivity and food security.

Background. Land—embodying soils, climate, and other characteristics—is one of the most basic resources used in agricultural production. Land and other resources interact with food security through production, consumption, and other processes. Growth in agricultural productivity increases farmers' incomes and lowers food prices for consumers, thereby improving access to food. Improved access to food in turn allows increased investment in the protection and improvement of resources that help generate food security in the future.

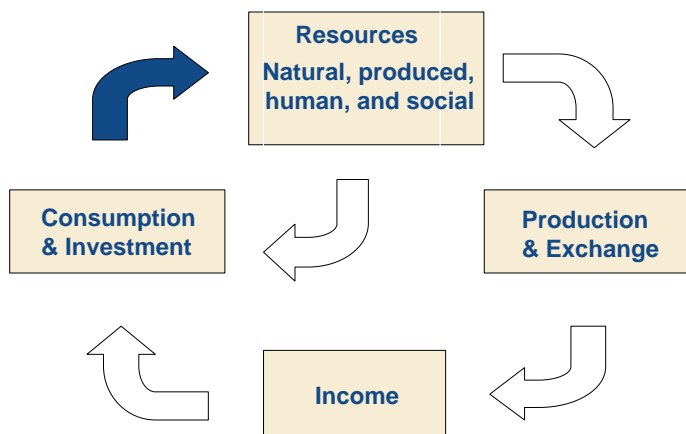
Extensive areas of land well suited for agriculture are found in North America and Europe. Land is generally of lower quality in Latin America, Asia, and Africa, where many low-income food-deficit countries are located. Poor soils and climate do not make agricultural production impossible, but they do mean that costs of production are likely to be higher, and that productivity is likely to be lower than it would be under more favorable conditions. While the quality of all land is lowest in the Middle East and North Africa, the quality of cropland (identified via satellite imagery) is lowest in Sub-Saharan Africa. About 6

percent of cropland is classified in the top three land-quality classes in Sub-Saharan Africa, compared with 16 percent in Asia, 19 percent in the Middle East and North Africa, and 27 percent in Latin America. By contrast, 29 percent of cropland in the high-income countries, as defined by the World Bank, and over 50 percent of cropland in Eastern Europe is high quality.

After taking account of agricultural input levels and other factors, differences in cropland quality are significantly related to differences in agricultural productivity in 110 countries over the period 1961-97. Within Sub-Saharan Africa, the productivity of agricultural land is 28 percent higher, on average, in countries with high land quality than in countries with poor land quality. The productivity difference attributable to high land quality is 34 percent in Asia, and 22 percent in the high-income countries. (In Latin America, only the best soils and climate are significantly associated with increased productivity.)

Resources and food security

Resources affect food security through decisions about production and exchange. It is important to remember that consumption and investment decisions also affect the resources on which future food security depends.



Land quality

Class 1 land is best suited for agricultural production;
Class 9 land is least suited for agricultural production



Source: USDA/NRCS

Data on land degradation rates and impacts are even more scarce than data on land quality, but most studies have found that productivity losses due to processes such as soil erosion, nutrient depletion, and salinization are small on a global scale (on the order of 0.1 - 0.2 percent per year) in relation to historic gains in productivity (on the order of 2 percent per year) due to improvements in technology and input use. Nevertheless, some areas with poor or fragile soils and inappropriate agricultural management practices could have productivity losses that are significantly higher. Such conditions are found in parts of Sub-Saharan Africa, for example, where productivity levels are already low and the need for growth is correspondingly high.

Alternatives. In Sub-Saharan African countries with relatively poor soils and climate, the policy measures most needed for increased agricultural productivity are investments in the efficient delivery and use of water and fertilizer, combined with efforts to improve institutional stability through the cessation of armed conflict. In Sub-Saharan African countries with good soils and climate, these factors remain important, but agricultural productivity becomes relatively more sensitive to improvements in labor quality and infrastructure. Policymakers in those countries may thus find it appropriate to focus additional resources on investment in education, health, extension services, and transportation.

Similar conclusions apply in Latin America and Asia (although increased application of fertilizer is not associated with improved agricultural productivity in Asia, regardless of land quality, reflecting the relatively high levels of use already observed there). In the Middle East and North Africa, not surprisingly, improvements in irrigation offer the greatest potential gains in agricultural productivity.

In general, the greatest improvements in agricultural productivity will be realized from relaxing the constraints that bind most tightly—constraints that vary from region to region according to differences in resource endowments and other factors. It is not surprising that the quality of soils and climate should play a key role in defining these differences. Yet only recently, with improvements in spatial data and methods, has it become possible to characterize these differences with increased precision on a global scale. Continued research at ERS will further refine our understanding of the links between resource quality, agricultural productivity, and food security—and of the tools that policymakers can use to improve them.

Information Sources. More information can be found in a related article published recently by ERS in *Food Security Assessment 2000* (<http://www.ers.usda.gov/publications/gfa12/>) and in the references cited there.

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