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Environmental Effects of Agricultural Land-Use Change

The Role of Economics and Policy

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Abstract

This report examines evidence on the relationship between agricultural land-use changes, soil productivity, and indicators of environmental sensitivity. If cropland that shifts in and out of production is less productive and more environmentally sensitive than other cropland, policy-induced changes in land use could have production effects that are smaller—and environmental impacts that are greater—than anticipated. To illustrate this possibility, this report examines environmental outcomes stemming from land-use conversion caused by two agricultural programs that others have identified as potentially having important influences on land use and environmental quality: Federal crop insurance subsidies and the Conservation Reserve Program (CRP), the Nation's largest cropland retirement program. The report finds that lands moving between cultivated cropland and less intensive agricultural uses are, on average, less productive and more vulnerable to erosion than other cultivated lands, both nationally and locally. These lands are also associated with greater potential nutrient runoff and leaching compared with cultivated cropland nationally. Crop insurance subsidies and CRP have estimated effects on erosion and other environmental factors that are disproportionate to the acreage and production effects, but specific environmental impacts vary with the features of each program.

Keywords: Conservation Reserve Program (CRP), crop insurance, erosion, extensive margin, farm policy, imperiled species, land use, land-use change, land quality, nutrient loss, soil productivity.

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Summary

While total U.S. cropland has remained roughly constant for 100 years, this stability belies larger underlying movements of land into and out of crop production. Almost three-quarters of the cropland that shifted into or out of cultivation between 1982 and 1997 had soil productivity ratings below the average acre of cropland. Farmers tend to keep highly productive cropland in cultivation regardless of changing economic conditions. But economic conditions, such as changing commodity prices or production costs, encourage farmers to expand production to less productive land or to shift less productive croplands to other uses. Agricultural and conservation policies also affect land use. These land-use changes affect environmental quality, particularly when affected lower-quality lands are environmentally sensitive.

What Is the Issue?

Although many have speculated that less productive croplands are more environmentally sensitive, little empirical evidence is available to substantiate this idea. If cropland that shifts in and out of production is less productive and more environmentally sensitive than other cropland, policy-induced changes in land use could have production economic effects that are smaller—and environmental impacts that are greater—than anticipated.

This report examines how the attributes of lands shifting into and out of crop production differ from those of continuously cultivated cropland. We focus particularly on cropland change affected by the Conservation Reserve Program (CRP) and Federal crop insurance, government programs that others have identified as potentially having important influences on land use and environmental quality. Since 1985, CRP has been the largest driver of cropland changes. This land retirement program pays farmers to retire cropland acreage to achieve environmental goals. In 2005, the CRP paid farmers \$1.7 billion to retire a land area almost the size of Iowa. Due to its competitive bidding process and selection criteria, CRP enrolls land that is less productive and more environmentally sensitive than average cropland. The Federal crop insurance program, on the other hand, raises incentives to expand crops to less productive land. Environmental groups, economists, and others have expressed concern that this may induce cultivation in frequently flooded and other risky areas containing wetlands or other environmentally sensitive lands.

What Did the Study Find?

Between 1982 and 1997, there was a net decline in cultivated cropland of 43 million acres (11 percent). Over the same time, more than 127 million acres or 32 percent of cultivated cropland shifted between cultivated cropland and less intensive uses. These shifting lands are generally less productive than continuously cultivated croplands.

On average, land shifting in and out of cultivation is more vulnerable to erosion (from rainfall and often wind) and—except for CRP acreage—has greater nutrient runoff and leaching potential than more productive crop-

land. While these nutrient loss estimates take into account land erodibility, they may not accurately reflect differences in fertilizer applications on lower productivity lands.

Lands enrolling in CRP are generally less productive than other lands shifting into and out of crop production. On average, CRP acres (if returned to cultivation) would be more vulnerable to erosion, but do not have higher potential nutrient runoff and leaching to water, than other cropland areas. The 8-percent reduction in cultivated cropland area attributed to CRP reduced aggregate wind and water erosion by an estimated 16 and 7 percent annually, as of 1997.

Increased crop insurance subsidies in the mid-1990s motivated farmers to expand cultivated cropland area in the contiguous 48 States by an estimated 2.5 million acres (0.8 percent) in 1997, with the bulk of this land coming from hay and pasture. This land-use change increased annual wind and water erosion by an estimated 1.4 and 0.9 percent, as of 1997.

Lands brought into or retained in cultivation due to these crop insurance subsidy increases are, on average, less productive, more vulnerable to erosion, and more likely to include wetlands and imperiled species habitats than cultivated cropland overall. Based on nutrient application data, these lands are also associated with higher levels of potential nutrient losses per acre.

Lands shifting in and out of cultivation are generally located in areas with more imperiled plant and vertebrate species than cropland persisting in cultivation. Lands in cultivation due to increased insurance subsidies tend to lie in watersheds with higher average counts of imperiled vertebrate, plant, and fish/mollusk species, relative to cultivated cropland overall. CRP lands are in areas with greater average counts of imperiled birds but not of other imperiled species examined. (Our species indicator is the number of species considered imperiled throughout their range from NatureServe's Natural Heritage data. Although these data are the most comprehensive measure of U.S. biodiversity conservation status, the available data are insufficient to determine whether the associated changes in land use have an impact—either positive or negative—on imperiled species.)

These results suggest that policies that increase incentives for crop cultivation and stimulate production on economically marginal land may have disproportionately large unintended environmental consequences. Conversely, large environmental benefits could be achieved at lower cost using targeted conservation programs because owners of low-quality and environmentally sensitive land require less payment to remove land from production than owners of higher quality land.

How Was the Study Conducted?

Historical patterns of land-use change are examined to establish relationships between land quality and land use. This report also estimates land-use and environmental impacts stemming from two government programs that may affect less productive and environmentally sensitive croplands: federally subsidized crop insurance and the CRP.

The report compares the economic and environmental characteristics of lands that persist in cultivation and those that have recently shifted between cultivated cropland and other, less intensive, uses such as hay, forest, pasture, range, and CRP. These are lands on which uses actually have been affected by recent economic changes or other factors. Using parcel-level data on land use and land characteristics from USDA's National Resources Inventory (NRI), the report examines associations between measures of agricultural productivity, enrollment in CRP and other land-use changes, and environmental factors including rainfall and wind erosion; potential nutrient losses reaching groundwater, surface water, and estuaries; and location relative to imperiled species habitat.

While lands in CRP are analyzed directly, we estimate the extent, location, and characteristics of lands cropped due to insurance subsidies through a statistical analysis of land-use changes surrounding the large increase in crop insurance subsidies after the 1994 Crop Insurance Reform Act. The report compares land-use changes between 1992 and 1997 given different increases in the expected gains from the newly increased subsidies.