

Agricultural Expansion and Environmental Sustainability

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Sustainable supplies of food and energy, and a livable, sustainable environment, are essential requisites and rights of humanity. However, unless food and energy production and use patterns undergo dramatic transformations, these three human needs will come into increasingly strong conflict during the next 50 years. Global population and per capita income are on trajectories to increase by 50% and 40%, respectively, within the next 50 years, causing global demand for both food and energy to more than double. More than 5 billion hectares of land are currently dedicated to crops and pastures. The composition of diets is shifting with increasing incomes in ways that may require more fertile land per capita. Crop yield gains continue to depend on greater inputs of fertilizers and other agrichemicals. Fertile lands are also increasingly used to produce biofuels. If these trends and relationships continue, at least 1 billion hectares, and perhaps as much as 2 billion hectares, of natural ecosystems may be converted to croplands producing food and biofuels. Such land conversion would accelerate climate change through the release of globally significant amounts of greenhouse gasses, and greatly increase the number of species, especially those of tropical ecosystems, that are threatened with extinction. The increased use of fertilizers and pesticides would degrade freshwater ecosystems, aquifers, and coastal marine ecosystems, increasing the size and number of marine 'dead zones.'

Solutions to these problems must address various aspects of the food-energy-environment dilemma. If diets shift to favor efficiently-produced protein, global food demand could be moderated over the next 50 years, while still providing nutritionally-sound diets. Long-term investment in increasing the yields and fertilizer-efficiency of fruit, vegetable and cereal crops could greatly decrease the amount of land converted to agriculture and reduce the impacts of crop production on aquatic resources. Investments made towards increasing the protein efficiency of grain-fed livestock and fish aquaculture would provide similar benefits. Biofuel production should focus on wastes and perennial, multispecies biomass crops grown on degraded lands of low agricultural utility, and not convert foodstuffs into fuels. Food, energy and environment are now inextricably linked, and global lands must be managed to optimize the total net food, energy and environmental benefits that these systems provide to society.