TRADE RESEARCH CENTER

Montana State University
Bozeman

The Economics of World Wheat Markets: Implications for North America

May 29–June 1, 1997

Conference Proceedings

October 1997

Objective Analysis
for Informed
Decision Making

Implications of Changes in World Markets and Domestic Policies for the Sustainability of Northern Plains Wheat Production

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This paper examines issues that arise in extending economic analysis of farm-level impacts to consider the environmental consequences of agricultural production practices. We construct economic models that are site specific, link the economic and environmental analyses on a site-specific basis, and aggregate the economic and environmental outcomes to the regional level for analysis of economic-environmental tradeoffs. We provide an overview of an approach to assess quantitatively the economic and environmental tradeoffs associated with the use of agricultural production technologies and use this framework to conduct a preliminary analysis of economic and environmental tradeoffs in the principal grain-producing areas of Montana. The approach accounts for key measurement issues that arise in addressing sustainability concerns including spatial variability of the impacts, the need to integrate disciplinary models and data at a small scale or level of aggregation, and the need to assess impacts at a larger scale for purposes of policy analysis.

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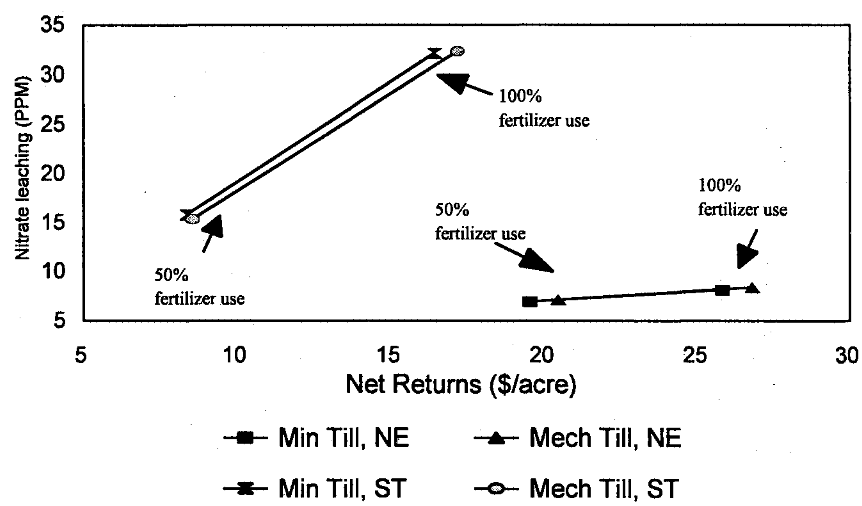
Market prices, policies, and the physical attributes of land affect farmers' management decisions in terms of both land use and other input uses. These decisions affect agricultural production and also may affect the environment through two distinct but interrelated mechanisms. Land-use decisions determine which particular acres of cropland are put into production and which crops are grown; land-management decisions determine the application rates of chemicals, water use, and tillage practices. Physical relationships between the environmental attributes of the land in production and management practices then jointly determine agricultural output and environmental impacts associated with a particular unit of land. The distribution of farm and environmental characteristics induces a joint distribution of input uses, outputs, and environmental impacts. This joint distribution provides the basis for aggregating field-specific impacts to the regional level for policy analysis.

We present some preliminary results from a pilot study of the economic-environmental tradeoffs associated with alternative cropping systems of dryland wheat and barley in three subareas of Montana: the Northeast (NE) part of the state; and the Southern Triangle area (ST) and the Northern Triangle area (NT) located in the north central part of the state. We also present some preliminary economic data from a large-scale survey of crop production practices in Montana to assess the possible economic impacts that international and domestic policies may have on wheat producers in the region.

The economic data from the pilot study show that there is no appreciable difference in the profitability of the two dominant cropping systems in the three areas for a given farm size. One implication of this finding is that farmers do not have an economic incentive to choose one system over another, so that choice is driven by other considerations such as previous investments in equipment. Another implication is that any environmental regulations that would increase the cost of using one system over another or any subsidies targeted at environmental effects, such as erosion or water quality, could impact a farmer's choice of cropping system.

Figure 13. Leaching vs Net Returns
Trade offs by Area and Tillage



The environmental-economic tradeoffs are calculated in terms of distinct environmental indicators, such as nitrate leaching and soil erosion (Fig. 13). The leaching response to fertilizer use is much greater in the ST area than in the NE area, reflecting the difference in precipitation. In contrast to the leaching tradeoffs, in the soil erosion dimension the ST area shows little, if any, tradeoff, whereas the NE area shows a modest positive effect of fertilization on erosion as shown in Fig. 14. This effect is due to the increase in land cover and crop residue associated with higher fertilizer application rates. For other environmental indicators the findings also varied across the landscape. For example, the minimum tillage, higher-intensity cropping system that provided lower levels of soil erosion and nitrate losses also was found to produce *greater* amounts of herbicide (2,4-D LV6) runoff relative to the production systems that are less environmentally damaging in the soil loss and nitrate leaching dimensions.

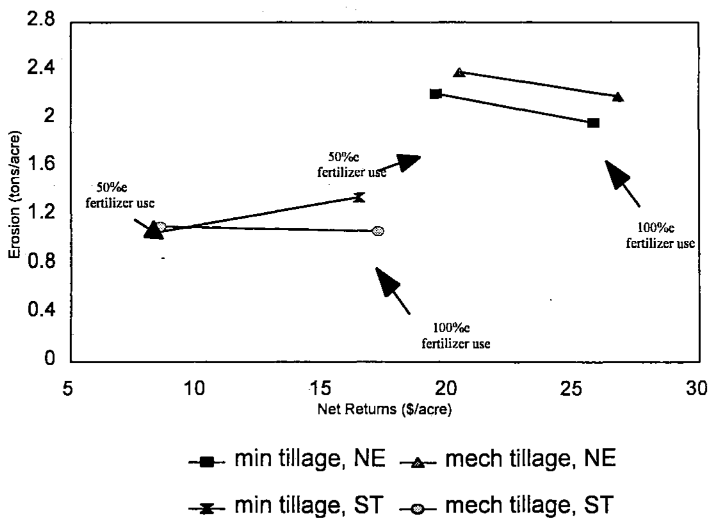
The plant growth model employed in the pilot study is also used to predict relative changes in concentrations of organic carbon in the soil at the end of each thirty- year simulation. Although the predicted concentrations of organic carbon declined for all production systems, the rate of decline was less when tillage was reduced and cropping intensity increased. This brings into question the longer-term impacts of these production systems on productivity and how those impacts should be balanced against shorter-term impacts on other environmental dimensions such as surface and groundwater quality.

The pilot study results also illustrate that a sustainable production technology can not always be identified or defined for a given area, even for a system as relatively homogeneous as dryland grain production in Montana. Most of the production technologies that are winners in some environmental dimensions are often losers in other environmental or long-term productivity dimensions. Furthermore, the tradeoffs shift as physical conditions and production technology options change.

Utilizing data from the large-scale survey of Montana wheat producers conducted in 1996, we have constructed estimates of the per acre economic returns to wheat production in the major wheat producing areas of the state. These data show clearly that there is substantial spatial variability in wheat profitability within Montana and that with the exception of the Triangle region, a substantial share of the acreage in wheat production becomes economically marginal at prices below the range that was observed in 1995. These data imply that Northern Plains wheat production could be economically vulnerable if wheat prices were to return to the levels seen in the early 1990s.

Future research will use these data and methods to model the predominant wheat production systems of the region and to quantify the economic and environmental impacts of possible changes in world market conditions and domestic policies.

Figure 14. Erosion vs. Net Returns
Trade Offs by Area and Tillage



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