AGRICULTURAL EXTENSION SERVICE • UNIVERSITY OF MINNESOTA

Minnesota AGRICULTURAL ECONOMIST

No. 564 FEBRUARY 1975

Commercial Navigation On The Upper Mississippi : Economic And Environmental Choices

To Minnesotans, the Mississippi is more than a scenic recreational area. It's a lifeblood of the state, providing a low-cost transportation route important to farmers and others. Nevertheless, ecological processes and environmental values are important and must not be neglected.

By Rodney Christianson

NAVIGATIONAL development of the upper Mississippi River and its major tributaries has greatly improved Minnesota's economic and social well-being. The 9-foot navigational channel and similar improvements have provided a low-cost transportation route to bring coal, petroleum, fertilizer, and other important commodities into Minnesota. In addition, grain harvested from Minnesota and surrounding states can be transported to domestic and foreign markets at low cost—thus assuring a competitive position in world grain markets. The Twin Cities has grown into the fifth largest shipping area along the Mississippi. Increased commerce has meant more employment and general economic growth.

River development has also provided a better habitat for fish and wildlife; water surface area has been increased, and the public now controls much of the river bottom. In addition, recreational opportunities have been greatly improved.

Nevertheless, the upper Mississippi has been developed primarily for transportation. Ecological processes and environmental values have often been neglected. There is strong opposition to any further development. Two court battles continue over the operation, maintenance, and replacement of present development. Planning is carried on at three levels: state; regional; and national. As a result, planners often arrive at conflicting conclusions.

Development of the upper Mississippi for commercial navigation

The United States has five modes of commercial transportation: highways; railways; airways; pipelines; and

The research this article reports was supported, in part, by funds provided by the United States Department of Interior as authorized under the Water Resources Research Act of 1964, Public Law 88-379.

Rodney Christianson is a research assistant in the Department of Agricultural and Applied Economics at the University of Minnesota.

waterways. These have been developed at different times and under different organization, ownership, and management. Water transportation is the oldest.

Even though the modes compete, they form one national transportation system. However, development of transportation modes is not coordinated by any public or private agency.

The United States has the most extensive domestic water transportation system in the world. Its waterways are commonly divided into two groups: (1) domestic deep sea and coastal waterways which move traffic from U.S. port to U.S. port by ocean, inland bays, and coastal rivers; and (2) inland waterways comprised of natural and artificial waterways approximately 27,000 miles long. Inland waterways basically are in two large systems—the Great Lakes system and the Mississippi River system.

The Mississippi River and its major tributaries—the Illinois, Missouri, Ohio, and Tennessee Rivers—form the heart of the inland waterway system, serving 25 states. The system extends from the Twin Cities and Chicago to Pittsburgh to New Orleans.

"Upper" and "lower" sections are designated from the mouth of the Ohio River near Cairo, Ill. The upper Mississippi, extending from Lake Itasca to the mouth of the Ohio River, is 1,366 miles long; the lower river, extending from the Ohio River to the Gulf of Mexico, is 984 miles in length. The lower Mississippi has an improved navigation channel at least 12 feet deep; the upper Mississippi has a 9-foot minimum depth.

The history of inland waterways—particularly the upper Mississippi—reveals several stages of development. From colonial times to about 1860, water transportation was significantly developed for both freight and passengers. After the Civil War, both these services diminished because of railroad development. However after 1900, revival of waterway freight shipping occurred because of federal interest, especially during the Hoover Administration. Passenger traffic, however, has never been revived.

Two major developments occurred before 1860 to help settle the Middle West and improve inland waterways. In 1807, Robert Fulton developed the steam boat. Second, canals were constructed to connect major bodies of water, providing cheap inland freight movement.

During this first period, the Mississippi River system was partially developed by several states and the federal government. The first Rivers and Harbors Act was passed in 1823. A year later, Congress authorized the Army Corps of Engineers to remove snags, sandbars, and wrecks from the Mississippi. In the 1830's, rocks were dynamited and excavated to clear several rapids, and meandering sloughs and backwaters were closed to confine flows to the main channel, assuring better depths during low water.

However, inland waterways were limited by topography and climate. The railroads could overcome these obstacles. As a result, 1860 to 1920 was the era of the railroad. However, technological developments before and after World War I not only revived inland waterways, but created three new modes of transportation—highways, airways, and pipelines. Transportation progressed from monopoly to a competitive segment of the economy.

Interest in inland waterways revived around the beginning of the 20th century. Revival occurred for several reasons (some of which are relevant today). First, inland waterway development was part of a conservation program which was strong under Theodore Roosevelt. Second, people believed waterways provided lower cost transportation than did railroads. Demand for lower freight rates was especially strong when railroad rates rose sharply after 1910, especially with the outbreak of World War I. Third, some people believed waterways would bring railroad rates down and regulate them as well as relieve periodic railroad congestion. Fourth, waterways projects were actively promoted by local communities and other interests which would benefit from them. The "national interest" appeared to be secondary to local interests and the ambitions of rival cities to secure federal aid. Finally, nostalgic memories of the steamboat days on the Mississippi reinforced the revival of interest in inland waterway development.

The revival was soon translated into government action, and the upper Mississippi River was extensively developed. By 1912, a 6-foot channel was constructed from hundreds of rock and brush "wing dams," and six

reservoir dams had been constructed in the headwaters of the Mississippi at Leech, Winnibigoshish, Pokegama, Sandy, Pine, and Gull Lakes. These reservoirs were designed to aid commercial navigation during the low flow of the Mississippi River between St. Paul and Lake Pepin.

Congress authorized construction of the present 9-foot channel in 1927, and it was completed in 1940. Most of the 9-foot depth was accomplished by construction of locks and dams to regulate and maintain the desired water level in each pool. The locks, in effect, are steps on which vessels are lifted or lowered from one pool to the next. Construction of the locks and dams on the Upper Mississippi also created slack water pools which extended navigation upstream on the Minnesota and St. Croix Rivers.

Public funds (mostly federal) have not only provided the 9-foot navigation channel, but also numerous harbors and fleeting areas along the Upper Mississippi and its tributaries. In Minnesota, this includes harbors at Winona, Wabasha, Lake City, Red Wing, Hastings, Stillwater, St. Paul, and Minneapolis. The annual rehabilitation, maintenance, and operation costs associated with all these navigation projects in Minnesota is about $4 million. Private investments in terminals, towing vessels, and barges has been and continues to be substantial. Modern diesel towboats can cost over $2,000,000, and the price of a 1,200-ton capacity barge is $120,000.

Economic role of the waterway

Three principal economic considerations have determined Minnesota's position in the planning and development of inland waterway transportation. First, Minnesota is further from the sea coasts than any other state in the nation. As a result of added freight costs, Minnesota goods traded internationally are higher priced than the same products from other states, and the cost of manufacturing in Minnesota is also higher when foreign inputs are used in production.

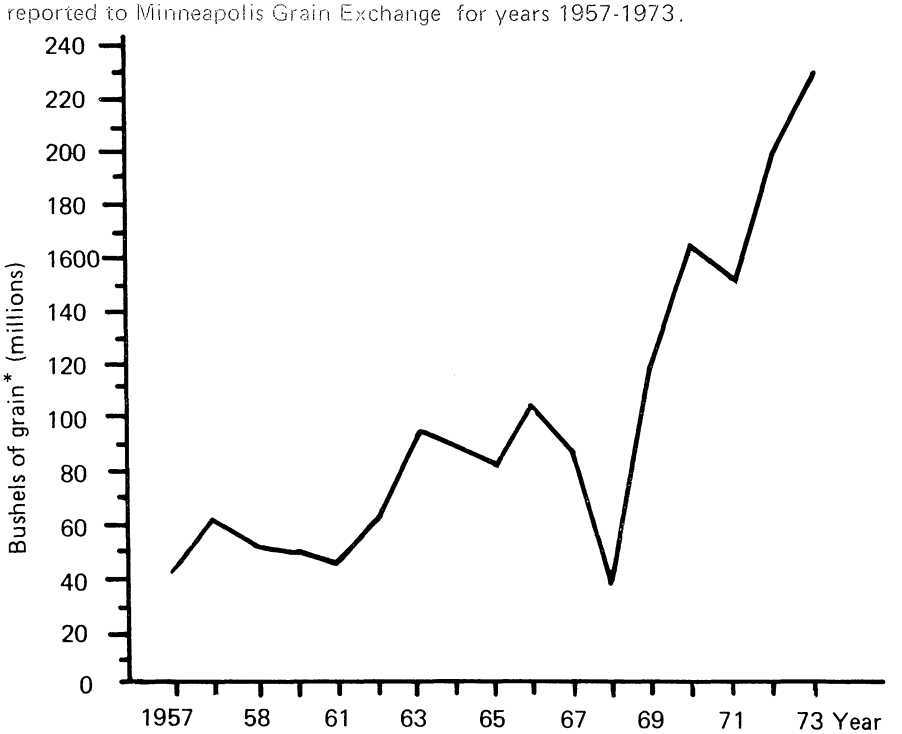
Second, since Minnesota lies at the head of navigation on the Mississippi River (and on the Great Lakes), goods in the Upper Midwest are brought to the Twin Cities (and Duluth) for transshipment by waterway to markets outside this region. Also, incoming barge traffic is transshipped to rail and truck in the Twin Cities for distribution throughout the Upper Midwest. Consequently, commercial navigation generates significant revenue and employment not only for transport firms, but also for secondary economic activities such as banks, insurance companies, wholesale and retail trade, and other supporting services located in the Twin Cities, throughout Minnesota, and in the Upper Midwest.

Finally, Minnesota is a major producer of goods that are high in weight and low in unit value (grain, iron ore, forest products). A large segment of the State's economy depends upon the marketing of these bulk products at the lowest freight rates possible since transportation costs often make up a significant share of their total cost. Before 1950, almost 95 percent of the freight traffic on the upper Mississippi River in Minnesota was upbound. After 1950, grain began moving downriver in large volume. As a result, downbound cargo presently accounts for over 50 percent of total traffic. And of this downbound cargo, grain makes up about 85 percent.

The volume of grain moving out of the Twin Cities area by barge on the Minnesota and Upper Mississippi Rivers has increased enormously in the last two decades. Figure 1 depicts this dramatic growth for the 1957 to 1973 period. In 1972, a record 203.9 million bushels of grain were shipped by barge from Twin Cities area river terminals. Despite a 4- to 6-week delay in the start of the 1973 navigation season (due to flooding downstream), 230.4 million bushels of grain were shipped in 1973. This is an increase of more than 13 percent over 1972 shipments. The Minneapolis Grain Exchange predicted a further 15 to 20 percent increase in barge-shipped grain for 1974. Some of this grain transported by barge is for domestic consumption, but the great majority of it is for export. Foreign demand has been high for several years, and this trend is expected to continue for the foreseeable future. Altogether, about 35 percent of grain movement from origin points in Minnesota and surrounding states moves by barge down the Mississippi.

Upbound cargoes of coal and petroleum are also significant and vital to Minnesota's economy. In the St. Paul district in 1973, upbound barge movements of these commodities amounted to 3,471,376 tons of coal, 1,163,251 tons of gasoline, and

Figure 1. Barge shipments of grain handled by Minneapolis—St. Paul Area Elevators as reported to Minneapolis Grain Exchange for years 1957-1973.



* Includes wheat, corn, oats, barley, rye, flax, and soybeans.

Source: Computed from statistical information in the Annual Reports of the Minneapolis Grain Exchange for the years 1957-1973.

435,364 tons of fuel oil and other petroleum products. To these should be added fertilizer; it's in strong demand as total farm acreage is being increased (marginal land being brought back into cultivation requires more fertilization). Most of the potash is shipped by rail from Canada, but phosphates from Florida and nitrogen fertilizer from the Gulf area are shipped by barge on the Mississippi.

Commercial navigation's economic importance to Minnesota is evident. An efficient transportation system—using both rail and barge traffic—is necessary for Minnesota's agriculture. In 1973, an estimated 15,916,500 tons of commodities were received and shipped from the St. Paul district. Assuming the average box or hopper car carried 50 tons, this is 318,330 railroad cars or about 3,183 100-car trains or approximately nine trains per day. Even with barge transportation, there was a shortage of box cars to move grain to terminals and to New Orleans for export in 1973. In fact, the U.S. experienced its greatest freight car shortage in history during the first 6 months of 1973—some months an average daily shortage of between 30,000 and 40,000 box cars.

Finally, barge rates are—on the average—4 to 5 mills per ton-mile cheaper than the cheapest alternatives to water shipment. As a result, low-cost barge transport keeps Minnesota products—such as grain—competitive in domestic and world markets. And it provides for lower-priced inputs, such as fertilizer, coal, gas, and oil which must be shipped into Minnesota.

A policy dilemma

Significant public and private investments have been made to develop the upper Mississippi River for commercial navigation. To accommodate increased demand predicted for barge services, governmental agencies and commissions at three levels—national, regional, and state—have developed plans. Two proposals studied recently include a 12-foot navigation channel and yearround navigation on the upper Mississippi. However for both proposals, feasibility studies found the costs exceeded benefits. In fact, both studies indicated further study was needed of the environmental effects of operating and maintaining the upper Mississippi's present 9-foot navigation channel.

Environmental interests (government agencies—such as Wisconsin's Department of Natural Resources, Minnesota's Pollution Control Agency, and the U.S. Fish and Wildlife Service—and citizen groups—such as the Sierra Club and Izaak Walton League) oppose further development of the upper Mississippi River for commercial navigation. Environmentalists contend that the Corp of Engineers' present manner of maintaining the 9-foot channel (by dredging) poses critical environmental problems. Dredging, say these environmentalists, blocks the flow of backwater sloughs which are environmentally the most valuable part of the river's ecological system.

The Corps admits that the present least-cost disposal method of dredged spoil has resulted in some loss of productive fish and wildlife habitat, both through initial spoil placement and through secondary movement of the dredged material. Environmental proponents maintain this secondary movement of unconfined spoil material causes serious and irreparable harm to fish and wildlife habitat, to recreation navigation in the shallow areas of the upper Mississippi River, and to river's water quality. They say this results because extensive shallow aquatic backwater habitats depend upon flowing sloughs for fresh, oxygenated water and for flushing of dissolved nutrients. Without freshening and flushing, backwater areas tend to stagnate and are eventually replaced by terrestrial habitat.

As a result of the feasibility studies and subsequent legal action by Wisconsin's Department of Natural Resources to stop dredging in Wisconsin waters, the Corps of Engineers prepared an Environmental Impact Statement (EIS) in early 1974 regarding operation and maintenance activities (chiefly dredging) in the St. Paul District of the upper Mississippi River.

In the EIS, the Corps states that, since maintenance of the 9-foot channel requires dredging and the disposal of dredged material, it is impossible to avoid some habitat conversion. The Corps also points out that all sediments—including natural bedload and suspended materials—help close flowing sloughs.

However, not all environmentalists fully agree with the Corps' conclusion that a trade-off exists, i.e. lost water volume and aquatic habitat is simply replaced by increased land area and terrestrial habitat. First, such a trade-off is occurring, but it should be pointed out that it is between a high-quality aquatic habitat and a low-quality terrestrial habitat. Second, environmentalists believe sand accumulation problems associated with the 9-foot navigation channel could have been moderated if preventive maintenance had been initiated when the project was first opened to barge transportation. Anyway, there are several alternatives to the existing dredging method and placement of dredged material. The Corps selected four alternative methods in its EIS for their varying degrees of ability to reduce the adverse environmental impacts of dredging and long term placement of dredged spoil.

The environmental impact statement represents one method of achieving input from other government agencies and from environmental interests regarding the dredging issue on the upper Mississippi River. A second, often more costly method, is represented by the court battle between the Corps of Engineers and Wisconsin's Department of Natural Resources. In this suit, Wisconsin sought the Corp's compliance with the National Environmental Policy Act (NEPA) which requires federal agencies to report on the environmental impact of their projects. Although Wisconsin asked that the Corps be permanently restrained from dredging until compliance with NEPA was accomplished, it sought, in the alternative, that dredging be restrained until spoil deposit sites with minimal adverse environmental effects have been selected—with the consultation and approval of its Department of Natural Resources.

In other words, many environmentalists in this conflict (between economic developmental values and environmental values) recognize the great significance of commercial navigation on the upper Mississippi and that dredging is required to operate and maintain the 9-foot channel. However, the environmentalists are asking that the Corps take measures to protect environmental values and ecological processes on America's largest and most unique river system, and, second, government agencies and other groups concerned with environmental matters be given an active role in the

decisionmaking process (with veto power) regarding dredging and disposal of dredged spoil. Only then can this dredging issue on the upper Mississippi be resolved to the satisfaction of most of the people.

In addition to dredging, another conflict between developmental and environmental values on the upper Mississippi River affects Minnesota. The controversy centers on the construction of a new lock and dam (No. 26) at Alton, Ill. Although this is outside Minnesota's boundaries, much of Minnesota's waterborne commerce is with the Gulf Coast and the Southeast. Therefore, obstruction of barge traffic anywhere on the Mississippi directly affects Minnesota's economy.

There are 28 dams on the upper Mississippi River, each with a single lock of 110 X 600 feet. The capacity of these existing locks is crucial in determining the waterway's utilization. When the locks become crowded, the costs of waiting increase greatly. The normal capacity of the lock at Alton, Ill., is 46 million tons annually. However in 1973, 52 million tons of cargo passed through the Alton lock; during critical periods, waits of up to 18 hours were encountered. Also, the Alton lock is the oldest one in the upper Mississippi River lock and dam system; it has become rickety and dangerous. But the Corps' plans to construct a new lock and dam have been stopped in the courts by environmentalists and the railroads.

Environmental groups, such as the Sierra Club and Izaak Walton League, filed suit, claiming that replacement of the present Alton lock and dam is the opening wedge of a multibillion dollar project that eventually would increase barge traffic fourfold on the upper Mississippi River, thus destroying many of the river's ecological processes and environmental values. The Western Railroad Association also filed suit to stop construction of the lock and dam. It alleged that such a large increase in barge traffic on the upper Mississippi would have a severely damaging effect on 21 western railroads. These railroads contend they could lose up to $400 million annually in anticipated revenue if the project were completed. Constructing a new lock and dam would increase the capacity at Alton from the present 46 million tons to 190 million tons of cargo annually. Once this project is completed, locks upstream could become bottlenecks. The environmentalists and railroads claim the Corps would then use this as an argument for building more new locks and dams to accommodate the increased traffic.

But the Corps of Engineers and barge interest groups—like the Upper Mississippi Waterway Association—dispute the claim that the Alton lock and dam is a first step in an enlarged waterway system. They maintain this lock replacement is an isolated project designed to remove a bottleneck which has existed for years. The old lock at Alton has simply become too crowded and dangerous, they say, to accommodate the increased demand for barges to haul more coal and fertilizer upstream and to haul more grain downriver.

Toward a rational compromise

A recent agreement between the Corps of Engineers and the U.S. Fish and Wildlife Service not only shows progress toward resolving the dredging issue, but also indicates a willingness on the part of the Corps to allow "outside" participation in the management of the upper Mississippi River. The main feature of the agreement is development of a comprehensive river management plan. This plan is to include a detailed program for each pool of the upper Mississippi River where dredging is required to maintain the 9-foot navigation channel.

The river management plan is to accommodate dredging needs and the need to preserve and increase fish and wildlife habitats along the upper Mississippi River. This is to be accomplished by the Corps' rejuvenation of stagnant backwater areas, protection of the river's water quality, and reduction of the wastes annually dredged from the river. Instead of the dredged material being placed where most convenient, it may be used for the creation of new beaches, islands, parks, and boat launching areas and for the protection of shoreline areas, or it may be made available to river communities for their use on icy roads and streets.

The Corps also recognized that developing environmentally sound methods of dredge spoil disposal will require active participation and agreement from the states along the upper Mississippi—namely Minnesota and Wisconsin. In fact to study and initiate new dredge disposal methods, the Corps recently received additional funds ($375,000) from Congress as a result of a request made by the Minnesota-Wisconsin Boundary Area Commission (an advisory body to the two states). The Corps tentatively plans to initiate new methods of dredge spoil disposal in March or April, 1975—the beginning of the next dredging season.

However to institute environmentally sound disposal methods, the Corps will need a much larger Congressional appropriation than its present level of funding. Currently, the Corps spends an annual average of $740,000 for dredging. The additional $375,000 recently appropriated is generally considered far too inadequate. Cost estimates for four alternative plans—which would reduce, in varying degrees, the adverse environmental impacts of current dredging operations—were presented by the Corps in its Environmental Impact Statement. The estimates ranged from $3.67 million to $8.95 million annually. Consequently, the dredging issue reduces to what cost the public is willing to bear to preserve environmental values being destroyed by present methods of dredging and placement of dredge spoil.

With planning techniques sensitive to ecological processes and effects, environmental values will be better accounted for in future feasibility studies. However in addition to requiring environmentally sensitive feasibility studies, Congress has been presented with proposals for imposing user charges on shippers who utilize publicly provided waterway facilities. The central thesis of advocates of these proposals is that, with the imposition of user charges on water shippers, the full real costs and benefits of water transportation are revealed. Barge transport can, thus, be assigned to its most efficient position in the national transportation system.

Proponents also argue that imposition of user charges would insure that those who propose new navigation projects sincerely believe development is justified. They argue that support for proposed projects, such as the 12-foot channel on the upper Mississippi, would, in all likelihood, have been considerably less if users had to pay full costs (economic and environmental) of constructing, operating, and maintaining the project. Thus, environmental values would be better

accounted for if users had to pay full economic and environmental costs of developing the waterway. In the case of the 9-foot channel on the upper Mississippi, users could be required to pay for environmentally sound dredge spoil disposal. Increased costs would finally rest on producers and consumers through higher prices for inputs and final products.

The Corps could decide to remove the dredged material from the floodplain. Since disposal is outside the floodplain, this would be the surest way to reduce runoff of spoil material. This would result in the least habitat change from aquatic to terrestrial. Removing the dredge spoil from the floodplain is estimated to cost $5.40 per cubic yard with an average annual cost of $8,120,000 for the St. Paul district. This is over 10 times the present cost of dredging.

With a user charge system to recover the costs of removing dredge spoil from the floodplain, the charge per ton-mile might be approximately 2.5 mills. ($.0025 = $8,120,000 divided by an estimated 3.2 billion ton-miles of traffic which moved through the St. Paul District in 1973). Add the other costs of operating and maintaining the 9-foot channel, and the total charge per ton-mile is estimated to be under 3 mills. It may be even less, since removal of dredged material from the floodplain is much more costly than some other alternatives. This is significant because the river-management plan adopted by the Corps will likely combine several alternatives for disposing dredged material, depending on the particular river stretch.

Barge rates average 4 to 5.4 mills per ton-mile less than the cheapest alternatives. This suggests that increasing the cost through user charges to cover environmentally sound methods of dredge spoil disposal would not significantly reduce use. However, it would increase transportation costs.

Herein lies the conflict. The full real costs (economic and environmental) of operating and maintaining the 9-foot project could be accounted for with user charges. However, such an accounting will increase the cost of transport services. This means lower prices received for Minnesota products, such as grain, and higher prices paid for inputs, such as gasoline, oil, coal, and fertilizer which must be shipped into Minnesota. The issue boils down to how much the ultimate beneficiaries of low cost transportation—producers, and ultimately, consumers and taxpayers—will pay to preserve the environment.

Most observers agree more emphasis is needed on environmental values for present and future commercial navigation projects than has existed in the past. That trend has been manifested in numerous environmentally oriented bills in Congress and in the Minnesota Legislature. New procedures and institutions, such as environmental impact statements and interagency agreements, as well as more conventional means such as legal action, are how interest groups are bringing their values into the decision-making process. The market and price system is also an effective communications device; user charges can be used to signal increased costs of environmental protection measures.

The policy choices are difficult. Commercial navigation is of great economic importance to Minnesota. But it is not likely that further development can be totally at the expense of environmental values. The controversy will settle on the degree and manner in which economic and environmental considerations are taken into account.

Minnesota AGRICULTURAL ECONOMIST

Agricultural Extension Service
University of Minnesota

No. 564 FEBRUARY 1975
Agricultural Extension Service
Institute of Agriculture
University of Minnesota
St. Paul, Minnesota 55108

Roland H. Abraham, Director

Cooperative Agricultural Extension Work
Acts of May 8 and June 30, 1914

OFFICIAL BUSINESS

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108.

John J. Waelti . . . . . Editor

Prepared by the Agricultural Extension Service and the Department of Agricultural and Applied Economics. Views expressed herein are those of the authors, but not necessarily those of the sponsoring institutions. Address comments or suggestions to Associate Professor John J. Waelti, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota 55108.

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF
AGRICULTURE
AGR 101
THIRD CLASS

U.S. MAIL