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AGRICULTURE AND ECONOMIC DEVELOPMENT - THE MINNESOTA CASE

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Agriculture has played a key role in the economic development of most modern industrialized societies. And, historically, most of the human resources in Minnesota were at one time employed in agriculture and related services. Employment in lumbering and mining, though substantial during some periods, was still minor compared to employment in agriculture. Technological advance in agriculture subsequently freed a major portion of these human resources for employment in other economic sectors. In Minnesota, agriculture remains an important economic sector not only because of its employment and income generation as a primary production sector but also because of the income and employment generated in agriculturally related supply, marketing, processing and service industries. There may be times, including that of the current drought period, for example, when service industries in Minnesota, such as finance, would prefer to be less dependent than they are on agriculture. But, agriculture in Minnesota will remain an important economic sector for a long time to come. This is not a fact to be lamented, however, as Minnesota's agriculture has a strong future and it will almost certainly recover from the current drought. It would be useful, though, if the current drought were to effectively alert Minnesotans to some impending problems relating to water use.

The comments which follow relating to the role of agriculture in Minnesota's economic development are organized into four sections. First a brief look is taken at historical changes in production agriculture in Minnesota. Second some

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[1/] This paper represents only a slight modification of a presentation made at the 127th Meeting of the Minnesota Historical Society, October 16, 1976.

[2/] Professor and Head, Department of Agricultural and Applied Economics, University of Minnesota.

crude comparisons are made of growth over time in agriculture and in other major economic sectors. Third a brief assessment is made of current employment and income in Minnesota's agriculture and related industries. Finally, a list is presented of several future issues which appear important for Minnesota's agriculture with particular reference to its natural resource base.

STRUCTURAL CHANGES IN MINNESOTA'S PRODUCTION AGRICULTURE

Some aspects of historical developments in agriculture are of interest for their own sake. More typically, however, economists find historical events of interest primarily because they help set the stage for assessing the future. This paper relates to both sets of interests.

In Minnesota, most of the activities relating to development of sedentary agriculture had their major growth after 1870. And, in the initial decades of Minnesota agriculture, one of the important products generated was that of "overhead capital." Land clearance, drainage, fencing and the construction of houses and other farm buildings necessarily preceded the development of traditional production agriculture and thus were a critically important and substantial output of farmers and their families. Table 1[1/] shows that during the decade of the 1870's when crop land acreage in Minnesota more than doubled, as did the number of new farms, overhead capital in the form of land clearing, fencing and buildings exceeded $1 billion in 1950 dollars.

A major part of the job of land clearing, fencing and building production had been completed by 1900. Most buildings and fences have been replaced, sometimes several times over, since the decades of the late 1800's. Those early efforts devoted to land clearing are, however, still yielding their annual

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[1/] I am indebted to Joseph C. Fitzharris for much of the historical data presented in this paper. I have drawn particularly on data which he presents in Staff Paper P76-4, Minnesota Agricultural Growth, 1880-1970, Department of Agricultural and Applied Economics, University of Minnesota, January 1976.

dividends to Minnesota's agricultural industry and to the state's economy. The 7.2 million acres of improved farm land in Minnesota in 1880 had almost quadrupled to 27.7 million acres by 1930. This figure peaked at about 30 million acres in 1950 in response to high World War II and post-World War II grain prices, particularly for flax and wheat. It then settled back to 22.6 million acres in 1970 before moving upward again in response to high grain and soybean prices in the mid-1970's.

Table 1

Decadal Increases in the Values of Land Clearing and Fencing, and Buildings
(in millions of constant 1950 dollars)

	1870-1880	1880-1890	1890-1900	1900-1910	1910-1920	1920-1930	1930-1940
Land Clearing and Fencing	988.5	780.6	1471.1	24.2	37.1	126.1	--
Buildings	32.0	17.1	26.4	1.0	16.2	4.7	8.5
Total	1020.5	797.7	1497.5	25.2	53.3	130.8	8.5

Source: Joseph C. Fitzharris, Staff Paper P76-4, Minnesota Agricultural Growth, 1880-1970, Department of Agricultural and Applied Economics, University of Minnesota, January 1976.

As early as 1880 there were an estimated 92,400 farms in Minnesota. This number peaked at just under 200,000 farms in 1940 and has been steadily declining since to the current number of between 110,000 and 120,000 units.[1/] Though the rate of decline has moderated since 1970 it almost certainly will continue at some modest rate. Virtually no commercial farms are decreasing in size while a large number continue to add land either by rental or by purchase.

[1/] Official State Crop and Livestock Reporting Service statistics place the 1976 number of Minnesota farms at 118,000. Census numbers, however, are estimated at a somewhat lower level.

The total number of farm workers rose quickly during the decade of the 1870's to about 185,000 by 1880. The growth in farm worker numbers was much more gradual from then until these numbers reached their peak of about 434,000 in 1940. By 1970 they had declined to less than 50 percent of the 1940 level as most of the underemployed labor moved out of the agricultural sector. The decline continues still but at a much reduced rate.

Measurement of the change in agricultural capital over time poses a number of difficult problems. Despite this difficulty, it is easy to spot the very substantial contributions to the stock of agricultural capital made during the period from 1880 to 1910. We are awed, and rightfully so, by the huge investments currently being made by many individual farmers in Minnesota. And, in many cases, the expenditures being made for large-scale buildings, equipment, feedlots, machinery and irrigation systems are overwhelming. Yet, we do well to remember that the period of major real agricultural capital creation in Minnesota was in those decades surrounding the turn of the century.

With respect to structural change in Minnesota agriculture, history contains the story of several major shifts in the makeup of agricultural output. Few people recall that small grains, principally spring wheat, accounted for almost 60 percent of the value of Minnesota's commodity production in 1880 and helped set the stage for major developments in the Twin Cities' flour milling and grain trade industries. By 1970, livestock, milk, corn and soybeans all far exceeded wheat in their economic importance to the state's farmers. Fitzharris[1/] describes well the changes in the structural mix of Minnesota's production agriculture over time. Wheat, the crop that spurred agricultural settlement of much of Minnesota, declined in prominence rapidly between 1880 and 1920. And, the 1910-20 decade

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1/ Joseph C. Fitzharris, op. cit.

saw a major increase in milk production. From 1920 to 1960 diversified farming, beef production and livestock and livestock products in general increased in prominence while small grains declined by two-thirds. We are seeing some positive response to small grain acreage associated with the current drought. I believe, however, that over the longer term, corn and soybeans have some strong competitive advantages over small grains for all but the northwestern and western parts of the state.[1/]

The major trend since the 1950's toward specialized farming has been well documented. This shift to specialization includes the spectacular increase in soybean and corn production and the shift to highly specialized production of turkeys and poultry and away from the small poultry flocks. Livestock enterprises have declined in total number and in number per farm while increasing rapidly in size of enterprise.

One could go on at great length to cite the changes in the mix of commodity production and in the changes in technology, input use and relative prices (both of commodities and inputs) which have driven the changes in commodity production. Suffice it to say, however, that Minnesota's agriculture has moved from a largely "extractive" type "natural resource based" industry in the late 1800's to one with major components of a "value added" type in 1976. Along the way production agriculture has generated major changes in the farm supply and output industries, particularly, and in the Minnesota economy generally. And, more changes are certainly in store for the future.

[1/] This general phenomenon is supported by projections made by Reynold Dahl and Michael Martin in Grain Production Projections by County and District, Minnesota, 1980 and 1985, Minnesota Agricultural Experiment Station Bulletin 518, 1977.

GROWTH IN AGRICULTURE VS. GROWTH IN OTHER ECONOMIC SECTORS

Growth in Minnesota agriculture over the last century or more is a complex story. One could, for example, spend a good deal of time just describing the differential rates of technological development for different farm crops and in turn, their differential rates of impact on employment and income. Oats and flax are illustrative of crops of declining economic importance with soybeans and corn leading the way in increased economic importance. Or, one could compare crops as a group with livestock. All I have time to do, however, is to suggest that there have been very substantial differences in the rates at which technology has impacted on different commodity groups and they, in turn, on the state's economy.

As one looks at the supply side of growth in Minnesota's agricultural industry, three categories of expediters of economic growth stand out. The first is the shift from animal power to tractor power in farming. This change had two major ramifications:

1) It freed a large acreage of land and large volumes of building and labor resources which were previously used to feed, house and otherwise service draft animals, mainly horses, and

2) It expanded the capacity of a single farm worker to handle more horsepower and, consequently, gave that worker more production capacity.

Second, the development of effective mechanization in the form of machinery and equipment resulted in the substitution of these resources for labor in farming. Again, the impact was a two-fold one:

1) Many farm tasks were made less onerous and their physical energy requirements were reduced, and

2) The capacity of a single farm worker was expanded by the substitution of machinery for labor.

Third, and by far the most complex, was the development of a wide range of yield enhancing technologies both in crops and livestock. New breeds and varieties had their impacts on increased production. So did the development of chemical fertilizers, pesticides and other production inputs. Improved management practices were a natural outgrowth of the shift to increased commodity specialization by farmers. And, the role of the off-farm supply industry took on greatly expanded dimensions.

Technological change then was a driving force in freeing labor from the on-farm production process. The migration of this "freed-up labor" to other locations and other economic activities is again a complex story which is still unfolding. Some people migrated out of the state and the region to employment in other economic sectors and other regions. And, some migrated only to the local town where they became employed in the evolving agricultural service industries. But many provided both the labor force and the intellectual resource base for new industries or for further growth in other, already established industries in Minnesota.

No simple comparison between economic sectors very adequately reflects the changing importance of agriculture in the state's economy or the shift of resources out of farming and into other economic activities. The data shown in Table 2 do, however, show changes which have occurred between production agriculture and manufacturing, the latter as measured by "value added." The total crops and livestock numbers shown here refer to estimated "net output" from the farm production sector. This is to say that the numbers are net of seed and feed consumed internally within the farm production sector. These numbers illustrate that, whereas production agriculture contributed about 80 percent of the total economic value of these categories in 1880, and though it increased about 24-fold by 1969, manufacturing exceeded net farm production by a ratio of

about 2½ to 1 by the latter year. And, one can envision the behind-the-scenes shifting of resources that was going on toward the non-agricultural sectors.

Table 2

Minnesota Economic Sectors Data

	1880	1900	1919	1939	1959	1969
	(Millions of Current Dollars)					
Total Crops and Livestock	84.2	163.2	558.8	739.1	1240.4	1956.7
Manufacturing Value Added	20.4	73.4	327.9	306.8	2050.4	4943.0
Retail Sales	N.A.	N.A.	N.A.	1017.2	4108.2	8742.0
Total	104.6	236.6	886.7	2063.1	7399.0	15646.7
Agriculture as % of Total	80.5	69.0	63.0	35.8	16.8	12.5

Source: Unpublished data estimated by Joseph C. Fitzharris from farm records, Censuses of Manufacturers, the Census of Business and the Statistical Abstract

Retail sales increased more than eight-fold between 1939 and 1969 as shown in Table 2. But it is difficult to judge just how the value of total retail sales should be compared with other economic sectors since some "net value added" figure would be a more relevant comparative component of retail sales than is the total.

Most individuals are familiar with the concept of income and employment multipliers whereby one judges, for example, that a single job in primary agricultural or other production sectors results in another two or three jobs mainly in service industries such as food retailing, finance, education, farm machinery sales and service, etc. Also of key importance, but less obviously so, is the existence of a strong farming sector which keeps a significant portion of the state's population, economic activity, traffic, etc., spread out geographically

and not bunched up even more in the Twin Cities metropolitan area. Any way it is measured, production agriculture has continued to contribute in a major way to the state's economy. And, in a later section brief consideration is made of the current contributions of the input and output related agribusiness sectors as well.

Crucially, if one is to fully appreciate the key contributions of the agricultural sector to the state's economic development, one has to look beyond production of income and jobs, beyond the human resources freed for employment in other economic sectors, and even beyond the effects of income and employment multipliers. One has to look, for example, to the investment in infrastructure including highways, railroads, communications, power and the like which were put in place initially mainly to service agriculture. But once in place this infrastructure has been accessible to support the non-farm economic activities which have followed. Thus, the contribution which agricultural development has made to the opening up of our state in a physical sense is a major, but largely immeasurable, one.

CURRENT CONTRIBUTIONS OF MINNESOTA'S AGRICULTURE TO THE STATE'S ECONOMY

Most of the estimates which have been made for employment and income from the broader agricultural sector have their origin in the post-World War II period. But, the standard statistics developed for employment and income do not break out the broader agricultural sector as a separate entity. Thus, some of the desired statistics are not generated and published on a regular basis. Table 3 shows estimates of employment in Minnesota agriculture as of 1973. These estimates indicate that about 60,500 persons were employed in the input industries, 183,000 in farming and 215,000 in the agriculturally related output industries. In total, this employment accounts for about 26 percent of the total for the state. As

agriculture takes on more and more of the characteristics of a "value added" rather than an "extractive" industry, and as technology permits each farmer to operate a larger and larger unit, one sees an inevitable reduction in the number of persons employed directly in farming.

Table 3

Minnesota Agriculturally Related Employment, 1973

	Employment	% of Total
Input Industries	60,500	3.5
Farming	183,000	10.8
Output Industries	215,000	12.7
Total	458,500	26.0

Source: Unpublished estimates made by Dale C. Dahl, Department of Agricultural and Applied Economics, University of Minnesota

The level of employment in the agriculturally related input and output industries depends importantly on the trade-off between (a) increased labor efficiency and (b) increased volume of business in these subsectors. In recent years the trend has generally been toward increased employment in the agricultural input industries with possibly a slightly downward employment trend in the agricultural output industries. Here again, the impact on employment depends heavily on the commodity concerned. Some commodities, such as wheat, undergo very little modification in product form as they move from the farm to market outlets. This is particularly true for that portion of grain commodities which moves into international trade or to other regions of the U.S. for further

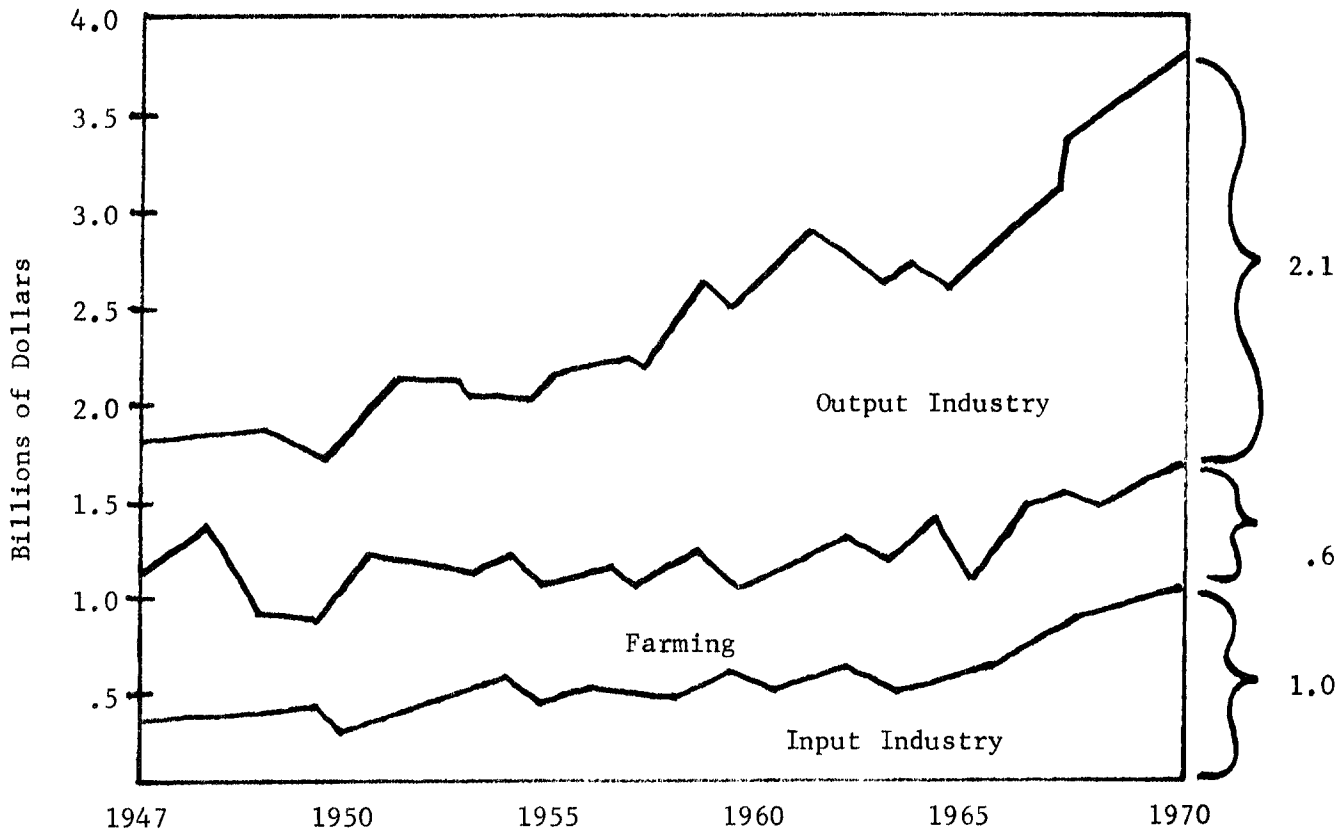
processing. For these products employment in the output industries is small. Sugar beets, on the other hand, are a commodity where, because of bulk in the farm product relative to the refined product, the processing and refining into the marketable product, sugar, must occur close to the farm production source. And, the implications for location of the processing industry and employment of workers are obvious.

Figure 1 gives some perspective on the extent to which even since World War II, the proportion of discretionary income generated in Minnesota's agricultural input and output industries has come to far exceed the income accruing to sellers of commodities at the farm gate. The concept of income used here is, of course, a very different one from that represented by gross commodity sales. Here we are talking about the income earned by farm operators and hired workers for their contributions to on-farm production activity. The absolute value of income categories in Figure 1 has grown substantially since 1970. And, we need badly to find a mechanism by which to update these figures. One can safely assume, however, that the relative proportion of agricultural income earned by farm operators and hired farm workers will continue to decline since an increasing proportion of the economic activity related to agriculture will occur in the input and output industries, particularly the former.

The major conclusion that can be drawn from the above discussion of employment and income in the broad agricultural sector of Minnesota is probably that the sector remains a crucial one to Minnesota's economy. Also, from an employment standpoint, it is a sector which adds stability to the state's economy even during periods when other economic activities are influenced substantially by general business cycles and their attendant impacts on the construction industry, etc. This is not to say that there will not be major swings in the sales value

Figure 1

Income From Minnesota Farming and Agribusiness, 1947-70



Source: Estimates made by Dale C. Dahl, Department of Agricultural and Applied Economics, University of Minnesota

of farm commodities between years and in response to weather vagaries and commodity prices. Rather it is to suggest that such changes will generally be absorbed with less impact on employment than is the case for other economic sectors where both the incentive and the capability to lay off workers in the face of economic recession is much greater.

Finally, on the plus side, two broad considerations augur well for the future economic health of Minnesota's agriculture. One is a supply consideration for farm commodities and the other a demand consideration.

Recent research by Maury Bredahl and Willis Peterson[1/] shows that public and private research for agriculture is yielding very high returns; 36 percent for cash grains, 37 percent for poultry, 43 percent for dairy and 46 percent for livestock in 1969. And, strong commodity prices in the 70's suggest that recent returns to research have been even higher. These returns, of necessity, reflect a healthy agriculture; one which can implement new varieties, new breeds and new technologies profitably and productively. Even if land prices dropped and farm assets were recapitalized at lower price levels, though this is not to suggest that these events will occur, the basic productive capacity of the state's agricultural plant and the managerial capacity of its farmers and agribusinessmen would remain strong and competitive.

On the demand side, the precarious world-wide balance between the supply of food stuffs and the world's growing population argues against a lessening future economic role for U.S. and Minnesota agriculture. And, increases in per capita incomes in much of the developing and in much of the developed world suggest strong future markets for Minnesota's export commodities. Specification of details of these strong future markets for farm commodities necessarily lies beyond the scope of this paper.

FUTURE ISSUES REGARDING AGRICULTURE AND MINNESOTA'S ECONOMIC DEVELOPMENT

During its century or more of existence, Minnesota's agricultural industry has lived in relative harmony with other economic sectors and with the interests and values of the major portion of the state's population. Several issues are on the horizon, however, which need the constructive attention of agriculturalists

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1/ Maury Bredahl and Willis Peterson, "The Productivity and Allocation of Research: U.S. Agricultural Experiment Stations", American Journal of Agricultural Economics, Vol. 58, No. 4, November 1976.

and non-agriculturalists alike if they are to avoid becoming major problem and/or conflict areas. Several of these issues are listed below.

1) Priorities for water resources. The current drought in much of Minnesota helps to focus on potential problems relating to utilization of the state's water resources.[1/] The changing structure of agriculture as well as its changing technology presents potential problems in the event of an extended drought cycle. First, the likelihood of rapid expansion and geographical concentration in irrigation by farmers presents the possibility of a draw down in water tables. Such an event has implications not only for irrigating farmers but for other users of water for industrial and home consumption purposes. Also, since the time of the last severe drought during the 1930's, the livestock population of the state has become much more concentrated into fewer and larger units. Thus, the demand pressure in some areas on both surface and underground water supplies from a high volume livestock population may become serious. A number of new agricultural processing plants, such as sugar beet plants, potato processing plants, etc., are heavy users of water and return large quantities of waste materials into the rivers and streams from which they also draw their water supplies. A number of other industrial and manufacturing activities not present in the 1930's are now major water users.

It would appear to be of critical importance for us to begin to systematically estimate the future demand for the state's water resources and to plot this demand against the expected supply of water during extended periods of adverse weather. It may well be that a large number of heavy water uses are projected to occur simultaneously and in concentrated areas during the very periods when the supply of water is likely to be at low point.

[1/] My awareness of this potential problem has been sharpened by the observations of my colleague, Philip M. Raup.

2) Land use priorities. Up to this point in the economic development of the state of Minnesota, most major economic activities, except farming, have not been stymied by lack of available land resources. This may not continue to be the case, however. Current use of some prime agricultural land is critical, not only to producers of the specific farm commodity involved, but to substantial supporting economic activities of farm supply and farm output firms as well. This farm land may also represent the lowest cost land for a specfic non-farm development. But, in the broader economic context in which the benefits to the farm supply and output industry subsectors are also measured, continued use for farm production may be the highest value use. And, of course, the converse may also be true.

At a minimum, it would appear that the normative analysis of land use in Minnesota should be expanded so that a broad group of public and private decision makers can better relate priorities in land use to the available supply of and demand for land.

3) Utilization of transportation resources. Minnesota's agriculture, its other economic sectors and its general population have in the past shared the use of the state's highway resources effectively and in relative harmony. Generally speaking, however, they have not effectively utilized its rail resources in a similar manner. In fact, use of railroads by the general public has become virtually non-existent. And, the economic rationalization of the railroad system in the state and the region must generally be for uses other than personnel carrying. In many cases the principal use is agriculturally related. Again, it appears desirable to provide more extensive normative analysis which would indicate the optimization or near optimization of the state's transportation resources in their use by the several key economic sectors in the state and by its general population.

Within the transportation complex, the greatest future problems may lie in utilization of the state's water resources. As the state's agriculture has developed into a more productive one, and as a larger volume of farm commodities have moved into out-of-state and foreign export markets, the water transportation system has come into increasingly intensive use and at a significant saving in shipping costs as compared to alternative transportation modes. Movement of bulk commodities on Lake Superior both to foreign markets and to out-of-state domestic markets has increased dramatically. And, during a recent period, approximately 85 percent of the downstream bound cargo on the Mississippi River was grain. Meanwhile, large volumes of coal and petroleum moved upstream on the River. Because Minnesota is a major producer of high bulk commodities, including grain, it is highly dependent on effective utilization of low cost waterways for economical transportation. And, the preservation of Minnesota's comparative advantage in grain production, marketing and processing depends, in no small degree, on effective resolution of issues pertaining to water transportation.[1/]

4) Unrealistic pricing of resources. One of the critical issues facing the future of Minnesota's agriculture is the unrealistic pricing of resources, particularly land. Most would agree that the determination of farm land prices should remain a relatively open process. Effort should probably be made, however, to minimize the opportunity for profits via excessive land speculation. Schemes for quick capital gains and/or high leverage financing generally serve no productive economic purpose and they may well be damaging to the conduct of sound economic enterprises including farming.

1/ An interesting background for this and related topics is provided by Rodney Christianson in "Commercial Navigation on the Upper Mississippi River," Minnesota Agricultural Economist, University of Minnesota, February 1975.

Experience has indicated that there are no simple solutions to curb excessive speculation in resource pricing. The most effective single effort, however, is probably the one of establishing priorities via a master plan of resource use and then implementing effective zoning and other land use control instruments to discourage excessively speculative investing and pricing.

5) Environmental constraints. One of the chief concerns of agriculturalists is the potential for placing unrealistic constraints on uses of specific agricultural technologies, particularly those of chemical fertilizers and pesticides. With respect to this topic, agriculturalists probably need to appreciate more fully that they live in a society in which the bulk of the population are concerned about environmental quality and related issues. Non-agriculturalists, on the other hand, probably need to obtain a more accurate picture of the economic need by the state's farmers for certain technologies in order 1) to compete with producers in other regions of the country and other countries of the world and 2) to provide an adequate supply of low-cost food for the nation and the world. This suggests the need for more relevant technical information and more economic analysis which provides insights into optimization or near optimization of agricultural production with alternative types of environmental constraints. This, in turn, requires the effective contributions of technical experts and economists, both within and outside of agriculture.

Several other pollution-related issues appear less critical. Cattle feeding, poultry production, large volume dairy farming and agricultural processing plants share the common need to develop operations which meet current regulatory guidelines for waste disposal and other dimensions of air and water pollution. A number of farm and agribusiness operations clearly do have trouble in economically modifying existing facilities to meet current standards. It seems likely,

however, that most new facilities will be constructed, albeit at generally higher costs, to conform to the current set of pollution standards. Thus, much of the economic problem appears to relate to the profitable utilization of existing facilities until construction of the next generation of new facilities can be supported by higher commodity prices.

6) Energy utilization and conservation. Agriculture is not a major consumer of the total energy use in the United States. In fact, agriculture uses only from two to three percent of the total energy used in the economy. Of this, about one-half is used directly on farms and the other one-half indirectly in the production of farm inputs off the farm. Economic analysis conducted at the University of Illinois and Ohio State University indicates that energy prices will have to increase substantially before there are any major shifts in the location of crop production in the corn belt. Yet it would not be surprising to see a combination of increased energy prices, short supplies of energy and/or constraints on energy use which would require at least temporary rationing of energy to some users. Again, normative economic analysis and effective discussion of priority allocations for limited energy supplies need to precede the evolvement of a crisis situation. It is even conceivable that Minnesotans may, within the next several years, have to make some choices with respect to energy allocations which influence significantly the availability of jobs and income in major economic sectors of the state's economy. It is even conceivable, in fact, that within the agricultural sector, high energy prices and/or short energy supplies may result in a shifting of economic advantage from some of the commodities which are currently profitably produced in the state. It would be shortsighted for agriculturalists to assume automatically that energy will be available in the supplies needed and at costs which the agricultural industry can pay and pass on through the commodity market place.

One could go on at more length about the kind of future issues which face Minnesota's agriculture within the setting of the state's agricultural development. Generally speaking, however, it would appear that if these issues are well articulated, well analyzed and well managed they are resolvable.

In summary, I want only to mention a couple of points briefly:

Production agriculture has, despite its several-fold growth in absolute terms over the past century, moved from a role as the major employer and income generating economic sector in Minnesota to a proportionately more modest role. The agricultural industry broadly defined continues, however, as a major economic sector in the state's economy and it shows the necessary vital signs for a strong competitive future. There are, on the horizon, several topics of potential future conflict between agriculture and the state's other major economic sectors and its general population. Strong technical inputs, economic analysis of feasible alternatives, and effective forums for constructive discussion of these issues are all needed if agriculture is to move ahead as a solid contributor to the state's economy.