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The Sugar Industry in Minnesota and North Dakota

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The word increase best describes what has happened to domestic sugar production over the last decade. This increase rests in an important way on a change in our sugar policy in the early sixties that eliminated Cuba from our domestic market, population growth, and our domestic industry's capacity to expand sugarbeet and sugar cane production and processing.

One of the major uncertainties facing the industry is determining needed future capacity. Annual domestic per capita consumption of sugar has remained close to 100 pounds. Important questions for the future are: What changes can be expected in population and per capita incomes here and elsewhere in the world and what effect will they have on sugar demand? and What potential do various areas in the country have for economic production of sugarbeets and sugar cane?

The purpose of this article is to report on a study of sugarbeet production potential in Minnesota-North Dakota. First, let us briefly describe some of the changes that have characterized our local sugar industry over the recent past.

PRODUCTION AND PROCESSING

The combined sugarbeet production of Minnesota and North Dakota has increased sharply over the last decade. Production in the two states increased from 1,347,000 tons in 1958 to 2,270,000 in 1967, for an increase of about 69 percent. This increase reflects essentially an increase in sugarbeet acreage, since per acre yields have changed little. Total acres harvested in the two states increased from 110,500 in 1958 to 206,400 in 1967, for an 87 percent increase.

Most Minnesota and North Dakota sugarbeet production is in the Red River Valley counties, but production in southern Minnesota is significant. Acres harvested there increased from about 17 percent of the state total in 1958 to 36 percent in 1964, but then dropped back to 25 percent over the next 3 years. Reasons for the decline cannot be easily identified. Relative prices do not appear to be a factor. Since 1964, seasonal average prices per ton of sugarbeets have increased, while prices for corn and soybeans (the major competing crops) have remained essentially unchanged. Perhaps short labor supplies for hand thinning beets created a problem for some growers, causing them to shift into corn and soybeans, which do not require the labor associated with sugarbeet production. A pronounced increase in sugarbeet processing plant capacity has accompanied the increase in sugarbeet production. For the two states, plant capacity per 24-hour day increased from 14,600 tons in 1964 to 22,400 in 1968, a 53 percent increase. Over 90 percent of this increase has occurred in the Red River Valley area.

With the large increase in production has come a large increase in farm value of production. The combined value of farm production in the two states (excluding government payments) increased from $15,765,000 in 1958 to $29,994,000 in 1967, a 90 percent increase.

This large volume of production contributes significantly to the farm input industries of these two states. Consider that the typical grower has about $17,-000 in specialized beet machinery and that 20 percent of it is used up or replaced every year. With somewhere close to 1,900 growers in the two states, annual grower purchases of specialized beet machinery (planters, cultivators, sprayers, rotobeaters, beetlifters, trucks, and beet thinners) then amount to about $6.3 million. Add to this amount an estimate of the dollars that growers spend annual-

ly for fertilizer, herbicides, insecticides, chemicals for disease control, seed, and migrant labor and the total comes close to $23 million.

Changes in sugarbeet production technology have had a significant impact on input mix and cost structure in the industry. A 1939 study of the Red River Valley beet industry indicated that the total cost of beet production, excluding land charge, was $40 per acre.[1] Labor use was very high. A total of 46 hours of hand labor was required per acre. A 1950 study indicated that mechanization of harvest operations had eliminated nearly 20 hours of hand labor by the late forties.[2] A more recent study suggested further reduction in labor requirements for the beet enterprise.[3] Analyses of these studies all point to the large role that machines and herbicides have played in improving efficiency by reducing hand labor requirements.

ESTIMATED PRODUCTION POTENTIAL

As a part of an interregional sugar study, an analysis of the potential production (supply response) of sugarbeets was conducted for Minnesota and North Dakota.[4] The basic objective was to estimate the future (1975) supply potential of these two states at various price levels.

Study Methods. An estimate of sugarbeet production potential was made for each state by dividing each state's producing area into groups of counties on the basis of uniformity of soils and growing conditions. Production potential was then estimated for each of these groups or sub-areas, using a linear programming analysis that maximized profits to each sub-area with sugarbeets in competition for resources with other crops at varying sugarbeet prices. The sugarbeet supply responses for the sub-areas in each state were then summed to obtain the sugarbeet supply or production potential for each state.

Study Limitations. Using an area such as a group of counties as the unit of analysis may give rise to a different production response than if aggregate production response were the sum of in-

[1] Anderson, Harry G., *Sugarbeets in North Dakota*, Special Circular, N. Dak. Agr. Coll., Fargo, N. Dak., May 1940.

[2] Gillcrest, Roy M., *Sugarbeet Production in the Red River Valley*, N. Dak. Agr. Coll. Exp. Sta. Bull. 263, Dept. of Agr. Econ., Fargo, N. Dak., 1950.

[3] Yaggie and Loftsgard, *Sugarbeet Production, Costs and Practices*, N. Dak. State Univ. Exp. Sta. Bull. 466, Dept. of Agr. Econ., Fargo, N. Dak., Oct. 1966.

[4] In 1965 an interregional research effort was organized for (1) projecting the demand for sugar, (2) estimating the sugar supply in response to varying price and demand conditions, (3) studying the organizational structure of the sugar industry, and (4) appraising the implications of these demand-supply projections and structure on the domestic sugar industry. Minnesota and North Dakota cooperated in estimating their states' potential sugarbeet supply response to varying sugarbeet prices and resource constraints.

dividual grower responses. First, the individual grower's capital consists of what he owns and what he can or is willing to borrow. The amount he can borrow is a function of his past performance, his net worth, managerial ability, and other measures of financial strength. The risk involved for a single lending institution lending capital to individual farmers may in certain situations be quite high and may place severe limits on the amount loaned to individual growers. On the other hand, for a sub-area that includes several counties, this risk can be spread over a large number of farmers and lending institutions and thereby be greatly reduced. Therefore, the only limit considered on the use of credit capital for each sub-area in this study was whether it would return more in farm crop activities than its market cost. Such a limit is less restrictive than if amount loaned were based on individual grower situations. Thus sugarbeet production response based on areas or sub-areas as units of analysis is likely to be different from a response based on individual farm units aggregated for an area or sub-area.

Moreover, an area including several counties as a unit of analysis can't reflect individual differences in goals and objectives as they influence resource use and production. For this reason, too, an area unit response analysis may be different from one based on individual farm units.

Furthermore, production response for sugarbeets shown in this analysis is a response to varying sugarbeet prices. Other factors that influence response, such as sugarbeet processing capacity in the area, the cost of processing beets, and the cost of transporting processed materials to consuming centers, are not considered in this study. These factors will be considered in an interregional analysis that will use state and area studies to determine the optimal location of U.S. sugar production, together with the most efficient flow of sugar trade.

The sugarbeet production response shown in this study is therefore a potential response, a sort of upper limit on what could be produced, not what will be produced. This response was estimated on the assumption that seed, chemicals, and mechanical thinning operations have eliminated hand labor in sugarbeet production. It tells us not only how sugarbeet production responds to varying sugarbeet prices, but it tells us something about the competitive position of sugarbeets in each of the sub-areas relative to other crop alternatives.

Production Potential in the Red River Valley. The basic format of the analysis considered all the major cropping enterprises that compete with sugarbeets in the Red River Valley. The analysis used 1962-65 average cost and return relationships for all competing crops and various sugarbeet prices between the low and high extremes. At one extreme, sugarbeet
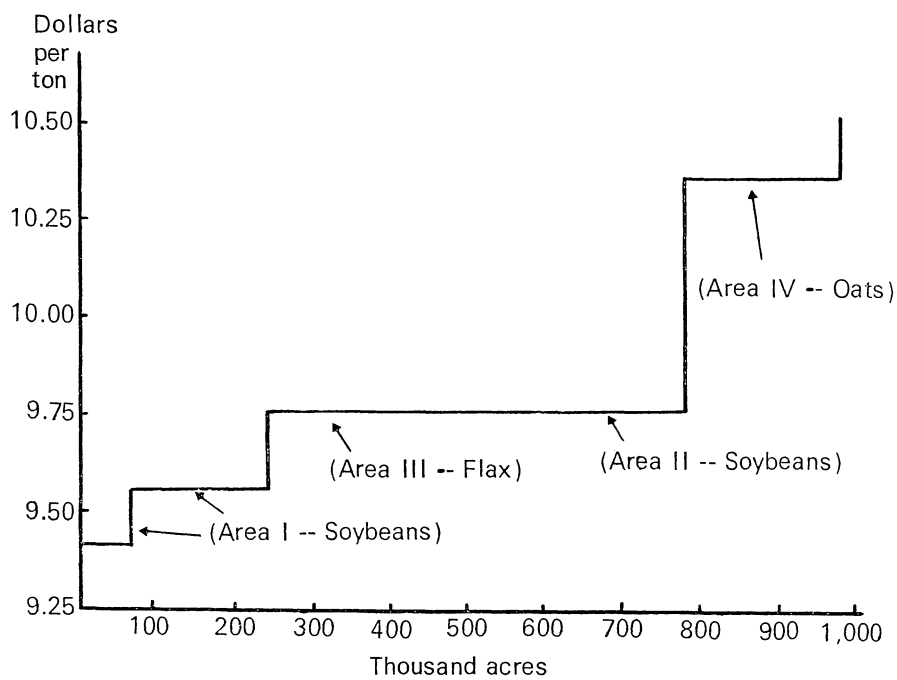
Items in parentheses indicate: areas where sugarbeets are increasing and crops sugarbeets are replacing.

Figure 1. Aggregate supply function for sugarbeets in the Red River Valley of North Dakota and Minnesota, average yields and average prices.

prices eliminated sugarbeets from the profit maximizing crop rotations of Valley farmers, while at the other extreme the price brought maximum beet acreage into the profit maximizing combination of enterprises.

The area of analysis consisted of the six Red River Valley counties of North Dakota and the seven Valley counties of Minnesota. The Valley was divided into four areas based on climate, soil, and labor mobility: area I — Cass and Richland Counties, North Dakota; area II — Clay, Norman, Wilkin, and Traverse Counties, Minnesota; area III — Grand Forks, Pembina, Walsh, and Traill Counties, North Dakota; and area IV — Kittson, Marshall, and Polk Counties, Minnesota.

Program Restrictions — Land, Crop Rotations, Labor. Based on soil survey maps and contacts with soil specialists in both states, a total of 4,116,835 acres of land was identified as capable of sustaining sugarbeet production in the total Valley area. A further land restriction was imposed by removing all farms of 260 acres or less from the total land resource. It was assumed that farms this size were too small to sustain a commercial beet enterprise. This left a net land resource of 3,932,635 acres.

The beet enterprise was limited to 1 year of a 4-year rotation with all beet acreage planted on fallow land. Wheat,

barley, oats, flax, soybeans, and corn were each limited to 2 years in a 4-year rotation. Potato acreage was limited to the 1962-65 average acreage in each of the areas studied. Since the sugarbeet production potential estimated here is projected several years into the future, government program restrictions on wheat and feed grains would be difficult to predict. So no such restrictions were assumed.

The labor supply in each area was composed of operator and family labor, local hired labor, and outside hired labor. The first two labor categories were restricted to projected 1975 levels. Outside hired labor was assumed to be available as needed at a rate of $3 per hour. Since hand hoeing and thinning were assumed to be eliminated in sugarbeet production, any hired labor used would be for tractor and truck driven field operations.

Projected Aggregate Supply Response. With the given acres of cropland adaptable to sugarbeets and with sugarbeets restricted to 1 year's production in a 4-year rotation, the Red River Valley could produce 983,158 acres of sugarbeets.

Figure 1 illustrates the acreage of sugarbeets Red River Valley farmers could profitably produce at various prices. If we assume a maximum profit objective and assume that resources are used in accord with that objective, Red River Valley farmers would produce

sugarbeets on all available acreage when sugarbeets are priced at $10.35 a ton and above, assuming 1962-65 price-to-cost relationships. When sugarbeets are priced at $9.40 a ton and below, sugarbeets would not be raised in any areas of the Valley.

The response function in figure 1 is a "step" function. The reason is that sugarbeets would be competitive at different price levels with alternative crops in the four areas of the Red River Valley. As the price of sugarbeets increases from $9.40, sugarbeets first substitute for soybeans in area I of the Red River Valley. At $9.75 a ton, sugarbeets substitute for flax in area III. As the price increases to $9.80 a ton, sugarbeets substitute for soybeans in area II, and when the price increases to $10.35 a ton, they substitute for oats in area IV.

Alternative crops are not competitive with sugarbeets at the same price level in all areas of the Red River Valley because of different crop alternatives and yield and price differences for alternative crops and sugarbeets from area to area. For example, sugarbeet yields varied from 10.5 tons per acre in area IV to 12.3 tons per acre in area I.

Sugarbeet Production Potential in Southern Minnesota. The sugarbeet production response to varying prices for sugarbeets in southern Minnesota was estimated with sugarbeets competing with corn, soybeans, wheat, oats, and flax for available resources.[5]

Differences in soils, climate, and hence crop yields suggested that we divide southern Minnesota into two sub-areas. One area was a group of counties around the upper Minnesota River with Barnes-Aastad-Flom as the major soils association. The other area included a group of counties in south-central Minnesota with Clarion-Nicollet-Webster as the major soils association. Estimated sugarbeet production potentials from each of these two sub-areas were added together to obtain the total for southern Minnesota. The sugarbeet production response in southern Minnesota, as in the Valley, was based on certain resource restrictions. The main resource supplies or constraints limiting sugarbeet supply response to varying prices in this analysis were land, labor, and the feed grain program.

Information from the area suggested that only farms of 260 or more tillable acres should be considered potential sugarbeet producing farms and that sugarbeets should be grown on the same land only once every 3 years. Since the sugarbeet production response was projected to 1975, the number of farms with 260 or more tillable acres was estimated for the two sub-areas on the basis of past rates of change in farm size groups.

Minimum participation in the feed grain program was assumed. Available information suggested that farmers generally would not enter the wheat program.

Labor restraints were associated with several kinds of labor. The available amounts of operator and family labor and hired farm labor for each sub-area were based on the quantities typically found on those farms designated as potential sugarbeet producing farms. Hired labor beyond that typically present on these farms was assumed to be available at $4 per hour. Certain restraints also were placed on labor to assure that operator and family labor supplies were fully used before hired farm and outside labor were brought in. Finally, labor supplies in various time periods through the year were adjusted to simulate the influence of weather on field days.

Projected Aggregate Supply Response. With mechanized sugarbeet production, the land available for sugarbeet production through crop rotation becomes the only constraint on sugarbeet production. Since such land availability is many times the acreage currently in sugarbeets, the potential sugarbeet production response to varying sugarbeet prices is very large.

Thus, in the western sub-area the sugarbeet production response to a price of $7.22 per ton was 430,232 acres or about 6 million tons, figuring 14 tons per acre. Increasing the price to $7.22 shifted 217,154 acres from soybeans and 213,078 acres from competing corn (nonallotment) into sugarbeets. A price higher than $7.22 shifted no additional land and no other resources to sugarbeets, because all the available sugarbeet land, given rotation restrictions, was used at that price.

In the south-central sub-area, the sugarbeet production response was 436,219 acres or about 12.6 million tons (assuming a 15-ton yield per acre) to a price of $7.99 per ton. Between this price and $8.22, no additional acres and other resources were shifted into sugarbeets. Within that range of prices, sugarbeets drew in all the resources that were in soybeans, but were unable to draw any resources away from corn. However, as soon as the price per ton of sugarbeets was increased to $8.22, sugarbeets drew about 500,000 acres and complementary resources away from nonallotment corn production. At prices above $8.22 per ton, no more land or other resources were shifted into sugarbeets since all the available sugarbeet land, given rotation restrictions, had been used at that price.

Figure 2 shows the summation of the two sub-areas' sugarbeet production responses to varying sugarbeet prices. It assumes that production alternatives are limited to crops and that migrant labor for thinning and weeding sugarbeets has been replaced by mechanical and chemical substitutes. As indicated, a relatively small change in price results in a very large production response.
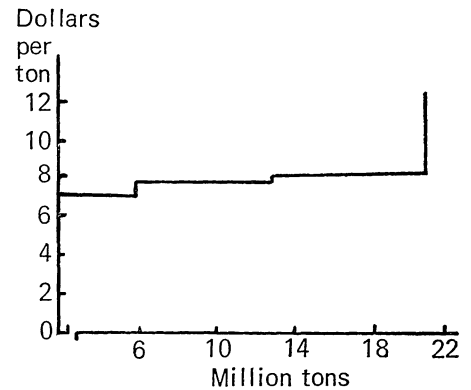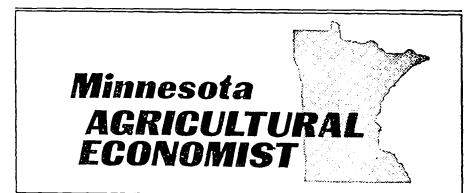

Figure 2. Aggregate sugarbeet supply response to varying sugarbeet prices for western and south-central Minnesota sub-areas, assuming use of machines and chemicals for hand thinning and weeding of sugarbeets and with production choices limited to crops.

IMPLICATIONS OF FINDINGS

Within the crop rotation and other land use constraints, the sugarbeet supply responses of the Red River Valley and southern Minnesota show that in most instances land is the only limiting resource. These supply responses also show that within the range of about $1 per ton above the sugarbeet price necessary to bring sugarbeets into the profit maximizing crop plans, sugarbeets can outcompete soybeans, flax, and oats for land in the Valley and outcompete soybeans and nonallotment corn in southern Minnesota. Given the sugarbeet prices at which sugarbeets enter the profit maximizing crop plans, the study suggests that sugarbeets are in a relatively strong competitive position for resources.

The study shows that sugarbeets enter profit maximizing crop plans at a lower price in southern Minnesota than in the Red River Valley. Important in an explanation of that outcome is that a land cost of $12 per acre is charged against sugarbeets in the Red River Valley because of the fallow restriction. Because no fallow restriction was assumed for sugarbeets in southern Minnesota, no special land cost was charged against sugarbeets in southern Minnesota. Because of the land charge associated with fallow in the Valley, the sugarbeet price there had to be raised to a higher than usual level to replace competing crops. ∎

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[5] Flax was an alternative in southwestern Minnesota, but not in the south-central area.

IN PERSPECTIVE

An Outline of the U.S. Sugar Program

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The research results reported on the previous pages suggest that there could be considerable expansion in sugarbeet acreage in the Red River Valley of Minnesota if this crop were not tightly controlled. The purpose of this brief outline of the U.S. sugar program is to highlight the way in which its main control features translate to sugarbeet growers.

The United States has a long history of sugar trade regulation. Before 1934, regulation took the form of tariffs or levies to retard the flow of imports into the domestic market. With the depressed conditions of the thirties, more positive control was sought. Legislation that made use of quotas as the control device was enacted.

The Sugar Act of 1948 and its various amendments serve as the legal basis for our present sugar programs. It is due to expire at the end of 1971.

There are four main control points that bear upon the sugar market and influence the amount of acreage an individual grower can plant: (1) annual U.S. sugar requirements, (2) domestic and foreign sugar quotas, (3) processor marketing allotments, and (4) farm proportionate acreage shares.

Annual Sugar Requirements

By law, the Secretary of Agriculture must determine how much sugar will be required to meet the needs of the continental United States during each calendar year. An announcement of the estimated requirements for the ensuing year usually is made in December. This estimate is based on factors such as the amount of sugar distributed during the previous 12-month period; the size of sugar inventories; and expected changes in per capita consumption, population, and various other demand factors. The price target, of course, is an important consideration.

In December 1969, the U.S. sugar requirement for 1970 was estimated to be 10.8 million short tons of sugar, raw value. This was above the comparable estimate for 1969, but below the final utilization of 11 million tons in 1969. Since per capita consumption has remained quite stable, the trend in the total annual U.S. sugar requirement has been about in line with population growth.

Domestic and Foreign Sugar Quotas

Based upon the official estimate of the annual sugar requirement, shares are allocated to foreign and domestic producers. In 1962 the formula used for allocating sugar requirements was revised in favor of domestic producers. Under this formula, 65 percent of the annual growth in sugar requirement above 9.7 million tons is allocated to domestic producers.

In 1969, domestic areas were allocated 6,610,000 short tons, raw value, while foreign producers were allocated 3,990,-000 tons. Of the domestic allocation, Hawaii, Puerto Rico, and the Virgin Islands were assigned about 36 percent, the mainland cane areas about 17 percent, and the sugarbeet areas about 47 percent. Since production in some beet areas in 1969 was less than expected because of freezes during harvesting and low sucrose content of beets, the national sugarbeet acreage requirement for the 1970 crop has been increased by 100,000 acres over last year.

Processor Marketing Allotments

Processor marketing allotments are used to allocate shares of the cane and beet area quotas to sugar processors. The amount of each processor's marketing allotment, together with his inventory on hand and expected per acre yields then determine the amount of sugarbeet acreage he will contract with beet growers. A number of factors play a part in determining the size of the marketing allotment received by a processing company. In general it is based upon past marketings, an evaluation of the processor's ability to market during the ensuing season, and on proportionate acreage shares assigned to growers in the area. Marketing allotments are allocated to the sugar company rather than to the individual plant.

Farm Proportionate Acreage Shares

Farm proportionate acreage shares are used when necessary to avoid a buildup of domestic sugar supplies beyond that needed to meet an area's quota and to provide a normal carryover inventory. In implementing proportionate acreage shares, the Secretary of Agriculture must see that each sugar producing farm gets its fair share of the available market. Farm proportionate acreage shares were last in effect for sugarbeets for the 1966 crop. When they are not in effect, sugarbeet acreage is restricted only by the contracting arrangements with the sugar company. So the processor's marketing allotment is extended back to growers via the contracting arrangements when farm proportionate shares are not in effect.

Besides rigorously regulating the supplies of sugar available to the domestic market and stabilizing processor and producer returns, the sugar program provides for conditional payments to growers. These payments are made to growers at the rate of $16 per short ton on the first 350 short tons. Rates are progressively reduced down to $6 per ton for production in excess of 30,000 tons per farm. In 1968, Minnesota growers received conditional payments that averaged slightly over $29 per planted acre. To be eligible for these payments, growers, besides complying with proportionate shares when in effect, must not employ child labor and must pay fair wages to workers, as determined by the Secretary of Agriculture. The cost of the program is borne through an excise tax of ½ cent per pound of raw value on all sugar marketed within the quota system. Since 1938 these funds have more than offset the cost of the program. ■