OPTIMUM DISTRIBUTION PATTERNS FOR DURUM WHEAT AND FLOUR

By

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UGPTI Publication No. 3

May 1969

OPTIMUM DISTRIBUTION PATTERNS FOR DURUM WHEAT AND FLOUR IN DOMESTIC AND EXPORT MARKETS 1965 AND PROJECTED TO 1970 AND 1975

BY

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North Dakota State Wheat Commission
Bismarck, North Dakota

MAY 1969

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FOREWARD

This report is one of a series of five reports prepared for the North Dakota State Wheat Commission under a project entitled IMPACT OF CHANGING RAIL FREIGHT RATES ON MARKETS FOR NORTH DAKOTA HARD RED SPRING AND DURUM WHEAT. The preparation of this report was financed in part through a contract grant from the Commission to the Upper Great Plains Transportation Institute. Other reports in this series are:

Optimum Distribution Patterns for Hard Red Spring Wheat and Flour in Domestic and Export Markets, 1965, and Projected to 1970 and 1975, UGPTI Report No. 4

Optimum Distribution Patterns for Durum, Hard Red Spring, Hard Red Winter Wheat and Flour, Considering Substitutability in Domestic and Export Markets, 1965, and Projected to 1970 and 1975, UGPTI Report No. 5

Competitive Transportation Rate Ranges for North Dakota Hard Red Spring and Durum Wheat and Flour in Domestic and Export Markets, 1965, and Projected to 1970 and 1975, UGPTI Report No. 6

Statistical Appendix to UGPTI Reports 3, 4, 5, and 6, UGPTI Report No. 7

Alternative market outlets for wheat production of North Dakota and the Upper Great Plains are important. Hard red spring and durum wheat produced in this area can now be sold in either domestic or export markets. These alternatives provide more competition among buyers for these products. This situation provides a partial solution to a basic problem that has faced area farmers for many years. That is, the production of spring wheat has been tied to the activity of the Minneapolis and Duluth markets. During periods of labor problems and/or when the Great Lakes become impassable, these markets become narrower or disappear. There is evidence that the remaining mills located in the Twin Cities and southern Minnesota are looking toward hard winter wheat supply areas for more and more wheat inputs. In addition, a trend exists toward moving milling capacity to points of consumption, i.e., where population is centralizing and expanding at rapid rates. Reductions in the costs of hauling the raw product encourage these types of changes.

Reductions in westbound export rail rates on wheat have played an important role in providing an additional market outlet for spring wheat produced in the Upper Great Plains. It is important to recognize, however, that these reductions apply only on westbound movements consigned to destinations outside of the United States. Therefore, this product is not legally available to millers of the Northwest and the West Coast of the United States except through the existing structure of high domestic freight rates.

In order to intelligently negotiate adjustments in rail rates, railroad management and farm producers must possess objective analyses of the impact of such adjustments. The effects of adjustments on existing distribution patterns for substitutable wheats must be known. The several reports from this study are intended to partially satisfy the requirements for information to answer the questions of carriers and producers.

David C. Nelson
Director

OPTIMUM DISTRIBUTION PATTERNS FOR DURUM WHEAT AND FLOUR IN DOMESTIC AND EXPORT MARKETS 1965 AND PROJECTED TO 1970 AND 1975

Clair W. Cudworth*

INTRODUCTION

The Nature of the Problem

The wheat-flour-bakery industry is constructed from the wheat-grain producer to the bakery product buyer or consumer. Country elevators, subterminals, terminals, numerous marketing interests, flour millers, flour blenders and processors, and bakeries exist between the two ends of this spectrum. The movement of raw wheat from the farm to the consumer is influenced by a myriad of artificial, metrological, economical, and political forces. As wheat is moved from the producer to the consumer, several participants compete for their share of the consumer's dollar for the final product in this movement. In recent years, the wheat producer has been receiving relatively the same reward (price) for his participation in this movement, whereas the consumer has to pay a considerable amount more than he did in previous years. It is consequential for the producer to be aware and soberly concerned about his fair share of the marketing value to the consumer.

North Dakota grown wheat can be marketed in two types of markets: the domestic market and the export market. Wheat that is produced in a state and not used in the same state is said to be in surplus or available for transport to states or areas that are in short supply of wheat. These states or areas are said to be in deficit. The wheat marketing system has to perform the function of distributing wheat from the surplus area to the deficit area (from the producer to the consumer). The specific means used to implement this distribution function is the available transportation system.

North Dakota wheat can be marketed only where it is in demand. The demand for North Dakota wheat is primarily influenced by the price at which the buyers will take it off the market. The difference between the price of wheat in a surplus area and a deficit area is theoretically a transportation bill, shipping cost, or freight rate. Therefore, relationships between prices in surplus and deficit areas (defined here as transportation costs) influence the volume of wheat moving within the marketing distribution system.

A reduction in a transportation cost between two areas would tend to increase prices for the producer in the surplus area, decrease prices to the buyers in the deficit area, and increase the volume transported or shipped between the two areas. An additional effect such a decrease

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in transportation cost will have is that this decrease will sometimes also affect the prices and volume transported to other surplus and deficit areas.

A change in supply or demand (price - defined as transportation cost) between surplus and deficit areas will create a new equilibrium distribution pattern and will cause changes in volume of grain moving between particular areas. Changes in supply-demand relationships (price) or transportation costs are basically short-run changes. Long-run changes, such as production and use in each of the areas, also affect movements of wheat distribution.[1]

There are basically three alternatives in the transportation of wheat: rail, truck, or barge. Basically, trucks are used for short transporting distances, whereas railroads and barges are basically used for longer transportation distances. All three modes of transportation are used for intermediate hauls. Each method has inherent advantages that lead to varying transportation costs. Transportation costs appear to be one of the main causes in the changes of the grain marketing structure. Both the size and location of merchandising, processing, and storage facilities are influenced by the transportation costs or freight rates. The number, size, and location of merchandising, processing, and storage facilities that handle the volume of grain and its by-products and perform an efficient marketing process, can do so only when the inherent advantages of the three modes of transportation are realized.

Objectives

Basically, the three objectives of this study are:

1. To determine the potential West Coast market for hard red spring and durum wheat.

2. To assess the existing and potential capacity for producing spring wheat in North Dakota.

3. To determine the impact on the North Coast and Intermountain flour milling industry of reductions in westbound domestic rail freight rates on hard red spring and durum wheat.

The following procedure and methodology were used in fulfilling these objectives.

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[1] Marketing Grain, Proceedings of NCM-30 Grain Marketing Symposium, North Central Regional Research Publication No. 7, Agricultural Experiment Station, Purdue University, Lafayette, Indiana, January, 1968, pp. 109-110.

RESEARCH PROCEDURE, ASSUMPTIONS, AND DATA USED

Major Assumption

The western half of the United States was divided into smaller areas than the eastern half. This was done because Thompson's study[2] showed that about 80 percent of the expected increase in the domestic demand by 1975 for hard red spring wheat will occur in the western area. The export market on the West Coast is also expanding. One hundred percent of the expected increase for the domestic demand for durum by 1975 will occur in this area. This half of the United States also supplies 99 percent of the spring wheat, 100 percent of the durum wheat, and over 70 percent of the winter wheat. Therefore, a more specific analysis of this area was needed. The western portion of the United States was divided into 17 states representing the domestic market and one export area representing the West Coast export market. The remaining portion of the country was divided into nine regions representing the domestic market and three areas representing the Great Lakes export market, the Gulf export market, and the Atlantic export market. This division was made on the basis of production, consumption, population, geographic size, number of flour mills, and the existing markets for wheat and flour (Figure 1).

A particular point was selected within each area to represent an origin or destination of particular shipments for that region or state. These points were selected on the basis of population, existence of markets, and available railroad service (Table 1).

A number of different points were selected according to the distance from the supply area for the export areas considered. For further illustrations, see the export rate appendix tables in the Statistical Report.

Time Periods of Analysis

There were three time periods that were analyzed. The first time period analyzed was the year 1965. This year was chosen because it is the latest year in which actual data was available. The years 1970 and 1975 were chosen to provide a basis for future decisions for those concerned. To predict beyond this point would certainly involve some highly intuitive reasoning.

The calendar year defined the years of 1965, 1970, and 1975 for production data. The calendar year also defined the years 1965, 1970,

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[2] Nelson, David C., and Robert G. Thompson, An Economic Analysis of the Domestic Demand for Wheat by Class in the United States, Agricultural Economics Report No. 64, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, March, 1969, pp. 41-42.

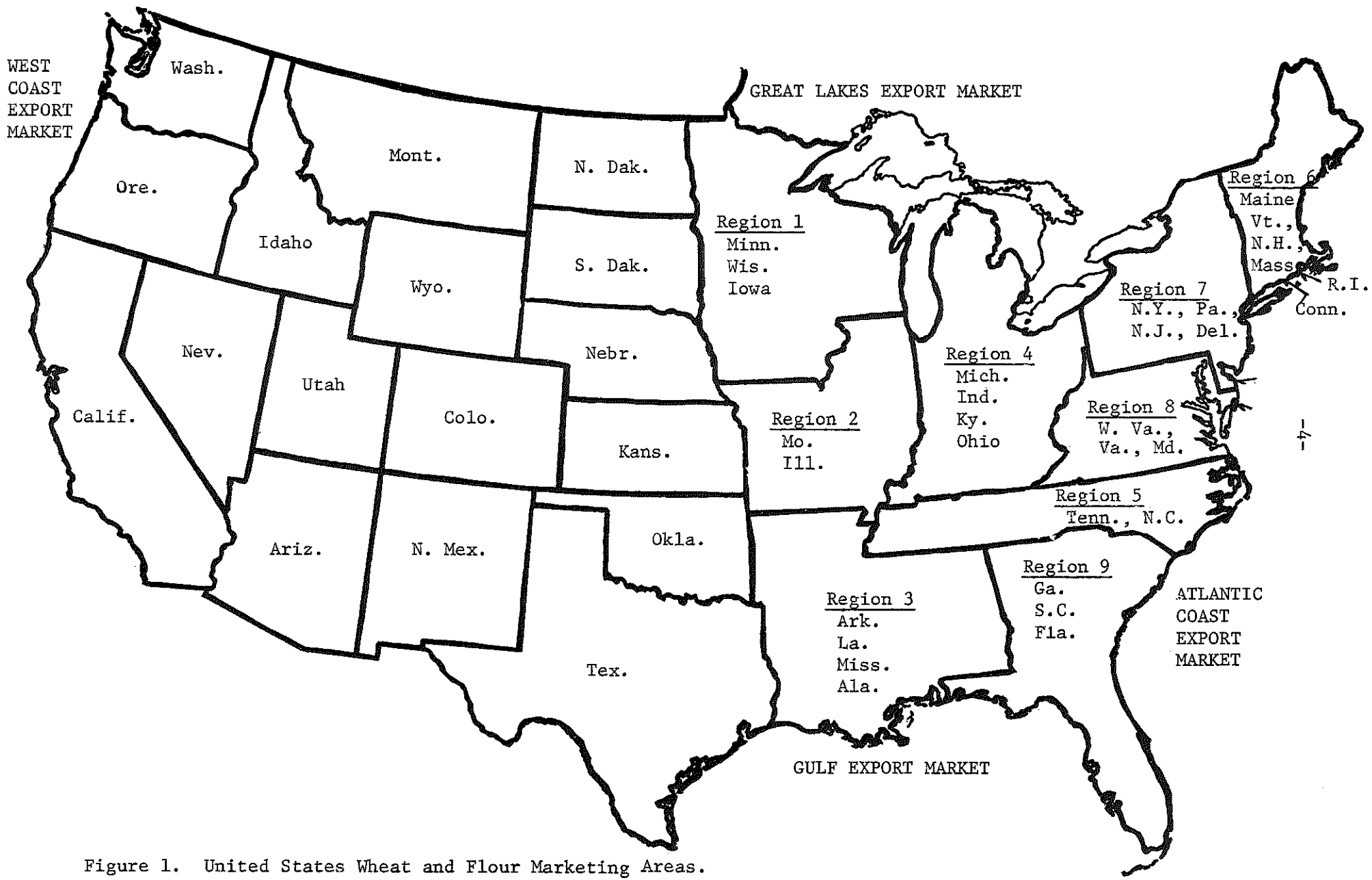

Figure 1. United States Wheat and Flour Marketing Areas.

and 1975 for flour millers' demand for raw wheat. These same years were also defined for total per capita consumption of wheat by the calendar year.

TABLE 1. DOMESTIC SURPLUS AND DEFICIT AREAS WITH THEIR SELECTED POINTS OF ORIGIN AND DESTINATION

State	Origin and Destination
Washington	Spokane
Oregon	Portland
California	Los Angeles
Idaho	Idaho Falls
Nevada	Winnemucca
Utah	Salt Lake City
New Mexico	Albuquerque
Arizona	Phoenix
Montana	Billings
Wyoming	Cheyenne
Colorado	Denver
North Dakota	Minot
South Dakota	Huron
Nebraska	Lincoln
Kansas	Hutchinson
Oklahoma	Oklahoma City
Texas	Houston
Minnesota, Iowa, Wisconsin	Minneapolis
Illinois, Missouri	St. Louis
Arkansas, Louisiana, Mississippi, Alabama	New Orleans
Michigan, Indiana, Ohio, Kentucky	Cincinnati
Tennessee, North Carolina	Knoxville
Maine, Vermont, New Hampshire, Rhode Island, Connecticut, Massachusetts	Boston
New York, Pennsylvania, New Jersey, Delaware	Buffalo
West Virginia, Virginia, Maryland	Baltimore
South Carolina, Georgia, Florida	Savannah

The government fiscal year of June 30 through July 1 was used for export data. The reason for this was that export sales are usually made well in advance (months in advance) of actual exportation. Therefore, in order to match export sales with more immediate sales to flour millers, a "slack" time period for export shipments was used to correspond with the calendar year purchases, production, and consumption data.

Production Data Used

Production data for the 1965 analysis were taken from statistics of the U. S. Department of Agriculture. Production data for the 1970

and 1975 analyses were derived from a supply response study conducted by the departments of agricultural economics at universities in the Great Plains and Pacific Northwest states in cooperation with the U. S. Department of Agriculture.[3] This study was a result of a joint venture of two regional technical committees. The two projects of these committees were GP-5 and W-54. They determined profitable adjustments on typical wheat farms which include individual and aggregate farm supply response for alternative price relationship and levels with emphasis on wheat, feed grains, and livestock. The studies included over 98 percent of the 1964 acreage and production of hard red winter wheat and 90 percent of the acreage and production of hard red spring wheat.

Total production was estimated from the ratio of production by class of each state in the study to the total production by class for the United States in the 1964-1965 crop year. The states that were not included in this study were allocated a portion of the estimated total which was based on the percentage of total production of each state by class in the 1964-1965 crop year.[4]

Durum wheat that was not included in the supply response study was assumed to have production increases by the average percentage increase of the classes included in the study. The estimated total was allocated according to the proportion of production by class and state to the total production by class for the 1964-1965 crop year.

Production data by state and region for the classes of hard red spring, hard winter, and durum wheat appear in the Statistical Report, Appendix Tables 1, 2, and 3.

Domestic Consumption Data Used

The consumption data used in this analysis consisted of three types: total flour millers' demand for raw wheat, total per capita demand for raw wheat and flour, and total per capita demand for flour.

Flour Millers' Demand for Raw Wheat

Data on domestic wheat purchases by flour millers were based on a mail survey of all wheat processors in the United States.[5] Ratio

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[3] Proceedings of the Meeting of the Great Plains Agricultural Council, Denver, Colorado, August 1-2, 1968, mimeograph paper, p. 151-.

[4] Luessen, Frederick W., Wheat Distribution Patterns by Class, Master of Science Thesis, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, September, 1968, pp. 8-9.

[5] Survey made by Robert G. Thompson, former Graduate Assistant, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota.

estimators or total wheat ground divided by reported wheat ground were used to expand the data received from the millers who did report (Statistical Report, Appendix Table 4). Thus, by multiplying reported wheat purchases (Statistical Report, Appendix Table 5) by class and by state times the ratio estimator for that area would yield the total purchases for that class of wheat for that particular area (Statistical Report, Appendix Table 6). This procedure was used to estimate the 1965 domestic wheat purchases by the millers.

Projected total wheat purchases for 1970 and 1975 (Statistical Report, Appendix Table 7) were estimated by adding the average change in the proportion of the total wheat purchased in that region or state to the proportion of the total wheat purchased in that region for 1965 (Statistical Report, Appendix Table 8). Projected wheat purchases by class for 1970 and 1975 were made by adding the average changes in the proportion of that particular class of wheat purchased in that region or state to the proportion of that class of wheat purchased in that region or state for 1965. The quantity of wheat purchases by region or state and by class was derived by multiplying the proportions by the projected total wheat purchases. Statistical Report, Appendix Table 9 contains the proportions of wheat purchased by class.

Total Per Capita Demand for Raw Wheat and Flour

Population estimates that appear in the Statistical Report, Appendix Table 10 are the Series I-B type which is considered to be one of the more liberal projection types. These population figures are multiplied by the actual and projected per capita consumption requirements for the years 1965, 1970, and 1975 (Table 2).

TABLE 2. PER CAPITA CONSUMPTION OF FLOUR FROM HARD WHEATS, UNITED STATES, 1965, 1970, AND 1975[a]

Year	Class of Flour		
	Hard Red Winter	Hard Red Spring	Durum
	pounds		
1965	49.62	24.34	5.63
1970	47.42	23.26	5.38
1975	45.22	22.19	5.13

[a]Estimated from data reported in the Wheat Situation, U. S. Department of Agriculture, Washington, D. C., November, 1967, p. 5.

The per capita consumption figures are based on the assumption of a decrease in the total per capita wheat consumption of one pound per year. It is also assumed that the proportion of each class consumed will remain constant. Combining the data from the Statistical Report, Appendix Table 10 and Table 2 yields the Statistical Report, Appendix Tables 1, 2, and 3 which include the total per capita consumption of wheat and flour by class, region or state, and year. These data were obtained by multiplying population figures times the per capita consumption figures.

Total Demand for Flour From Existing Milling System

The third and final set of consumption demand data necessary in this analysis is the demand for the flour that has been milled by the existing milling industry. Bakeries purchase at least three-fourths of all domestic flour produced. After the flour is transformed into bakery products, the market for these products typically consists of a metropolitan area and a rural-urban fringe. Most of the bread is distributed within 50 miles of the bakery.[6] Therefore, bakeries appear to be located according to population density. Since sufficient data representing the actual flour demand by bakeries was not available, a population density method was used to estimate the flour demand of the bakeries. In comparison, the wheat-flour consumed by bakeries and the total per capita demand for flour were very close in magnitude when analyzing the data that was available.

In the population density method that was used, after the amount of flour produced by class and by region or state had been determined, the total per capita demand was subtracted from this. Therefore, it was assumed that the needs of a region will be satisfied first. If this demand cannot be satisfied within the region, it is said to be a deficit region. If a region can oversupply its own flour needs, it is said to be in surplus of flour and will be in a position to distribute to other deficit regions. The surplus and deficit regions and states are listed in the Statistical Report, Appendix Tables 1, 2, and 3.

Export Data Used

Since wheat has two alternative markets: the export market and the domestic market, both had to be considered. The four export market areas analyzed were the Great Lakes area, the Gulf area, the West Coast area, and the Atlantic Coast area.

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[6] Organization and Competition in the Milling and Baking Industries, Technical Study No. 5, National Commission on Food Marketing, U. S. Government Printing Office, Washington, D. C., June, 1966, p. 51 (Based on a survey of 78 plants milling hard wheat).

Actual export figures for wheat-grain were used for 1965 (Statistical Report, Appendix Table 11). Flour exports were eliminated from all years, because flour exports are not broken down by class of wheat. Exports of flour do not make up a large portion of the total wheat-flour export market; therefore, no attempt was made to determine the amount of flour exports by class and coastal area. No projections were made for flour exports for 1970 and 1975.

For 1970 and 1975, estimates or projections were made for the amount of wheat-grain that will be exported. The determinants of changes in volume of United States exports are many and very complicated. The 1970 projections were based on a study designed to project exports (Statistical Report, Appendix Table 11).[7] To determine shares of the total market by class of wheat, an average proportional change method was utilized to show the growth and decline in the particular export areas. An allowance was also made for those export areas in which large volume changes have occurred in recent years. The 1975 projections were based on the assumption that India and Pakistan would no longer import United States hard wheats. The assumption in no way asserts a probability but only provides a contrast to the normal "growth in exports" projection year of 1970.

Transportation Costs

Truck Costs

Since there were no available truck rates on hauling the exempt commodity of wheat by either regulated or unregulated truckers, a system of estimating truck rates was employed.

The truck rates used in this study were computed from estimates of the operating costs of trucking firms.[8] Truck rates (Statistical Report, Appendix Tables 14--domestic and 15--export) were computed assuming a 22 cent per mile one-way operating cost and a trailer capacity of 750 bushels of wheat. A one cent per mile one-way charge was added to the 22 cent charge to allow for increases in cost due to inflation. Therefore, to obtain an estimated truck rate, the highway distance (Statistical Report, Appendix Tables 12 and 13) between the origin and destination is multiplied by 46 cents.

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[7] Bratland, Robert P., World Wheat Trade Projections for 1975 and 1985, Master of Science Thesis, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, January, 1968, p. 94.

[8] Casavant, Kenneth L., and David C. Nelson, An Economic Analysis of the Costs of Operating Grain Trucking Firms in North Dakota, Agricultural Economics Report No. 54, Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, July, 1967, p. 41.

Barge Costs

Barging was the second mode of transportation considered in this study. The obtained barge rates (Statistical Report, Appendix Table 16) apply at ports on the Mississippi, Illinois, Ohio, Cumberland, and Tennessee rivers and the Gulf ports. These are published rates and do not necessarily indicate that they are effective or actual rates (rates may be negotiable on exempt products such as grain). These rates are general indications of what is charged, but the actual charge may be lower or higher.

Rail Costs

The following two types of rail transportation costs were considered: the costs experienced under the existing railroad rate structure and the costs reported under a railroad rate structure based on fully distributed costs.

Existing Rail Rate Structure

The existing rail rate structure was developed by obtaining rates from railroads and government sources. They generally represent the lowest applicable rate between the specific origin and destination.

Rail rates for raw wheat are listed in the Statistical Report, Appendix Tables 17--domestic and 18--export. Rail rates for flour are listed in the Statistical Report, Appendix Table 19. Both types of rail rates are based upon a variety of factors. They may or may not be the same for wheat and flour.

Rail Rate Structure Based on Fully Distributed Costs

Fully distributed or fully apportioned costs reflect costs over a long-run period. They include all revenue needs covering 100 percent of the freight operating expenses, rents, taxes (excluding Federal income taxes), the passenger train and less than carload operating deficits, and a return of 4 percent after the Federal income taxes on 100 percent of road property and 100 percent of equipment used in freight service. These revenue needs were given a pro rata ton and ton-mile distribution over all revenue traffic without distinction as to type or class.

Fully distributed carload costs were obtained from Summary I of the rail cost formula, Rail Form A, and based on the 1966 operations. An allowance of 13 percent circuity is used to adjust short line distances. The short line mileage was increased by 13 percent and the resulting increased mileage used as the actual mileage.

The carload mileage cost scales for the Western, Official, and Southern regions were used in calculating "cost-oriented rates". The

particular cost scale used corresponded to the region in which all or most of the distance occurred. If the distance appeared to be equally distributed between regions, the region with the highest cost scale was used (Statistical Report, Appendix Table 20).

By applying the carload mileage costs to the short line rail distances between various points (Statistical Report, Appendix Tables 21--domestic and 22--export), rail rates were developed that were based on fully distributed costs. Two fully distributed cost rate structures were developed for wheat-grain shipments and one developed for wheat-flour shipments.

The first rate structure assumed that an average load of wheat-grain was 1,300 hundredweight, one transit included (Statistical Report, Appendix Tables 23--domestic and 24--export); and the average load of wheat-flour was 800 hundredweight, one transit included (Statistical Report, Appendix Table 25). The second rate structure assumed that an average load of wheat was 1,800 hundredweight, a covered hopper was utilized, and included one transit (Statistical Report, Appendix Tables 26--domestic and 27--export); and the same average load of flour was used as in the first rate structure.

Transportation Costs Used in the Analysis

Five systems of transportation costs were used in the analysis. Each system represented the least-cost combination of the three modes of transportation discussed previously. The best rates to use in this type of analysis would be the true least-cost rates determined by a weighted average method, but these rates are too difficult to obtain.

Least-Priced Rate System I

Least-priced Rate System I is a formation of existing least-priced rates from all modes of transportation for the distribution of wheat-grain (Statistical Report, Appendix Table 30).

Least-Priced Rate System II

With the exception of railroad rates, the least-priced Rate System II is a formation of existing least-priced rates from all modes of transportation. Rail rates were based on fully distributed costs adjusted to short line mileages for general service boxcars (Statistical Report, Appendix Table 28).

Least-Priced Rate System III

With the exception of railroad rates, the least-priced Rate System III is a formation of existing least-priced rates from all modes

of transportation. Rail rates were based on fully distributed costs adjusted to short line mileages for covered hopper cars (Statistical Report, Appendix Table 29).

Least-Priced Rate System IV

Least-priced Rate System IV is a formation of existing least-priced rail rates for wheat-flour distribution (Statistical Report, Appendix Table 19). Rate System I rates were used for export shipments.

Least-Priced Rate System V

Least-priced Rate System V is a formation of least-priced rail rates for wheat-flour distribution and were based on fully distributed costs adjusted to short line mileages for general service boxcars (Statistical Report, Appendix Table 25). Rate System II rates were used for export shipments.

In all five systems of transportation costs, no rates were obtained or developed for flour shipped by truck or flour shipped in large size rail shipments such as the hopper car. Truck rates for flour were not used, because the trucking of bulk flour has not been particularly adaptive either economically or technologically.[9] The rates for large shipments of flour by rail were not determined on the fully distributed cost basis, because individual flour deliveries historically have only been a fraction of the size of individual wheat shipments.[10] However, the importance of the cost of shipping large flour shipments should not be overlooked. If large shipments become adaptable to the marketing system, then more favorable rates for flour as compared to wheat should be sought.

THEORETICAL FRAMEWORK OF THE STUDY

Discussion of the Models Used

Transportation costs are contracted in three separate distributions of the wheat-flour economy.[11] They are:

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[9] Maillie, Jeff, and Dale Solum, An Analysis and Evaluation of Factors Which are Deleterious to the Competitive Interests of the Mid-America Wheat Flour Milling Industry, Midwest Research Institute, Kansas City, Missouri, July 1, 1968, p. 22

[10] Ibid., p. 16

[11] Wright, Bruce H., Impacts of Alternative Transportation Policies on Industrial Location and Regional Agricultural Development, Doctor's Thesis, Department of Economics, Iowa State University, Ames, Iowa, 1968, p. 66.

Distribution I. Transportation costs incur in effective rates on raw grain from the production area to the location of the flour mill.

Distribution II. Transportation costs incur in effective flour rates from the location of the mill to the consuming location.

Distribution III. Transportation costs incur in effective export rates for wheat from the production area to the point of export.

Assuming that the bulk of transportation costs in the wheat-flour economy remain within these three phases, the analysis will follow this procedure:

Step 1. Transportation costs of all three phases outlined will be determined under least-cost existing rates of any rail-truck-barge combination or individualization. The present location and flour production of existing flour mills will be honored.

Step 2. Transportation costs will again be measured in the same manner as Step 1 with the exception that any rail rate involved will not reflect the effective rate, but the rate will be based on fully distributed costs.

Step 3. Transportation costs will again be measured in the same manner as Step 2 with the exception that the present location and flour production of existing flour mills will be ignored.

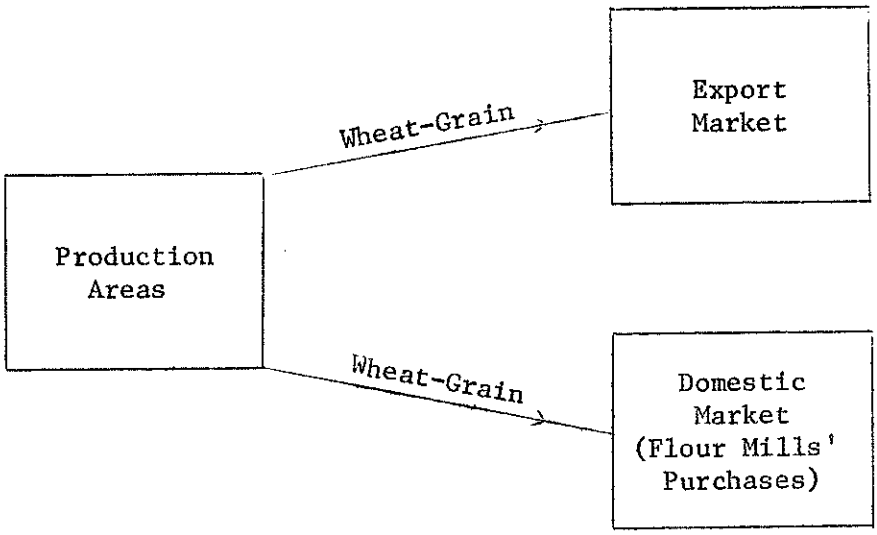
This analysis was performed through the use of three models illustrated as follows:

Model I. In Model I there were two phases of the distribution system: Phase I considered wheat-grain going from production or surplus areas to export markets and flour mills and Phase II considered wheat-flour from flour mills to consumption areas. This model was used to show transportation costs under existing flour milling capacities and locations. Both Phase I and Phase II together make up the total distribution system under these assumptions (Figure 2).

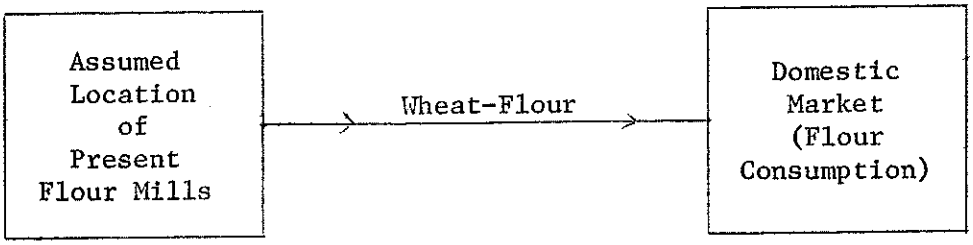
Model II. Model II consisted of only one phase which was wheat-grain going to the export markets and wheat-flour going to the consumption areas. Flour mills were assumed to be located in the production areas (Figure 3).

Model III. Model III also consists of only one phase which was wheat-grain going to the export markets and wheat-grain going to flour mills. The flour mills were assumed to be located in the consumption areas (Figure 4).

Model I, Phase I



Model I, Phase II



1965 Flour Mill Locations Assumed

Figure 2. Wheat-Grain and Wheat-Flour Market Flow Chart for Model I, Phases I and II.

Model II, Phase I

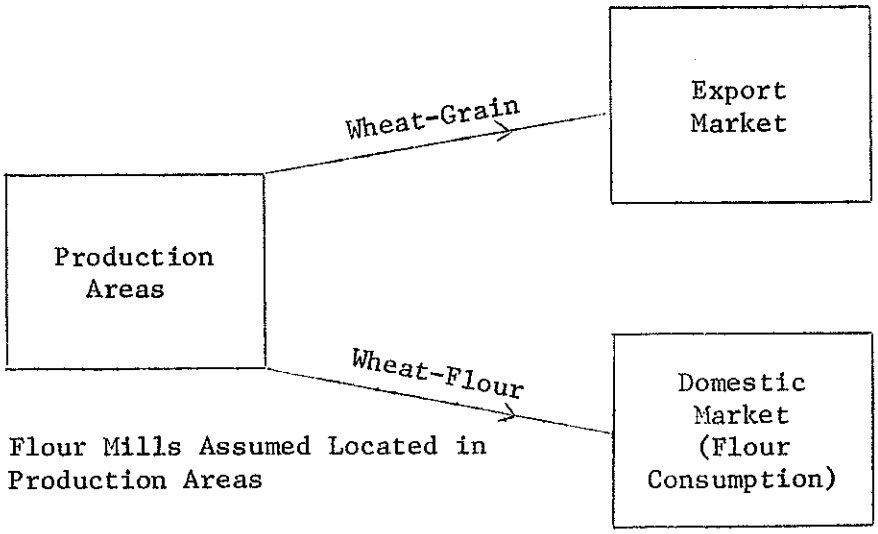


Figure 3. Wheat-Grain and Wheat-Flour Market Flow Chart for Model II, Phase I.

Model III, Phase I

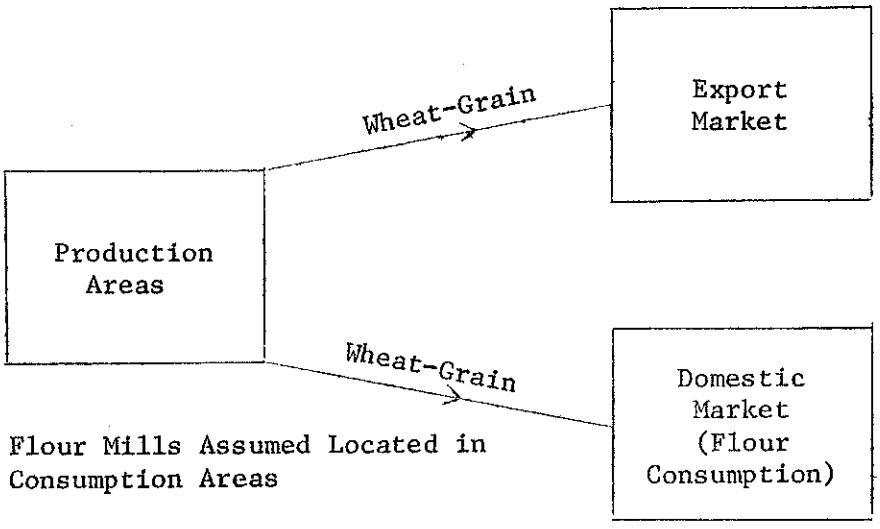


Figure 4. Wheat-Grain Market Flow Chart for Model III, Phase I.

Importance of Mathematical System Used in the Analysis

The analysis performed in this study was facilitated through the application of a special class of linear programming.[12] This class of programming is known as a spatial or transportation model. In this model, the objective is to determine the least-cost flow of wheat from surplus areas to deficit areas.

By using the 1965, 1970, and 1975 data, the application of this model will determine the minimum cost distribution pattern for wheat. The minimum cost distribution pattern will be determined under each of the five systems of transportation rates used.

There are many conditional assumptions under which this model functions.[13] They are as follows:

1. The supply of any one region or origin serves equally well to satisfy the demands of any destination or consuming center.

2. Each region meets its demand from its own domestic production; and in this process, intraregional transportation costs are not considered in the analysis.

3. Total demand has to equal total supply. If the supply is greater than the quantity demanded in terms of consumption, then the excess supply moves into storage.

4. The cost (rate) of moving supply from origins to destinations is known and is independent of the number of units moved. Particularly, the total cost of inter-regional transfers must be constant or linear.

5. There is a cost minimizing objective.

6. Movements from origins to destinations can only be carried on at non-negative levels.

7. Each region will be expected to make buying and selling decisions on the basis of perfect knowledge and maximization of profits.

8. There can be no cross hauling of the product, deficit regions cannot ship out, and surplus regions can only ship to deficit regions.

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[12]The data compiled was applied to linear programming through the use of the Mathematical Programming System/360 (360A-CO-14X) Linear and Separable Application Program.

[13]Heady, E. O., and Wilfred Candler, Linear Programming Methods, Iowa State College Press, Ames, Iowa, 1963, p. 332.

9. The buying or selling activities of a surplus or deficit area will have no effect on the buying or selling activities of another area.

10. There is a complete mobility of supply.

OPTIMUM DISTRIBUTION PATTERNS

The optimum or least-cost distribution patterns of durum wheat and flour are presented in the following analysis under various conditions. The tables presented exhibit origin and destination, volume of the shipment, applicable transportation rate, total shipments of each surplus area, amount of storage in each surplus area, and total cost of distribution.

There are four sections in this portion of the analysis.

Section A includes the analysis done under the assumptions of Model I, Phase I, for 1965, 1970, and 1975. There also were three different rate systems applied to Model I, Phase I. They were Rate Systems I, II, and III.

Section B includes the optimum distribution patterns of flour under the assumptions of Model I, Phase II, for 1965, 1970, and 1975. Two rate systems, Rate Systems IV and V, were applied to Model I, Phase II.

Section C includes the optimum distribution patterns of wheat-flour to domestic markets and wheat-grain to export markets under the assumptions of Model II, Phase I, for 1965, 1970, and 1975. Rate Systems I and II and IV and V were applied.

Section D includes the optimum distribution patterns of wheat-grain to domestic markets and wheat-grain to export markets under the assumptions of Model III, Phase I, for 1965, 1970, and 1975. The three rate systems, Rate Systems I, II, and III, were used.

A descriptive analysis and discussion is not presented for each table. The primary purpose or goal of this study was not to perform this type of descriptive analysis, however, these tables were included in the report for two reasons. First, for those interested in determining the specific markets for North Dakota wheat under the various assumptions, the data is readily available. Second, for those who wish to determine specific markets for states and/or regions other than North Dakota, the data is also readily available in table form.

In the summary and conclusions, a more general analysis appears of the total distribution of North Dakota's durum wheat and flour.

SECTION A

Model I, Phase I
Rate Systems I, II, and III

TABLE 3. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL I, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	494	51.5
Montana	Oregon	84	65.0
Montana	California	78	102.5
Montana	Idaho	32	50.5
Montana	West Coast Export	95	65.0
Montana	Great Lakes Export	445	80.0
TOTAL SHIPMENTS		1,228	
STORAGE		(398)	
South Dakota	Nebraska	1,360	40.0
STORAGE		(0)	
North Dakota	Nebraska	3,856	59.4
North Dakota	Region 1	11,758	44.5
North Dakota	Great Lakes Export	6,177	44.5
North Dakota	East Coast Export	8,790	55.0
North Dakota	Gulf Export	4,804	22.1
TOTAL SHIPMENTS		35,385	
STORAGE		(0)	
TOTAL COST =	$17,442,709		

TABLE 4. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL I, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	578	51.5
Montana	Oregon	318	65.0
Montana	California	49	102.5
Montana	Idaho	9	50.5
Montana	West Coast Export	719	65.0
TOTAL SHIPMENTS		1,673	
STORAGE		(2,113)	
South Dakota	Nebraska	1,836	40.0
STORAGE		(0)	
North Dakota	Nebraska	5,396	59.4
North Dakota	Region 1	11,022	44.5
North Dakota	Great Lakes Export	25,261	44.5
North Dakota	East Coast Export	4,912	55.0
North Dakota	Gulf Export	1,817	22.1
TOTAL SHIPMENTS		48,408	
STORAGE		(971)	
TOTAL COST =	$24,107,698		

TABLE 5. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL I, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	610	51.5
Montana	Oregon	258	65.0
Montana	California	128	102.5
Montana	West Coast Export	719	65.0
TOTAL SHIPMENTS		1,715	
STORAGE		(533)	

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TABLE 5. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL I, PHASE I, RATE SYSTEM I - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Nebraska	1,836	40.0
STORAGE		(0)	
North Dakota	Nebraska	7,017	59.4
North Dakota	Region 1	10,610	44.5
North Dakota	Great Lakes Export	22,117	44.5
North Dakota	East Coast Export	4,912	55.0
North Dakota	Gulf Export	1,817	22.1
TOTAL SHIPMENTS		46,473	
STORAGE		(2,843)	
TOTAL COST =	$23,536,615		

TABLE 6. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL I, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	West Coast Export	95	50.2
Montana	Washington	494	38.8
Montana	Oregon	84	52.0
Montana	California	78	71.6
Montana	Idaho	32	33.1
Montana	East Coast Export	445	86.3
TOTAL SHIPMENTS		1,228	
STORAGE		(398)	
South Dakota	Nebraska	1,360	28.1
STORAGE		(0)	
North Dakota	Nebraska	3,856	41.6
North Dakota	Region 1	11,758	34.0
North Dakota	Great Lakes Export	6,622	34.6
North Dakota	East Coast Export	8,345	68.9
North Dakota	Gulf Export	4,804	56.1
TOTAL SHIPMENTS		35,385	
STORAGE		(0)	
TOTAL COST =	$17,424,308		

TABLE 7. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL I, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	578	38.8
Montana	Oregon	318	52.0
Montana	California	49	71.6
Montana	Idaho	9	33.1
Montana	West Coast Export	719	50.2
TOTAL SHIPMENTS		1,673	
STORAGE		(2,113)	
South Dakota	Nebraska	1,836	28.1
STORAGE		(0)	
North Dakota	Nebraska	5,396	41.6
North Dakota	Region 1	11,022	34.0

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TABLE 7. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL I, PHASE I, RATE SYSTEM II - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Great Lakes Export	25,261	34.6
North Dakota	East Coast Export	4,912	68.9
North Dakota	Gulf Export	1,817	56.1
TOTAL SHIPMENTS		48,408	
STORAGE		(971)	
TOTAL COST =	$20,406,666		

TABLE 8. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL I, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	610	38.8
Montana	Oregon	258	52.0
Montana	California	128	71.6
Montana	West Coast Export	719	50.2
TOTAL SHIPMENTS		1,715	
STORAGE		(533)	
South Dakota	Nebraska	1,836	28.1
STORAGE		(0)	
North Dakota	Nebraska	7,017	41.6
North Dakota	Region 1	10,610	34.0
North Dakota	Great Lakes Export	22,117	34.6
North Dakota	East Coast Export	4,912	68.9
North Dakota	Gulf Export	1,817	56.1
TOTAL SHIPMENTS		46,473	
STORAGE		(2,883)	
TOTAL COST =	$19,886,342		

TABLE 9. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL I, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	494	37.8
Montana	Oregon	84	51.4
Montana	California	78	71.4
Montana	Idaho	32	26.0
Montana	West Coast Export	95	51.4
Montana	Great Lakes Export	445	52.4
TOTAL SHIPMENTS		1,228	
STORAGE		(398)	
South Dakota	Nebraska	1,360	26.9
STORAGE		(0)	
North Dakota	Nebraska	3,856	40.6
North Dakota	Region 1	11,758	32.9
North Dakota	Great Lakes Export	6,177	33.5
North Dakota	East Coast Export	8,790	67.5
North Dakota	Gulf Export	4,804	45.0
TOTAL SHIPMENTS		35,385	
STORAGE		(0)	
TOTAL COST =	$16,515,827		

TABLE 10. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL I, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	578	37.8
Montana	Oregon	318	51.4
Montana	California	49	71.4
Montana	Idaho	9	26.0
Montana	West Coast Export	719	51.4
TOTAL SHIPMENTS		1,673	
STORAGE		(2,113)	
South Dakota	Nebraska	1,836	26.9
STORAGE		(0)	
North Dakota	Nebraska	5,396	40.6
North Dakota	Region 1	11,022	32.9
North Dakota	Great Lakes Export	25,261	33.5
North Dakota	East Coast Export	4,912	67.5
North Dakota	Gulf Export	1,817	45.0
TOTAL SHIPMENTS		48,408	
STORAGE		(971)	
TOTAL COST =	$19,667,089		

TABLE 11. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL I, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	610	37.8
Montana	Oregon	258	51.4
Montana	California	128	71.4
Montana	West Coast Export	719	51.4
TOTAL SHIPMENTS		1,715	
STORAGE		(533)	
South Dakota	Nebraska	1,836	26.9
STORAGE		(0)	
North Dakota	Nebraska	7,017	40.6
North Dakota	Region 1	10,610	32.9
North Dakota	Great Lakes Export	22,117	33.5
North Dakota	East Coast Export	4,912	67.5
North Dakota	Gulf Export Export	1,817	45.0
TOTAL SHIPMENTS		46,473	
STORAGE		(2,838)	
TOTAL COST =	$19,170,441		

SECTION B

Model I, Phase II
Rate Systems IV and V

TABLE 12. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1965, MODEL I, PHASE II, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	141	90.0
Washington	Nevada	53	90.0
TOTAL SHIPMENTS		194	
STORAGE		(0)	
Oregon	California	77	90.0
STORAGE		(0)	
Montana	California	81	102.5
Montana	Idaho	16	50.5
TOTAL SHIPMENTS		97	
STORAGE		(0)	
Nebraska	California	430	134.0
Nebraska	Arizona	90	134.0
Nebraska	Colorado	110	51.5
Nebraska	New Mexico	57	55.0
Nebraska	Kansas	127	38.0
Nebraska	Oklahoma	138	54.0
Nebraska	Texas	596	65.0
Nebraska	Region 3	636	73.2
Nebraska	Region 9	717	41.5
TOTAL SHIPMENTS		2,901	
STORAGE		(806)	
Region 1	South Dakota	39	25.5
Region 1	Region 2	852	40.5
Region 1	Region 4	1,499	61.0
Region 1	Region 5	495	102.5
Region 1	Region 6	627	85.0
Region 1	Region 7	2,053	71.0
Region 1	Region 8	578	80.5
TOTAL SHIPMENTS		6,143	
STORAGE		(3,703)	
North Dakota	Utah	56	67.1
STORAGE		(974)	
TOTAL COST =	$6,673,093		

TABLE 13. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL I, PHASE II, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	255	90.0
STORAGE		(0)	
Oregon	California	137	90.0
STORAGE		(0)	
Montana	California	93	102.5
Montana	Idaho	37	50.5
TOTAL SHIPMENTS		130	
STORAGE		(0)	
Nebraska	California	388	134.0
Nebraska	Nevada	29	134.0
Nebraska	Arizona	98	134.0
Nebraska	Wyoming	18	51.5
Nebraska	Colorado	114	51.5
Nebraska	New Mexico	59	55.0
Nebraska	Kansas	124	38.0
Nebraska	Oklahoma	136	54.0
Nebraska	Texas	616	65.0
Nebraska	Region 3	643	73.2

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TABLE 13. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL I, PHASE II, RATE SYSTEM IV - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Nebraska	Region 9	758	41.5
TOTAL SHIPMENTS		2,983	
STORAGE		(2,216)	
Region 1	South Dakota	37	25.5
Region 1	Region 2	847	40.5
Region 1	Region 4	1,495	61.0
Region 1	Region 5	501	102.5
Region 1	Region 6	613	85.0
Region 1	Region 7	2,062	71.0
Region 1	Region 8	594	80.5
TOTAL SHIPMENTS		6,149	
STORAGE		(3,410)	
North Dakota	Utah	58	67.1
STORAGE		(1,025)	
TOTAL COST =	$6,843,649		

TABLE 14. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL I, PHASE II, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	244	90.0
Washington	Nevada	32	90.0
TOTAL SHIPMENTS		276	
STORAGE		(0)	
Oregon	California	183	90.0
STORAGE		(0)	
Montana	California	108	102.5
Montana	Idaho	39	50.5
TOTAL SHIPMENTS		147	
STORAGE		(0)	
Nebraska	California	226	134.0
Nebraska	Arizona	109	134.0
Nebraska	Wyoming	18	51.5
Nebraska	Colorado	120	51.5
Nebraska	New Mexico	62	55.0
Nebraska	Kansas	123	38.0
Nebraska	Oklahoma	136	54.0
Nebraska	Texas	640	65.0
Nebraska	Region 3	658	73.2
Nebraska	Region 9	807	41.5
TOTAL SHIPMENTS		2,899	
STORAGE		(3,485)	
Region 1	South Dakota	36	25.5
Region 1	Region 2	857	40.5
Region 1	Region 4	1,515	61.0
Region 1	Region 5	510	102.5
Region 1	Region 6	640	85.0
Region 1	Region 7	2,090	71.0
Region 1	Region 8	614	80.5
TOTAL SHIPMENTS		6,262	
STORAGE		(2,996)	
North Dakota	Utah	62	67.1
STORAGE		(1,071)	
TOTAL COST =	$6,817,243		

TABLE 15. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1965, MODEL I, PHASE II, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	141	86.0
Washington	Nevada	53	59.3
TOTAL SHIPMENTS		194	
STORAGE		(0)	
Oregon	California	77	64.0
STORAGE		(0)	
Montana	California	81	81.3
Montana	Idaho	16	34.4
TOTAL SHIPMENTS		97	
STORAGE		(0)	
Nebraska	California	430	99.8
Nebraska	Utah	56	62.8
Nebraska	Wyoming	19	34.8
Nebraska	Colorado	110	36.2
Nebraska	New Mexico	57	55.5
Nebraska	Kansas	127	25.8
Nebraska	Oklahoma	138	33.6
Nebraska	Texas	596	55.2
Nebraska	Region 2	840	36.9
Nebraska	Region 3	636	62.0
Nebraska	Region 9	717	74.8
TOTAL SHIPMENTS		3,726	
STORAGE		(0)	
Region 1	Arizona	90	97.8
Region 1	South Dakota	39	27.2
Region 1	Region 2	12	40.7
Region 1	Region 4	1,499	45.5
Region 1	Region 5	495	57.6
Region 1	Region 6	627	75.5
Region 1	Region 7	2,053	51.7
Region 1	Region 8	578	70.2
TOTAL SHIPMENTS		5,393	
STORAGE		(4,453)	
North Dakota		0	
STORAGE		(1,030)	
TOTAL COST =	$5,475,642		

TABLE 16. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL I, PHASE II, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	226	86.0
Washington	Nevada	29	59.3
TOTAL SHIPMENTS		255	
STORAGE		(0)	
Oregon	California	137	64.0
STORAGE		(0)	
Montana	California	93	81.3
Montana	Idaho	37	34.4
TOTAL SHIPMENTS		130	
STORAGE		(0)	
Nebraska	California	417	99.8
Nebraska	Utah	58	62.8
Nebraska	Wyoming	18	34.8
Nebraska	Colorado	114	36.2
Nebraska	New Mexico	59	55.5

-continued-

TABLE 16. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL I, PHASE II, RATE SYSTEM V - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Nebraska	Kansas	124	25.8
Nebraska	Oklahoma	136	33.6
Nebraska	Texas	616	55.2
Nebraska	Region 2	847	36.9
Nebraska	Region 3	643	62.0
Nebraska	Region 5	501	55.5
Nebraska	Region 9	758	74.8
TOTAL SHIPMENTS		4,291	
STORAGE		(908)	
Region 1	Arizona	98	97.8
Region 1	South Dakota	37	27.2
Region 1	Region 4	1,495	45.5
Region 1	Region 6	613	75.5
Region 1	Region 7	2,062	51.7
Region 1	Region 8	594	70.2
TOTAL SHIPMENTS		4,899	
STORAGE		(4,460)	
North Dakota		0	
STORAGE		(1,083)	
TOTAL COST =	$5,626,393		

TABLE 17. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL I, PHASE II, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	244	86.0
Washington	Nevada	32	59.3
TOTAL SHIPMENTS		276	
STORAGE		(0)	
Oregon	California	183	64.0
STORAGE		(0)	
Montana	California	108	81.3
Montana	Idaho	39	34.4
TOTAL SHIPMENTS		147	
STORAGE		(0)	
Nebraska	California	226	99.8
Nebraska	Utah	62	62.8
Nebraska	Wyoming	18	34.8
Nebraska	Colorado	120	36.2
Nebraska	New Mexico	62	55.5
Nebraska	Kansas	123	25.8
Nebraska	Oklahoma	136	33.6
Nebraska	Texas	640	55.2
Nebraska	Region 2	857	36.9
Nebraska	Region 3	658	62.0
Nebraska	Region 5	510	55.5
Nebraska	Region 9	807	74.8
TOTAL SHIPMENTS		4,219	
STORAGE		(2,165)	
Region 1	Arizona	109	97.8
Region 1	South Dakota	36	27.2
Region 1	Region 4	1,515	45.5

-continued-

TABLE 17. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL I, PHASE II, RATE SYSTEM V - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Region 1	Region 6	640	75.5
Region 1	Region 7	2,090	51.7
Region 1	Region 8	614	70.2
TOTAL SHIPMENTS		5,004	
STORAGE		(4,254)	
North Dakota		0	
STORAGE		(1,133)	
TOTAL COST =	$5,637,820		

SECTION C

Model II, Phase I
Rate Systems IV and V

TABLE 18. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1965, MODEL II, PHASE I, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	167	51.5
Montana	Oregon	109	65.0
Montana	California	911	102.5
Montana	Nevada	24	105.5
Montana	Idaho	39	50.5
Montana	Arizona	90	131.0
Montana	West Coast Export	69	89.0
TOTAL SHIPMENTS		1,409	
STORAGE		(139)	
South Dakota	Utah	56	80.4
South Dakota	Region 7	1,087	104.5
TOTAL SHIPMENTS		1,143	
STORAGE		(0)	
Region 1	Region 7	674	71.0
STORAGE		(0)	
North Dakota	Wyoming	19	68.5
North Dakota	Colorado	110	68.5
North Dakota	New Mexico	57	112.5
North Dakota	Nebraska	82	80.5
North Dakota	Kansas	127	112.5
North Dakota	Oklahoma	138	111.0
North Dakota	Texas	596	113.0
North Dakota	Region 2	852	81.5
North Dakota	Region 3	636	132.5
North Dakota	Region 4	1,499	103.0
North Dakota	Region 5	495	134.5
North Dakota	Region 6	627	127.5
North Dakota	Region 7	292	144.5
North Dakota	Region 8	578	115.5
North Dakota	Region 9	717	158.5
North Dakota	Great Lakes Export	4,834	61.0
North Dakota	East Coast Export	6,417	130.8
North Dakota	Gulf Export	3,507	91.2
TOTAL SHIPMENTS		21,583	
STORAGE		(10,825)	
TOTAL COST =	$25,475,254		

TABLE 19. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL II, PHASE I, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	167	51.5
Montana	Oregon	112	65.0
Montana	California	982	102.5
Montana	Nevada	29	105.5
Montana	Idaho	39	50.5
Montana	Arizona	98	131.0
Montana	West Coast Export	121	89.0
TOTAL SHIPMENTS		1,548	
STORAGE		(0)	
South Dakota	Kansas	18	74.0
South Dakota	Region 7	1,126	104.5
TOTAL SHIPMENTS		1,144	
STORAGE		(0)	
Region 1	Region 7	936	71.0
STORAGE		(0)	

-continued-

TABLE 19. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL II, PHASE I, RATE SYSTEM IV - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Wyoming	18	68.5
North Dakota	Colorado	114	68.5
North Dakota	New Mexico	59	112.5
North Dakota	Nebraska	80	80.5
North Dakota	Kansas	106	112.5
North Dakota	Oklahoma	136	111.0
North Dakota	Texas	616	113.0
North Dakota	Region 2	847	81.5
North Dakota	Region 3	643	132.5
North Dakota	Region 4	1,495	103.0
North Dakota	Region 5	501	134.5
North Dakota	Region 6	613	127.5
North Dakota	Region 8	594	115.5
North Dakota	Region 9	758	158.5
North Dakota	West Coast Export	404	95.9
North Dakota	Great Lakes Export	18,441	61.0
North Dakota	East Coast Export	3,586	130.8
North Dakota	Gulf Export	1,326	91.2
TOTAL SHIPMENTS		30,337	
STORAGE		(2,072)	
TOTAL COST =	$28,455,046		

TABLE 20. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL II, PHASE I, RATE SYSTEM IV

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	169	51.5
Montana	Oregon	115	65.0
Montana	California	1,090	102.5
Montana	Nevada	32	105.5
Montana	Idaho	39	50.5
Montana	Arizona	103	131.0
TOTAL SHIPMENTS		1,548	
STORAGE		(0)	
South Dakota	Region 7	1,145	104.5
STORAGE		(0)	
Region 1	Region 7	935	71.0
STORAGE		(0)	
North Dakota	Arizona	6	145.5
North Dakota	Wyoming	18	68.5
North Dakota	Colorado	120	68.5
North Dakota	New Mexico	62	112.5
North Dakota	Nebraska	79	80.5
North Dakota	Kansas	123	112.5
North Dakota	Oklahoma	136	111.0
North Dakota	Texas	640	113.0
North Dakota	Region 2	857	81.5
North Dakota	Region 3	658	132.5
North Dakota	Region 4	1,515	103.0
North Dakota	Region 5	510	134.5
North Dakota	Region 6	640	127.5
North Dakota	Region 7	10	144.5
North Dakota	Region 8	614	115.5
North Dakota	Region 9	807	158.5

-continued-

TABLE 20. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL II, PHASE I, RATE SYSTEM IV - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	West Coast Export	525	95.9
North Dakota	Great Lakes Export	17,763	61.0
North Dakota	East Coast Export	3,586	130.8
North Dakota	Gulf Export	3,586	91.2
TOTAL SHIPMENTS		32,255	
STORAGE		(155)	
TOTAL COST =	$30,512,180		

TABLE 21. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1965, MODEL II, PHASE I, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	167	51.2
Montana	Oregon	109	57.5
Montana	California	911	81.2
Montana	Nevada	24	57.1
Montana	Idaho	39	34.4
Montana	Utah	56	45.0
Montana	Arizona	90	89.6
Montana	Wyoming	19	41.9
Montana	Colorado	64	44.6
TOTAL SHIPMENTS		1,479	
STORAGE		(0)	
South Dakota	Nebraska	82	28.3
South Dakota	Kansas	127	40.6
South Dakota	Oklahoma	138	48.3
South Dakota	Texas	160	69.5
South Dakota	Region 3	636	75.6
TOTAL SHIPMENTS		1,143	
STORAGE		(0)	
Region 1	Gulf Export	674	30.3
STORAGE		(0)	
North Dakota	Colorado	46	61.4
North Dakota	New Mexico	57	83.2
North Dakota	Texas	436	84.9
North Dakota	Region 2	852	62.5
North Dakota	Region 4	1,499	67.3
North Dakota	Region 5	495	79.4
North Dakota	Region 6	627	98.9
North Dakota	Region 7	2,053	75.3
North Dakota	Region 8	578	93.9
North Dakota	Region 9	717	99.5
North Dakota	Great Lakes Export	4,834	47.5
North Dakota	East Coast Export	6,417	94.4
North Dakota	Gulf Export	2,833	76.8
TOTAL SHIPMENTS		21,444	
STORAGE		(10,964)	
TOTAL COST =	$18,352,874		

TABLE 22. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1970, MODEL II, PHASE I, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	California	982	81.2
Montana	Nevada	29	57.1
Montana	Idaho	39	34.4
Montana	Arizona	98	89.6
Montana	West Coast Export	400	68.8
TOTAL SHIPMENTS		1,548	
STORAGE		(0)	
South Dakota	Wyoming	18	43.8
South Dakota	Nebraska	80	28.3
South Dakota	Kansas	124	40.6
South Dakota	Oklahoma	136	48.3
South Dakota	Texas	143	69.5
South Dakota	Region 3	643	75.6
TOTAL SHIPMENTS		1,144	
STORAGE		(0)	
Region 1	Gulf Export	936	30.3
STORAGE		(0)	
North Dakota	Washington	167	58.5
North Dakota	Oregon	112	75.3
North Dakota	Colorado	114	61.4
North Dakota	New Mexico	59	83.2
North Dakota	Texas	473	84.9
North Dakota	Region 2	847	62.5
North Dakota	Region 4	1,495	67.3
North Dakota	Region 5	501	79.4
North Dakota	Region 6	613	98.9
North Dakota	Region 7	2,062	75.3
North Dakota	Region 8	594	93.9
North Dakota	Region 9	758	99.5
North Dakota	West Coast Export	125	88.4
North Dakota	Great Lakes Export	18,441	47.4
North Dakota	East Coast Export	3,586	94.4
North Dakota	Gulf Export	390	76.8
TOTAL SHIPMENTS		30,337	
STORAGE		(2,072)	
TOTAL COST =	$20,849,177		

TABLE 23. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL II, PHASE I, RATE SYSTEM V

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	California	1,090	81.2
Montana	Nevada	32	57.1
Montana	Idaho	39	34.4
Montana	Arizona	109	89.6
Montana	West Coast Export	278	68.8
TOTAL SHIPMENTS		1,548	
STORAGE		(0)	
South Dakota	Nebraska	79	28.3
South Dakota	Wyoming	18	43.8
South Dakota	Kansas	123	40.6
South Dakota	Oklahoma	136	48.3
South Dakota	Texas	131	69.5
South Dakota	Region 3	658	75.6
TOTAL SHIPMENTS		1,145	
STORAGE		(0)	

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TABLE 23. LEAST-COST DISTRIBUTION OF DURUM FLOUR, 1975, MODEL II, PHASE I, RATE SYSTEM V - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Region 1	Gulf Export	935	30.3
STORAGE		(0)	
North Dakota	Washington	169	58.5
North Dakota	Oregon	115	75.3
North Dakota	Colorado	120	61.4
North Dakota	New Mexico	62	83.2
North Dakota	Texas	509	84.9
North Dakota	Region 2	857	62.5
North Dakota	Region 4	1,515	67.3
North Dakota	Region 5	510	79.4
North Dakota	Region 6	640	98.9
North Dakota	Region 7	2,090	75.3
North Dakota	Region 8	614	93.9
North Dakota	Region 9	807	99.5
North Dakota	West Coast Export	247	88.4
North Dakota	Great Lakes Export	17,763	47.4
North Dakota	East Coast Export	3,586	94.4
North Dakota	Gulf Export	2,651	76.8
TOTAL SHIPMENTS		32,255	
STORAGE		(155)	
TOTAL COST =	$22,571,789		

SECTION D

Model III, Phase I
Rate Systems I, II, and III

TABLE 24. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL III, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	229	51.5
Montana	Oregon	149	65.0
Montana	California	1,248	102.5
Montana	Nevada	32	82.4
Montana	Idaho	53	50.5
Montana	Utah	76	51.1
Montana	Arizona	122	117.2
Montana	West Coast Export	95	65.0
TOTAL SHIPMENTS		2,004	
STORAGE		(116)	
South Dakota	Colorado	150	53.5
South Dakota	Nebraska	112	40.0
South Dakota	Kansas	173	59.7
South Dakota	Texas	815	58.4
South Dakota	Region 2	244	69.0
South Dakota	Region 5	71	58.8
TOTAL SHIPMENTS		1,565	
STORAGE		(0)	
Region 1	Region 2	923	12.0
STORAGE		(0)	
North Dakota	Wyoming	25	59.6
North Dakota	New Mexico	78	112.5
North Dakota	Oklahoma	188	46.4
North Dakota	Region 3	871	66.6
North Dakota	Region 4	2,053	92.0
North Dakota	Region 5	607	74.7
North Dakota	Region 6	860	127.0
North Dakota	Region 7	2,813	69.5
North Dakota	Region 8	792	122.0
North Dakota	Region 9	982	80.0
North Dakota	Great Lakes Export	6,622	44.5
North Dakota	East Coast Export	8,790	95.5
North Dakota	Gulf Export	4,804	66.6
TOTAL SHIPMENTS		29,485	
STORAGE		(14,910)	
TOTAL COST =	$25,225,189		

TABLE 25. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL III, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	228	51.5
Montana	Oregon	153	65.0
Montana	California	1,346	102.5
Montana	Nevada	40	82.4
Montana	Idaho	53	50.5
Montana	Utah	80	51.1
Montana	Arizona	135	117.2
TOTAL SHIPMENTS		2,035	
STORAGE		(0)	
South Dakota	Colorado	157	53.5
South Dakota	Nebraska	107	40.0
South Dakota	Kansas	170	59.7
South Dakota	Texas	844	58.4
South Dakota	Region 5	290	58.8
TOTAL SHIPMENTS		1,568	
STORAGE		(0)	

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TABLE 25. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL III, PHASE I, RATE SYSTEM I - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Region 1	Region 2	1,161	12.0
Region 1	Region 4	122	24.2
TOTAL SHIPMENTS		1,283	
STORAGE		(0)	
North Dakota	Wyoming	25	59.6
North Dakota	New Mexico	80	112.5
North Dakota	Oklahoma	187	46.4
North Dakota	Region 3	881	66.6
North Dakota	Region 4	1,926	92.0
North Dakota	Region 5	396	74.7
North Dakota	Region 6	840	127.0
North Dakota	Region 7	2,825	69.5
North Dakota	Region 8	814	122.0
North Dakota	Region 9	1,038	80.0
North Dakota	West Coast Export	633	70.0
North Dakota	Great Lakes Export	25,261	44.5
North Dakota	East Coast Export	4,912	95.5
North Dakota	Gulf Export	1,817	66.6
TOTAL SHIPMENTS		41,635	
STORAGE		(2,761)	
TOTAL COST =	$28,214,510		

TABLE 26. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL III, PHASE I, RATE SYSTEM I

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	232	51.5
Montana	Oregon	157	65.0
Montana	California	1,498	102.5
Montana	Nevada	44	82.4
Montana	Idaho	53	50.5
Montana	Utah	85	51.1
Montana	Arizona	56	117.2
TOTAL SHIPMENTS		2,120	
STORAGE		(0)	
South Dakota	Colorado	164	53.5
South Dakota	Nebraska	110	40.0
South Dakota	Kansas	168	59.7
South Dakota	Texas	875	58.4
South Dakota	Region 5	252	58.8
TOTAL SHIPMENTS		1,569	
STORAGE		(0)	
Region 1	Region 2	1,174	12.0
Region 1	Region 4	107	24.2
TOTAL SHIPMENTS		1,281	
STORAGE		(0)	
North Dakota	Arizona	99	145.0
North Dakota	Wyoming	25	59.6
North Dakota	New Mexico	85	112.5
North Dakota	Oklahoma	186	46.4
North Dakota	Region 3	901	66.6
North Dakota	Region 4	1,969	92.0
North Dakota	Region 5	447	74.7
North Dakota	Region 6	876	127.0
North Dakota	Region 7	2,863	69.5
North Dakota	Region 8	842	122.0

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TABLE 26. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL III, PHASE I, RATE SYSTEM I - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Region 9	1,106	80.0
North Dakota	West Coast Export	719	70.0
North Dakota	Great Lakes Export	25,261	44.5
North Dakota	East Coast Export	4,912	95.5
North Dakota	Gulf Export	1,817	66.6
TOTAL SHIPMENTS		42,108	
STORAGE		(2,290)	
TOTAL COST =	$28,684,978		

TABLE 27. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL III, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	229	38.8
Montana	Oregon	149	52.0
Montana	California	1,248	71.6
Montana	Nevada	32	51.7
Montana	Idaho	53	33.1
Montana	Utah	76	41.8
Montana	Arizona	122	78.7
Montana	Wyoming	25	39.3
Montana	Colorado	91	42.9
Montana	West Coast Export	95	50.2
TOTAL SHIPMENTS		2,120	
STORAGE		(0)	
South Dakota	Colorado	59	43.2
South Dakota	New Mexico	78	61.3
South Dakota	Nebraska	112	28.1
South Dakota	Kansas	173	38.2
South Dakota	Oklahoma	188	44.7
South Dakota	Region 4	163	50.0
South Dakota	Region 8	792	70.6
TOTAL SHIPMENTS		1,565	
STORAGE		(0)	
Region 1	Texas	815	29.8
Region 1	Great Lakes Export	108	13.8
TOTAL SHIPMENTS		923	
STORAGE		(0)	
North Dakota	Region 2	1,167	46.0
North Dakota	Region 3	871	56.1
North Dakota	Region 4	1,890	58.2
North Dakota	Region 5	678	64.2
North Dakota	Region 6	860	84.4
North Dakota	Region 7	2,813	65.5
North Dakota	Region 9	982	70.0
North Dakota	Great Lakes Export	6,514	34.6
North Dakota	East Coast Export	8,790	68.9
North Dakota	Gulf Export	4,804	56.1
TOTAL SHIPMENTS		29,369	
STORAGE		(15,026)	
TOTAL COST =	$19,264,998		

TABLE 28. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL III, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	228	38.8
Montana	Oregon	153	52.0
Montana	California	1,346	71.6
Montana	Nevada	40	51.7
Montana	Idaho	53	33.1
Montana	Utah	80	41.8
Montana	Arizona	135	78.7
TOTAL SHIPMENTS		2,035	
STORAGE		(0)	
South Dakota	Wyoming	25	40.8
South Dakota	Colorado	157	43.2
South Dakota	New Mexico	80	61.3
South Dakota	Nebraska	107	28.1
South Dakota	Kansas	170	38.2
South Dakota	Oklahoma	187	44.7
South Dakota	Region 4	28	50.0
South Dakota	Region 8	814	70.6
TOTAL SHIPMENTS		1,568	
STORAGE		(0)	
Region 1	Texas	844	29.8
Region 1	Great Lakes Export	439	13.8
TOTAL SHIPMENTS		1,238	
STORAGE		(0)	
North Dakota	Region 2	1,161	46.0
North Dakota	Region 3	881	56.1
North Dakota	Region 4	2,020	58.2
North Dakota	Region 5	686	64.2
North Dakota	Region 6	840	84.4
North Dakota	Region 7	2,825	65.5
North Dakota	Region 9	1,038	70.0
North Dakota	West Coast Export	633	64.5
North Dakota	Great Lakes Export	24,822	34.6
North Dakota	East Coast Export	4,912	68.9
North Dakota	Gulf Export	1,817	56.1
TOTAL SHIPMENTS		41,635	
STORAGE		(2,761)	
TOTAL COST =	$21,816,373		

TABLE 29. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL III, PHASE I, RATE SYSTEM II

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	232	38.8
Montana	Oregon	58	52.0
Montana	California	1,493	71.6
Montana	Nevada	44	51.7
Montana	Idaho	53	33.1
Montana	Utah	85	41.8
Montana	Arizona	155	78.7
TOTAL SHIPMENTS		2,120	
STORAGE		(0)	
South Dakota	Wyoming	25	40.8
South Dakota	Colorado	164	43.2
South Dakota	New Mexico	85	61.3
South Dakota	Nebraska	110	28.1

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TABLE 29. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL III, PHASE I, RATE SYSTEM II - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Kansas	168	38.2
South Dakota	Oklahoma	186	44.7
South Dakota	Region 8	831	70.6
TOTAL SHIPMENTS		1,569	
STORAGE		(0)	
Region 1	Texas	875	29.8
Region 1	Great Lakes Export	406	13.8
TOTAL SHIPMENTS		1,281	
STORAGE		(0)	
North Dakota	Oregon	99	66.9
North Dakota	Region 2	1,174	46.0
North Dakota	Region 3	901	56.1
North Dakota	Region 4	2,076	58.2
North Dakota	Region 5	699	64.2
North Dakota	Region 6	876	84.4
North Dakota	Region 7	2,863	65.5
North Dakota	Region 8	11	80.4
North Dakota	Region 9	1,106	70.0
North Dakota	West Coast Export	719	64.5
North Dakota	Great Lakes Export	24,855	34.6
North Dakota	East Coast Export	4,912	68.9
North Dakota	Gulf Export	1,817	56.1
TOTAL SHIPMENTS		42,108	
STORAGE		(2,290)	
TOTAL COST =	$22,166,170		

TABLE 30. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL III, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	229	37.8
Montana	Oregon	149	51.4
Montana	California	1,248	71.5
Montana	Nevada	32	51.0
Montana	Idaho	53	26.0
Montana	Utah	76	40.8
Montana	Arizona	122	78.9
Montana	Colorado	116	40.3
Montana	West Coast Export	95	51.4
TOTAL SHIPMENTS		2,120	
STORAGE		(0)	
South Dakota	Wyoming	25	39.8
South Dakota	Colorado	34	42.3
South Dakota	New Mexico	78	60.9
South Dakota	Nebraska	112	26.9
South Dakota	Kansas	173	37.3
South Dakota	Oklahoma	188	44.0
South Dakota	Texas	815	61.5
South Dakota	Region 8	140	69.3
TOTAL SHIPMENTS		1,565	
STORAGE		(0)	
Region 1	Region 3	871	22.1
Region 1	Region 5	52	30.2
TOTAL SHIPMENTS		923	
STORAGE		(0)	

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TABLE 30. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1965, MODEL III, PHASE I, RATE SYSTEM III - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Region 2	1,167	44.9
North Dakota	Region 4	2,053	57.1
North Dakota	Region 5	626	63.1
North Dakota	Region 6	860	82.8
North Dakota	Region 7	2,813	64.1
North Dakota	Region 8	652	78.8
North Dakota	Region 9	982	68.9
North Dakota	Great Lakes Export	6,622	33.5
North Dakota	East Coast Export	8,790	67.5
North Dakota	Gulf Export	4,804	45.0
TOTAL SHIPMENTS		29,369	
STORAGE		(15,026)	
TOTAL COST =	$18,463,101		

TABLE 31. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1970, MODEL III, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	228	37.8
Montana	Oregon	153	51.4
Montana	California	1,346	71.5
Montana	Nevada	40	51.0
Montana	Idaho	53	26.0
Montana	Utah	80	40.8
Montana	Arizona	135	78.9
Montana	Colorado	2	40.3
Montana	West Coast Export	84	51.4
TOTAL SHIPMENTS		2,121	
STORAGE		(0)	
South Dakota	Wyoming	25	39.8
South Dakota	Colorado	155	42.3
South Dakota	New Mexico	80	60.9
South Dakota	Nebraska	107	26.9
South Dakota	Kansas	170	37.3
South Dakota	Oklahoma	187	44.0
South Dakota	Texas	844	61.5
TOTAL SHIPMENTS		1,568	
STORAGE		(0)	
Region 1	Region 3	245	22.1
STORAGE		(1,283)	
North Dakota	Region 2	1,161	44.9
North Dakota	Region 3	636	55.0
North Dakota	Region 4	2,048	57.1
North Dakota	Region 5	686	63.1
North Dakota	Region 6	840	82.8
North Dakota	Region 7	2,825	64.1
North Dakota	Region 8	814	78.8
North Dakota	West Coast Export	635	64.4
North Dakota	Great Lakes Export	25,261	33.5
North Dakota	East Coast Export	4,912	67.5
North Dakota	Gulf Export	1,817	45.0
TOTAL SHIPMENTS		41,635	
STORAGE		(2,761)	
TOTAL COST =	$21,204,719		

TABLE 32. LEAST-COST DISTRIBUTION OF DURUM WHEAT, 1975, MODEL III, PHASE I, RATE SYSTEM III

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Washington	232	37.8
Montana	Oregon	58	51.4
Montana	California	1,493	71.5
Montana	Nevada	44	51.0
Montana	Idaho	53	26.0
Montana	Utah	85	40.8
Montana	Arizona	155	78.9
TOTAL SHIPMENTS		2,120	
STORAGE		(0)	
South Dakota	Wyoming	25	39.8
South Dakota	Colorado	120	42.3
South Dakota	New Mexico	85	60.9
South Dakota	Nebraska	110	26.9
South Dakota	Kansas	168	37.3
South Dakota	Oklahoma	186	44.0
South Dakota	Texas	875	61.5
TOTAL SHIPMENTS		1,569	
STORAGE		(0)	
Region 1	Region 3	901	22.1
Region 1	Region 5	380	30.2
TOTAL SHIPMENTS		1,281	
STORAGE		(0)	
North Dakota	Oregon	99	66.9
North Dakota	Colorado	44	55.1
North Dakota	Region 2	1,174	44.9
North Dakota	Region 4	2,076	57.1
North Dakota	Region 5	319	63.1
North Dakota	Region 6	876	82.8
North Dakota	Region 7	2,863	64.1
North Dakota	Region 8	842	78.8
North Dakota	Region 9	1,106	68.9
North Dakota	West Coast Export	719	64.4
North Dakota	Great Lakes Export	25,261	33.5
North Dakota	East Coast Export	4,912	67.5
North Dakota	Gulf Export	1,817	45.0
TOTAL SHIPMENTS		42,108	
STORAGE		(2,290)	
TOTAL COST =	$21,554,453		

SUMMARY AND CONCLUSIONS

The largest market outlets for North Dakota's durum wheat-grain appear to be the export markets under an optimum or least-cost distribution system (Sections A, B, C, and D; Tables 3-32). This was true regardless of the location of flour mills, rate system used, and time period of analysis (Tables 33, 34, 35). The Great Lakes export market, in particular, accounts for a very large share in the years 1970 and 1975.

TABLE 33. NORTH DAKOTA'S WHEAT-GRAIN MARKET SHARE UNDER TRANSPORTATION RATE SYSTEMS I, II, AND III, MODEL I, 1965, 1970, AND 1975

Rate System	Year	Market Share
		000 hundredweight
I	1965	35,385
	1970	48,408
	1975	46,473
II	1965	35,385
	1970	48,408
	1975	46,473
III	1965	35,385
	1970	48,408
	1975	46,473

TABLE 34. NORTH DAKOTA'S WHEAT-GRAIN MARKET SHARE UNDER TRANSPORTATION RATE SYSTEMS I AND IV, BY FLOUR MILL LOCATIONS, 1965, 1970, AND 1975

Flour Mill Location	Model and Phase	Market Share		
		1965	1970	1975
		000 hundredweight		
in present location	Model I, Phase I	77	79	85
	Model I, Phase II	35,385	48,408	46,473
		35,462	48,487	46,558
in wheat producing location	Model II, Phase I	29,566	41,558	44,189
in flour consuming location	Model III, Phase I	29,485	41,635	42,108

TABLE 35. NORTH DAKOTA'S WHEAT-GRAIN MARKET SHARE UNDER TRANSPORTATION RATE SYSTEMS II AND V, BY FLOUR MILL LOCATIONS, 1965, 1970, AND 1975

Flour Mill Location	Model and Phase	Market Share		
		1965	1970	1975
		000 hundredweight		
in present location	Model I, Phase I	0	0	0
	Model I, Phase II	35,385	48,408	46,473
		35,385	48,408	46,473
in wheat producing location	Model II, Phase I	29,378	41,558	44,189
in flour consuming location	Model III, Phase I	29,369	41,635	42,108

The market outlets for North Dakota's durum wheat-flour appear to be quite scattered. The location of the mills in wheat producing areas provided the largest wheat-flour market outlets for North Dakota.

A change from the existing rail rate structure to a rail rate structure based on fully distributed costs would not be advantageous to North Dakota in terms of market gain. Such a change would lose all of North Dakota's flour market. This was true for all years analyzed (Table 36).

TABLE 36. NORTH DAKOTA'S WHEAT-FLOUR MARKET SHARE UNDER TRANSPORTATION RATE SYSTEMS IV AND V, MODEL I, 1965, 1970, AND 1975

Rate System	Year	Market Share
		000 hundredweight
IV	1965	56
	1970	58
	1975	62
V	1965	0
	1970	0
	1975	0

Under Rate System I, North Dakota's market share of wheat-grain did change when changing locations and demands of flour mills (Table 34).

In 1965, 1970, and 1975, the market share of North Dakota decreased when assuming flour mill locations to be located in both flour consuming and wheat producing areas. Therefore, the existing locations and demands of flour mills provided North Dakota with its largest market share of durum wheat. These conditions were also revealed when applying the data to Rate Systems II and V (Table 35).

Overall, North Dakota's market share of wheat-grain and wheat-flour was the greatest in 1965, 1970, and 1975, under Rate System I (existing rail rates) when flour mills were located in their existing locations.

In looking at total distribution costs for all durum wheat and flour in the United States for 1965 and 1970, it was found that the least-cost distribution occurred when flour mills were located in production areas while flour shipments were based on Rate System V and export shipments were based on Rate System II. In 1975 the least-cost distribution occurred when flour mills were located in flour consuming areas and wheat-grain shipments were based on Rate System II. However, the total distribution costs when flour mills were located in production areas for this year were slightly more than when mills were located in flour consuming areas (Table 37).

The conclusion can be simply explained. It costs less to ship flour than wheat when basing rail rates on costs. But it does not cost less to ship flour than wheat when using existing rail rates.

In summary, the least-cost distribution for 1965 was when flour mills were located in wheat producing areas and rail rates for wheat-grain and wheat-flour were based on fully distributed costs. However, North Dakota would have the largest market share of wheat-grain and wheat-flour when flour mills were assumed to be in their present locations. The same was true for the year 1970.

The least-cost distribution for 1975 was when flour mills were located in flour consuming areas and rail rates were based on fully distributed costs. In this case, the assumed decrease in exports may have a significant influence on changes in the optimum location of mills. On the other hand, the advantage of locating mills in wheat producing areas still exists if rail rates were based on fully distributed costs. North Dakota would gain the largest market share of wheat-grain and wheat-flour when flour mills were located in existing locations.

Whether or not it would be economically feasible to locate flour mills in wheat producing areas would also depend upon the amount of investment lost by relocating flour mills. This would be highly dependent upon the savings in distribution costs relative to the costs of relocation.

TABLE 37. TOTAL DISTRIBUTION COST ANALYSIS OF DURUM WHEAT IN THE UNITED STATES UNDER TRANSPORTATION RATE SYSTEMS I, II, III, IV, AND V, 1965, 1970, AND 1975

Model and Phase	1965		1970		1975	
	Rate Systems I and IV	Rate Systems II and V	Rate Systems I and IV	Rate Systems II and V	Rate Systems I and IV	Rate Systems II and V
	dollars					
Model I						
Phase I	15,443,130	17,424,300	24,107,698	20,406,666	16,746,696	19,886,342
	--	(16,515,827)[a]	--	(19,667,089)	--	(19,170,441)
Phase II	6,673,093	5,475,642	6,843,649	5,626,393	6,817,243	5,637,820
	22,116,223	22,899,942	30,951,347	26,033,059	23,563,939	25,524,162
Model II						
Phase I	25,475,254	18,352,874	28,455,046	20,849,177	30,512,180	22,571,789
Model III						
Phase I	25,225,189	19,264,998	28,214,510	21,816,373	28,684,978	22,166,170
	--	(18,463,101)	--	(21,204,719)	--	(21,554,453)

[a]All figures in parentheses indicate cost calculated under Rate System III. However, they were not used in calculating total costs.