OPTIMUM DISTRIBUTION PATTERNS FOR HARD RED SPRING WHEAT AND FLOUR

By

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

BY

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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 Durum Wheat and Flour in Domestic and Export Markets, 1965, and Projected to 1970 and 1975, UGPTI Report No. 3

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 HARD RED SPRING 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.

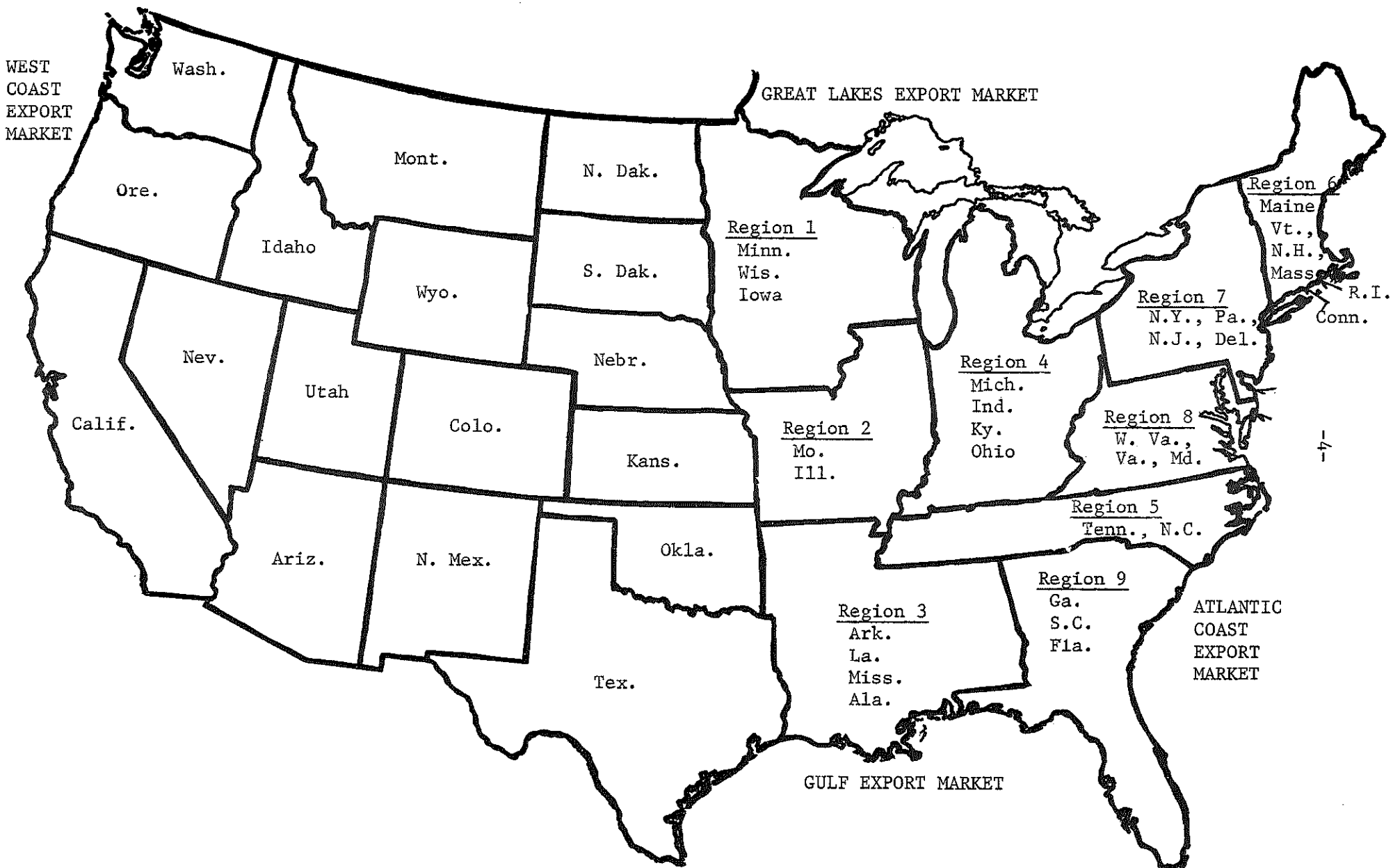

Figure 1. United States Wheat and Flour Marketing Areas.

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.

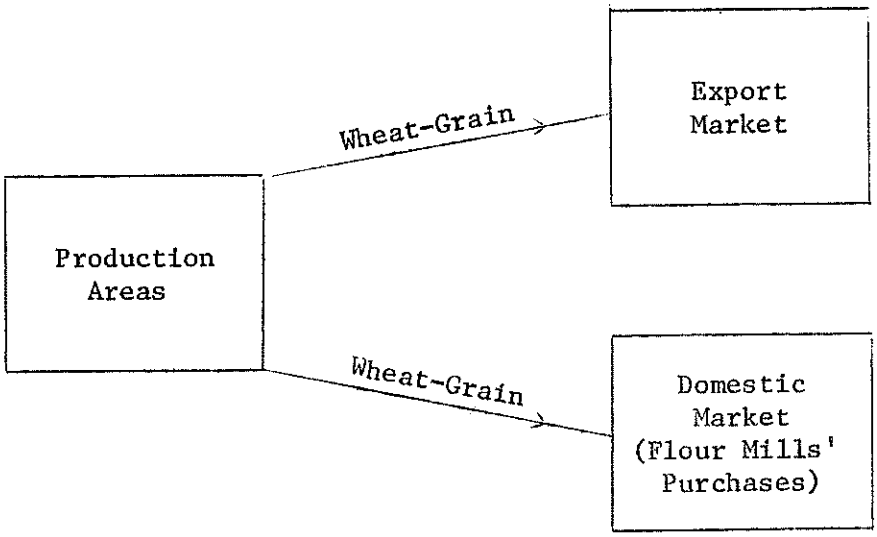
This analysis was performed through the use of three models illustrated as follows:

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).

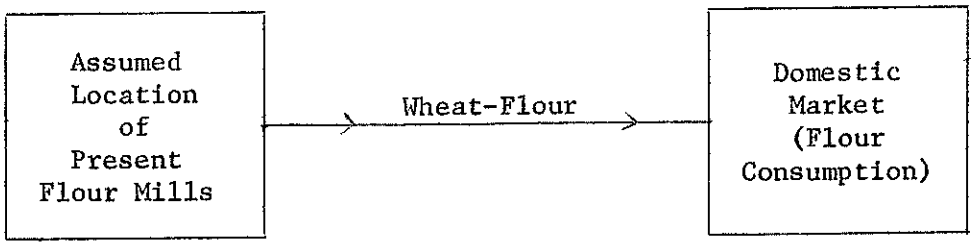
Model II. Model II consisted of only one phase which was wheat-grain going to the export markets and wheat-flour going to the consumption areas. Flour mills were assumed to be located in the production areas (Figure 3).

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

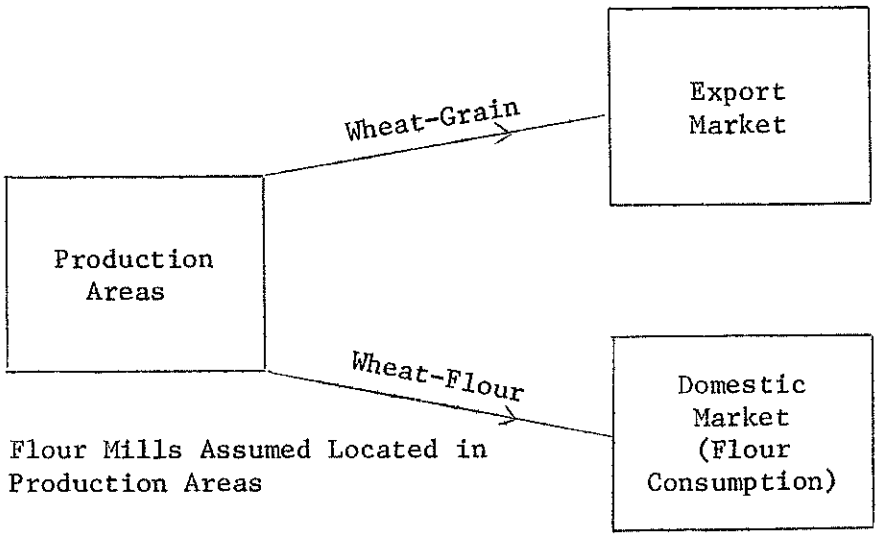


Figure 3. Wheat-Grain and Wheat-Flour Market Flow Chart for Model II, Phase I.

Model III, Phase I

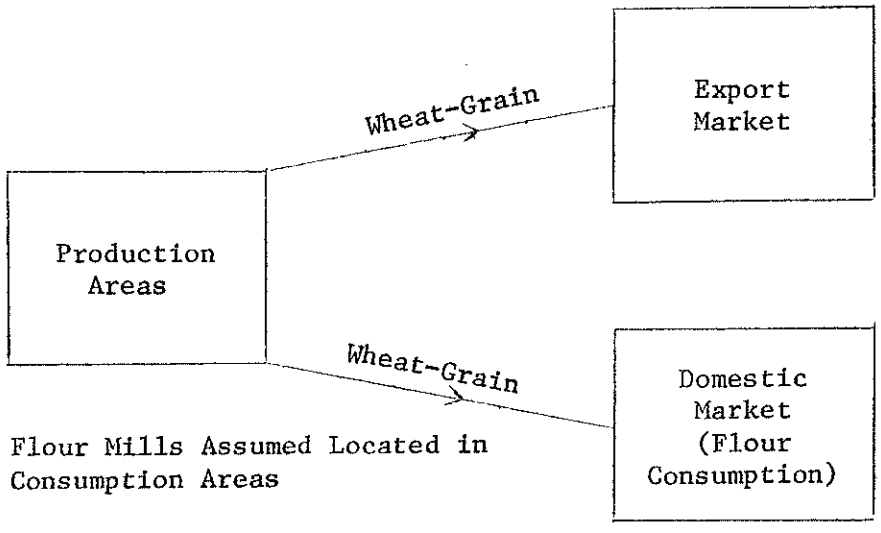


Figure 4. Wheat-Grain Market Flow Chart for Model III, Phase I.

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 hard red spring 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 hard red spring wheat and flour.

SECTION A

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

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	Oregon	1,397	44.6
Idaho	California	1,361	59.1
Idaho	West Coast Export	3,406	44.6
TOTAL SHIPMENTS		6,164	
STORAGE		(0)	
Utah	California	231	53.0
STORAGE		(0)	
Montana	West Coast Export	8,551	65.0
Montana	Washington	1,666	51.5
Montana	Oregon	1,397	51.4
TOTAL SHIPMENTS		10,217	
STORAGE		(8,248)	
Wyoming	Region 2	79	69.5
Wyoming	Colorado	79	10.1
TOTAL SHIPMENTS		158	
STORAGE		(0)	
South Dakota	Kansas	1,560	59.7
South Dakota	Texas	90	58.4
South Dakota	Region 1	11,897	28.6
South Dakota	Region 2	1,861	69.0
South Dakota	Gulf Export	349	50.7
TOTAL SHIPMENTS		15,757	
STORAGE		(0)	
North Dakota	Oklahoma	109	46.4
North Dakota	Region 4	1,361	92.0
North Dakota	Region 7	19,514	69.5
North Dakota	Region 8	76	122.0
North Dakota	Region 9	182	80.0
North Dakota	Great Lakes Export	7,701	44.5
North Dakota	East Coast Export	23,762	95.5
North Dakota	Gulf Export	6,304	66.6
TOTAL SHIPMENTS		59,009	
STORAGE		(8,511)	
TOTAL COST =	$60,816,763		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,409	59.1
Idaho	West Coast Export	7,056	44.6
TOTAL SHIPMENTS		8,465	
STORAGE		(0)	
Utah	California	350	53.0
STORAGE		(0)	
Montana	Oregon	1,517	65.0
Montana	West Coast Export	15,042	65.0
Montana	Washington	1,442	51.5
TOTAL SHIPMENTS		18,001	
STORAGE		(0)	
Wyoming	Region 2	102	69.5
Wyoming	Colorado	73	10.0
TOTAL SHIPMENTS		175	
STORAGE		(0)	

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TABLE 4. LEAST-COST DISTRIBUTION OF WHEAT - HARD RED SPRING, 1970, MODEL I, PHASE I, RATE SYSTEM I - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Kansas	2,504	59.7
South Dakota	Texas	113	58.4
South Dakota	Region 1	6,312	28.6
South Dakota	Region 2	1,188	69.0
South Dakota	Region 7	2,710	66.4
South Dakota	Region 8	65	112.0
South Dakota	Region 9	292	64.6
South Dakota	Great Lakes Export	7,354	40.0
South Dakota	Gulf Export	6,428	50.7
TOTAL SHIPMENTS		26,966	
STORAGE		(0)	
North Dakota	Oklahoma	149	46.4
North Dakota	Region 7	17,114	69.5
North Dakota	West Coast Export	20,315	70.0
North Dakota	East Coast Export	12,197	95.5
TOTAL SHIPMENTS		49,775	
STORAGE		(45,884)	
TOTAL COST =	$66,028,874		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,542	59.1
Idaho	West Coast Export	6,927	44.6
Idaho	Oregon	1,640	39.4
TOTAL SHIPMENTS		10,109	
STORAGE		(0)	
Utah	California	350	53.0
STORAGE		(0)	
Montana	Oregon	1,640	65.0
Montana	West Coast Export	15,420	65.0
Montana	Washington	1,218	51.5
TOTAL SHIPMENTS		18,278	
STORAGE		(0)	
Wyoming	Region 2	116	69.5
Wyoming	Colorado	58	10.1
TOTAL SHIPMENTS		174	
STORAGE		(0)	
South Dakota	Kansas	2,473	59.7
South Dakota	Texas	133	58.4
South Dakota	Region 1	5,195	28.6
South Dakota	Region 2	516	69.0
South Dakota	Region 7	4,361	66.4
South Dakota	Region 8	55	112.0
South Dakota	Region 9	431	64.6
South Dakota	Great Lakes Export	7,354	40.0
South Dakota	Gulf Export	6,428	50.7
TOTAL SHIPMENTS		26,946	
STORAGE		(0)	
North Dakota	Oklahoma	175	46.4
North Dakota	Region 7	8,025	69.5
North Dakota	West Coast Export	10,804	70.0
North Dakota	East Coast Export	12,197	95.5
TOTAL SHIPMENTS		31,201	
STORAGE		(64,557)	
TOTAL COST =	$53,691,541		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,361	54.5
Idaho	West Coast Export	3,406	44.6
Idaho	Oregon	1,397	44.6
TOTAL SHIPMENTS		6,164	
STORAGE		(0)	
Utah	California	231	45.6
STORAGE		(0)	
Montana	Region 9	182	63.2
Montana	West Coast Export	8,551	52.0
TOTAL SHIPMENTS		8,733	
STORAGE		(8,066)	
Wyoming	Texas	79	59.8
Wyoming	Colorado	79	10.1
TOTAL SHIPMENTS		158	
STORAGE		(0)	
South Dakota	Kansas	1,560	38.2
South Dakota	Oklahoma	109	44.7
South Dakota	Texas	11	61.9
South Dakota	Region 4	1,361	50.0
South Dakota	Region 7	12,640	57.4
South Dakota	Region 8	76	70.6
TOTAL SHIPMENTS		15,757	
STORAGE		(0)	
North Dakota	Region 1	11,897	34.0
North Dakota	Region 2	1,940	46.0
North Dakota	Region 7	6,874	65.5
North Dakota	Great Lakes Export	7,701	34.6
North Dakota	East Coast Export	23,762	68.9
North Dakota	Gulf Export	6,653	56.1
TOTAL SHIPMENTS		58,827	
STORAGE		(8,693)	
TOTAL COST =	$48,849,895		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,307	54.5
Idaho	West Coast Export	5,641	44.6
Idaho	Oregon	1,517	44.6
TOTAL SHIPMENTS		8,465	
STORAGE		(0)	
Utah	California	350	45.6
STORAGE		(0)	
Montana	West Coast Export	16,559	50.2
Montana	Washington	1,442	38.8
TOTAL SHIPMENTS		18,001	
STORAGE		(0)	
Wyoming	California	102	63.8
Wyoming	Colorado	73	10.1
TOTAL SHIPMENTS		175	
STORAGE		(0)	
South Dakota	Kansas	2,504	38.2
South Dakota	Oklahoma	149	44.7
South Dakota	Texas	113	61.9

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Region 1	4,018	27.0
South Dakota	Region 7	19,824	57.4
South Dakota	Region 8	65	70.6
South Dakota	Region 9	292	63.0
TOTAL SHIPMENTS		26,965	
STORAGE		(0)	
North Dakota	Region 1	2,294	34.0
North Dakota	Region 2	1,289	46.0
North Dakota	West Coast Export	20,213	64.5
North Dakota	Great Lakes Export	7,354	34.6
North Dakota	East Coast Export	12,197	68.9
North Dakota	Gulf Export	6,428	56.1
TOTAL SHIPMENTS		49,775	
STORAGE		(45,884)	
TOTAL COST =	$55,675,742		

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

Origin	Destination	Shipment	Rate
		000 cwt,	cents per cwt.
Idaho	California	1,425	54.5
Idaho	West Coast Export	5,404	44.6
TOTAL SHIPMENTS		6,829	
STORAGE		(0)	
Utah	California	350	45.6
STORAGE		(0)	
Montana	West Coast Export	17,060	50.2
Montana	Washington	1,218	38.8
TOTAL SHIPMENTS		18,278	
STORAGE		(0)	
Wyoming	California	117	63.8
Wyoming	Colorado	58	10.1
TOTAL SHIPMENTS		175	
STORAGE		(0)	
South Dakota	Kansas	2,473	38.2
South Dakota	Oklahoma	175	44.7
South Dakota	Texas	133	61.9
South Dakota	Region 1	5,195	27.0
South Dakota	Region 7	12,386	57.4
South Dakota	Region 8	55	70.6
South Dakota	Region 9	100	63.0
South Dakota	Gulf Export	6,428	49.1
TOTAL SHIPMENTS		26,945	
STORAGE		(0)	
North Dakota	Region 2	632	46.0
North Dakota	Region 9	331	70.0
North Dakota	West Coast Export	10,687	64.5
North Dakota	Great Lakes Export	7,354	34.6
North Dakota	East Coast Export	12,197	68.9
TOTAL SHIPMENTS		31,201	
STORAGE		(64,557)	
TOTAL COST =	$44,362,877		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,361	53.0
Idaho	West Coast Export	3,406	44.6
Idaho	Oregon	1,397	44.6
TOTAL SHIPMENTS		6,164	
STORAGE		(0)	
Utah	California	231	45.0
STORAGE		(0)	
Montana	West Coast Export	8,551	51.4
Montana	Washington	1,666	37.8
TOTAL SHIPMENTS		10,217	
STORAGE		(8,248)	
Wyoming	Texas	79	59.4
Wyoming	Colorado	79	10.1
TOTAL SHIPMENTS		158	
STORAGE		(0)	
South Dakota	Kansas	1,560	37.3
South Dakota	Oklahoma	109	44.0
South Dakota	Texas	11	61.5
South Dakota	Region 7	14,001	56.1
South Dakota	Region 8	76	69.3
TOTAL SHIPMENTS		15,757	
STORAGE		(0)	
North Dakota	Region 1	11,897	32.9
North Dakota	Region 2	1,940	44.9
North Dakota	Region 4	1,361	57.1
North Dakota	Region 7	5,513	64.1
North Dakota	Region 8	182	68.9
North Dakota	Great Lakes Export	7,701	33.5
North Dakota	East Coast Export	23,762	67.5
North Dakota	Gulf Export	6,653	45.0
TOTAL SHIPMENTS		59,009	
STORAGE		(8,511)	
TOTAL COST =	$47,344,055		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,307	53.0
Idaho	West Coast Export	7,158	44.6
TOTAL SHIPMENTS		8,465	
STORAGE		(0)	
Utah	California	350	45.0
STORAGE		(0)	
Montana	West Coast Export	15,042	51.4
Montana	Washington	1,442	37.8
Montana	Oregon	1,517	51.4
TOTAL SHIPMENTS		18,001	
STORAGE		(0)	
Wyoming	California	102	63.4
Wyoming	Colorado	73	10.1
TOTAL SHIPMENTS		175	
STORAGE		(0)	
South Dakota	Kansas	2,504	37.3
South Dakota	Oklahoma	149	44.0

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TABLE 10. LEAST-COST DISTRIBUTION OF WHEAT - HARD RED SPRING, 1970, MODEL I, PHASE I, RATE SYSTEM III - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Texas	113	61.5
South Dakota	Region 1	2,729	25.7
South Dakota	Region 2	1,289	37.2
South Dakota	Region 7	19,824	56.1
South Dakota	Region 8	65	69.3
South Dakota	Region 9	292	61.7
TOTAL SHIPMENTS		26,965	
STORAGE		(0)	
North Dakota	Region 1	3,583	32.9
North Dakota	West Coast Export	20,213	64.4
North Dakota	Great Lakes Export	7,354	33.5
North Dakota	East Coast Export	12,197	67.5
North Dakota	Gulf Export	6,428	45.0
TOTAL SHIPMENTS		49,775	
STORAGE		(45,884)	
TOTAL COST =	$54,482,480		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	1,542	53.0
Idaho	West Coast Export	6,927	44.6
TOTAL SHIPMENTS		8,469	
STORAGE		(0)	
Utah	California	350	45.0
STORAGE		(0)	
Montana	California	1,425	71.5
Montana	West Coast Export	13,995	51.4
Montana	Washington	1,218	37.8
Montana	Oregon	1,640	51.4
TOTAL SHIPMENTS		18,278	
STORAGE		(0)	
Wyoming	California	117	63.4
Wyoming	Colorado	58	10.1
TOTAL SHIPMENTS		175	
STORAGE		(0)	
South Dakota	Kansas	2,473	37.3
South Dakota	Oklahoma	175	44.0
South Dakota	Texas	133	61.5
South Dakota	Region 1	5,195	25.7
South Dakota	Region 2	632	37.2
South Dakota	Region 7	12,386	56.1
South Dakota	Region 8	55	69.3
South Dakota	Region 9	431	61.7
South Dakota	Great Lakes Export	5,465	29.7
TOTAL SHIPMENTS		26,965	
STORAGE		(0)	
North Dakota	West Coast Export	10,687	64.4
North Dakota	Great Lakes Export	1,889	33.5
North Dakota	East Coast Export	12,197	67.5
North Dakota	Gulf Export	6,428	45.0
TOTAL SHIPMENTS		31,201	
STORAGE		(56,088)	
TOTAL COST =	$45,316,005		

SECTION B

Model I, Phase II
Rate Systems IV and V

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	600	90.0
STORAGE		(0)	
Oregon	California	465	90.0
Oregon	Nevada	105	90.0
Oregon	Utah	186	82.0
TOTAL SHIPMENTS		756	
STORAGE		(0)	
Montana	California	1,584	102.5
Montana	Idaho	136	50.5
TOTAL SHIPMENTS		1,720	
STORAGE		(0)	
South Dakota	Nebraska	70	42.0
STORAGE		(0)	
Kansas	Texas	143	51.5
Kansas	New Mexico	36	55.0
Kansas	Oklahoma	462	38.0
TOTAL SHIPMENTS		641	
STORAGE		(0)	
Region 1	Nebraska	285	26.5
Region 1	Texas	2,149	82.5
Region 1	Region 2	2,062	40.5
Region 1	Region 3	2,659	90.5
Region 1	Region 4	4,246	61.0
Region 1	Region 5	2,138	102.5
Region 1	Region 9	2,709	116.0
TOTAL SHIPMENTS		16,248	
STORAGE		(0)	
Region 7	Region 4	773	50.5
Region 7	Region 6	2,715	43.0
Region 7	Region 8	2,231	37.5
TOTAL SHIPMENTS		5,719	
STORAGE		(0)	
North Dakota	California	376	145.5
North Dakota	Arizona	383	145.5
North Dakota	Wyoming	62	68.5
North Dakota	Colorado	358	68.5
North Dakota	New Mexico	211	112.5
TOTAL SHIPMENTS		1,390	
STORAGE		(0)	
TOTAL COST =	$20,233,970		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	485	90.0
STORAGE		(0)	
Oregon	California	600	90.0
Oregon	Nevada	127	90.0
Oregon	Utah	253	82.0
TOTAL SHIPMENTS		980	
STORAGE		(0)	
Montana	California	1,644	102.5

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Idaho	115	50.5
TOTAL SHIPMENTS		1,759	
STORAGE		(0)	
Kansas	New Mexico	254	55.0
Kansas	Oklahoma	250	38.0
Kansas	Texas	1,002	51.5
TOTAL SHIPMENTS		1,506	
STORAGE		(0)	
Region 1	California	125	145.2
Region 1	Arizona	425	135.0
Region 1	Nebraska	346	26.5
Region 1	Texas	1,178	82.5
Region 1	Region 2	2,300	40.5
Region 1	Region 3	2,350	90.5
Region 1	Region 4	4,886	61.0
Region 1	Region 5	2,164	102.5
Region 1	Region 9	2,590	116.0
TOTAL SHIPMENTS		16,364	
STORAGE		(0)	
Region 7	Region 4	1,546	50.5
Region 7	Region 6	2,721	43.0
Region 7	Region 8	2,127	37.5
TOTAL SHIPMENTS		6,394	
STORAGE		(0)	
North Dakota	California	196	145.5
North Dakota	Wyoming	78	68.5
North Dakota	Colorado	335	68.5
TOTAL SHIPMENTS		609	
STORAGE		(813)	
TOTAL COST =	$20,188,635		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	141	90.0
Washington	Nevada	140	90.0
TOTAL SHIPMENTS		281	
STORAGE		(0)	
Oregon	California	799	90.0
Oregon	Utah	268	82.0
TOTAL SHIPMENTS		1,067	
STORAGE		(0)	
Montana	California	1,427	102.5
Montana	Idaho	169	50.5
TOTAL SHIPMENTS		1,596	
STORAGE		(0)	
Kansas	New Mexico	270	55.0
Kansas	Oklahoma	362	38.0
Kansas	Texas	921	51.5
TOTAL SHIPMENTS		1,553	
STORAGE		(0)	
Region 1	Arizona	244	135.0
Region 1	Nebraska	341	26.5
TOTAL SHIPMENTS		585	
STORAGE		(0)	

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TABLE 14. LEAST-COST DISTRIBUTION OF FLOUR - HARD RED SPRING, 1975, MODEL I, PHASE II, RATE SYSTEM IV - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	California	746	145.5
North Dakota	Arizona	228	145.5
North Dakota	Wyoming	79	68.5
North Dakota	Colorado	354	68.5
TOTAL SHIPMENTS		1,407	
STORAGE		(0)	
TOTAL COST =	$21,098,770		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	217	86.0
Washington	Arizona	383	90.5
TOTAL SHIPMENTS		600	
STORAGE		(0)	
Oregon	California	756	64.0
STORAGE		(0)	
Montana	California	1,615	81.2
Montana	Nevada	105	49.3
TOTAL SHIPMENTS		1,720	
STORAGE		(0)	
South Dakota	Nebraska	70	28.3
STORAGE		(0)	
Kansas	New Mexico	247	43.3
Kansas	Oklahoma	394	24.1
TOTAL SHIPMENTS		641	
STORAGE		(0)	
Region 1	Nebraska	74	32.1
Region 1	Oklahoma	68	50.4
Region 1	Texas	2,292	69.8
Region 1	Region 2	2,062	40.7
Region 1	Region 3	2,659	70.4
Region 1	Region 4	5,019	45.5
Region 1	Region 5	2,138	57.6
Region 1	Region 9	1,936	80.3
TOTAL SHIPMENTS		16,248	
STORAGE		(0)	
Region 7	Region 6	2,715	28.6
Region 7	Region 8	2,231	28.0
Region 7	Region 9	773	64.1
TOTAL SHIPMENTS		5,719	
STORAGE		(0)	
North Dakota	California	437	104.1
North Dakota	Idaho	136	57.0
North Dakota	Utah	186	67.1
North Dakota	Wyoming	62	59.2
North Dakota	Colorado	358	61.4
North Dakota	Nebraska	211	44.7
TOTAL SHIPMENTS		1,390	
STORAGE		(0)	
TOTAL COST =	$14,945,427		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	485	86.0
STORAGE		(0)	
Oregon	California	980	64.0
STORAGE		(0)	
Montana	California	1,585	81.2
Montana	Nevada	127	49.3
Montana	Idaho	47	34.4
TOTAL SHIPMENTS		1,759	
STORAGE		(0)	
Kansas	Arizona	425	72.2
Kansas	New Mexico	254	43.3
Kansas	Oklahoma	250	24.1
Kansas	Texas	577	44.8
TOTAL SHIPMENTS		1,506	
STORAGE		(0)	
Region 1	Colorado	125	53.3
Region 1	Nebraska	346	32.1
Region 1	Texas	1,603	69.8
Region 1	Region 2	2,300	40.7
Region 1	Region 3	2,350	70.4
Region 1	Region 4	6,432	45.5
Region 1	Region 5	2,164	57.6
Region 1	Region 9	1,044	80.3
TOTAL SHIPMENTS		16,364	
STORAGE		(0)	
Region 7	Region 6	2,721	28.6
Region 7	Region 8	2,127	28.0
Region 7	Region 9	1,546	64.1
TOTAL SHIPMENTS		6,394	
STORAGE		(0)	
North Dakota	Idaho	68	57.0
North Dakota	Utah	253	67.1
North Dakota	Wyoming	78	59.2
North Dakota	Colorado	210	61.4
TOTAL SHIPMENTS		609	
STORAGE		(813)	
TOTAL COST =	$14,792,509		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Washington	California	53	86.0
Washington	Arizona	228	90.5
TOTAL SHIPMENTS		281	
STORAGE		(0)	
Oregon	California	1,067	64.0
STORAGE		(0)	
Montana	California	1,456	81.2
Montana	Nevada	140	49.3
TOTAL SHIPMENTS		1,596	
STORAGE		(0)	
Kansas	Arizona	244	72.2
Kansas	New Mexico	270	43.3
Kansas	Oklahoma	362	24.1
Kansas	Texas	677	44.8
TOTAL SHIPMENTS		1,553	
STORAGE		(0)	

-continued-

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Region 1	Nebraska	341	32.1
Region 1	Texas	1,421	69.8
Region 1	Region 2	2,480	40.7
Region 1	Region 3	2,847	70.4
Region 1	Region 4	6,384	45.5
Region 1	Region 5	2,206	57.6
Region 1	Region 9	825	80.3
TOTAL SHIPMENTS		16,504	
STORAGE		(0)	
Region 7	Region 6	2,697	28.6
Region 7	Region 8	2,547	28.0
Region 7	Region 9	1,598	64.1
TOTAL SHIPMENTS		6,842	
STORAGE		(0)	
North Dakota	California	537	104.1
North Dakota	Idaho	169	57.0
North Dakota	Utah	268	67.1
North Dakota	Wyoming	79	59.2
North Dakota	Colorado	354	61.4
TOTAL SHIPMENTS		1,407	
STORAGE		(0)	
TOTAL COST =	$15,430,645		

SECTION C

Model II, Phase I
Rate Systems IV and V

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	4,333	65.0
STORAGE		(0)	
Montana	California	146	102.5
Montana	Arizona	383	131.0
Montana	West Coast Export	8,729	89.0
Montana	Washington	672	51.5
Montana	Oregon	321	65.0
Montana	Nevada	105	105.5
TOTAL SHIPMENTS		10,356	
STORAGE		(4,650)	
Wyoming	New Mexico	35	36.1
STORAGE		(0)	
South Dakota	Nebraska	355	42.0
South Dakota	Kansas	547	74.0
South Dakota	Oklahoma	596	91.5
South Dakota	Region 7	8,874	104.5
South Dakota	Gulf Export	1,196	69.4
TOTAL SHIPMENTS		11,568	
STORAGE		(0)	
Region 1	East Coast Export	2,653	75.3
Region 1	Gulf Export	3,661	30.1
TOTAL SHIPMENTS		6,314	
STORAGE		(0)	
North Dakota	Colorado	459	68.5
North Dakota	New Mexico	212	112.5
North Dakota	Texas	2,578	113.0
North Dakota	Region 2	3,683	81.5
North Dakota	Region 3	2,659	132.5
North Dakota	Region 4	6,480	103.0
North Dakota	Region 5	2,138	134.5
North Dakota	Region 6	2,715	127.5
North Dakota	Region 8	2,500	115.5
North Dakota	Region 9	3,100	158.5
North Dakota	Great Lakes Export	5,622	61.0
North Dakota	East Coast Export	14,693	130.8
TOTAL SHIPMENTS		46,839	
STORAGE		(3,733)	
TOTAL COST =	$79,668,398		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	4,886	65.0
Idaho	Arizona	425	102.0
Idaho	West Coast Export	577	61.0
Idaho	Nevada	127	70.5
TOTAL SHIPMENTS		6,015	
STORAGE		(0)	
Utah	Region 9	3	106.0
STORAGE		(0)	
Montana	West Coast Export	13,726	89.0
Montana	Washington	653	51.5
Montana	Oregon	274	65.0
TOTAL SHIPMENTS		14,653	
STORAGE		(0)	

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Wyoming	New Mexico	49	36.1
STORAGE		(0)	
South Dakota	Nebraska	346	42.0
South Dakota	Kansas	536	74.0
South Dakota	Oklahoma	590	91.5
South Dakota	Region 2	3,644	66.0
South Dakota	Region 3	1,750	117.5
South Dakota	Region 7	8,915	104.5
South Dakota	Gulf Export	3,876	69.4
TOTAL SHIPMENTS		19,657	
STORAGE		(0)	
Region 1	East Coast Export	8,904	75.3
Region 1	Gulf Export	816	30.1
TOTAL SHIPMENTS		9,720	
STORAGE		(0)	
North Dakota	Colorado	476	68.5
North Dakota	New Mexico	205	112.5
North Dakota	Texas	2,664	113.0
North Dakota	Region 3	1,031	132.5
North Dakota	Region 4	6,432	103.0
North Dakota	Region 5	2,164	134.5
North Dakota	Region 6	2,721	127.5
North Dakota	Region 8	2,568	115.5
North Dakota	Region 9	3,273	158.5
North Dakota	West Coast Export	16,658	95.9
North Dakota	Great Lakes Export	5,368	61.0
TOTAL SHIPMENTS		43,560	
STORAGE		(27,492)	
TOTAL COST =	$86,656,198		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	5,354	65.0
Idaho	Arizona	472	102.0
Idaho	West Coast Export	48	61.0
Idaho	Nevada	140	70.5
TOTAL SHIPMENTS		6,014	
STORAGE		(0)	
Utah	Region 9	12	106.0
STORAGE		(0)	
Montana	West Coast Export	13,701	89.0
Montana	Washington	663	51.5
Montana	Oregon	288	65.0
TOTAL SHIPMENTS		14,652	
STORAGE		(0)	
Wyoming	New Mexico	49	36.1
STORAGE		(0)	
South Dakota	Nebraska	341	42.0
South Dakota	Kansas	532	74.0
South Dakota	Oklahoma	589	91.5
South Dakota	Region 2	3,709	66.0
South Dakota	Region 3	1,512	117.5
South Dakota	Region 7	9,042	104.5

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Gulf Export	3,955	69.4
TOTAL SHIPMENTS		19,680	
STORAGE		(0)	
Region 1	East Coast Export	8,904	75.3
Region 1	Gulf Export	737	30.1
TOTAL SHIPMENTS		9,641	
STORAGE		(0)	
North Dakota	Colorado	501	68.5
North Dakota	New Mexico	221	112.5
North Dakota	Texas	2,770	113.0
North Dakota	Region 3	1,335	132.5
North Dakota	Region 4	6,554	103.0
North Dakota	Region 5	2,206	134.5
North Dakota	Region 6	2,767	127.5
North Dakota	Region 8	2,657	115.5
North Dakota	Region 9	3,479	158.5
North Dakota	West Coast Export	10,451	95.9
North Dakota	Great Lakes Export	5,368	61.0
TOTAL SHIPMENTS		38,309	
STORAGE		(32,746)	
TOTAL COST =	$81,879,487		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	4,228	60.6
Idaho	Nevada	105	35.9
TOTAL SHIPMENTS		4,333	
STORAGE		(0)	
Montana	California	251	81.2
Montana	Arizona	383	89.6
Montana	Colorado	459	44.6
Montana	New Mexico	212	70.0
Montana	West Coast Export	8,729	68.8
Montana	Washington	672	41.2
Montana	Oregon	321	57.5
TOTAL SHIPMENTS		11,027	
STORAGE		(3,979)	
Wyoming	New Mexico	35	40.5
STORAGE		(0)	
South Dakota	Nebraska	355	28.3
South Dakota	Kansas	547	40.6
South Dakota	Oklahoma	596	48.3
South Dakota	Texas	2,578	69.5
South Dakota	Region 2	2,695	48.0
South Dakota	Region 3	2,659	75.6
South Dakota	Region 5	2,138	64.8
TOTAL SHIPMENTS		11,568	
STORAGE		(0)	
Region 1	Great Lakes Export	1,457	18.9
Region 1	Gulf Export	4,857	30.3
TOTAL SHIPMENTS		6,314	
STORAGE		(0)	

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TABLE 21. LEAST-COST DISTRIBUTION OF FLOUR - HARD RED SPRING, 1965, MODEL II, PHASE I, RATE SYSTEM V - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Region 2	988	62.5
North Dakota	Region 4	6,480	67.3
North Dakota	Region 6	2,715	98.9
North Dakota	Region 7	8,874	75.3
North Dakota	Region 8	2,500	93.9
North Dakota	Region 9	3,100	99.5
North Dakota	Great Lakes Export	4,165	47.4
North Dakota	East Coast Export	17,346	94.4
TOTAL SHIPMENTS		46,168	
STORAGE		(4,404)	
TOTAL COST =	$56,946,151		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	4,886	60.6
Idaho	Arizona	422	69.0
Idaho	West Coast Export	580	61.1
Idaho	Nevada	127	35.9
TOTAL SHIPMENTS		6,015	
STORAGE		(0)	
Utah	Arizona	3	33.2
STORAGE		(0)	
Montana	West Coast Export	14,653	68.8
STORAGE		(0)	
Wyoming	Colorado	49	18.3
STORAGE		(0)	
South Dakota	Colorado	427	46.8
South Dakota	New Mexico	254	68.7
South Dakota	Nebraska	346	28.3
South Dakota	Kansas	536	40.6
South Dakota	Oklahoma	590	48.3
South Dakota	Texas	2,664	69.5
South Dakota	Region 2	3,664	48.0
South Dakota	Region 3	2,781	75.6
South Dakota	Region 4	6,251	54.8
South Dakota	Region 5	2,161	64.8
TOTAL SHIPMENTS		19,674	
STORAGE		(0)	
Region 1	Great Lakes Export	5,028	18.9
Region 1	Gulf Export	4,692	30.3
TOTAL SHIPMENTS		9,720	
STORAGE		(0)	
North Dakota	Region 4	181	67.3
North Dakota	Region 6	2,721	98.9
North Dakota	Region 7	8,915	75.3
North Dakota	Region 8	2,568	93.9
North Dakota	Region 9	3,276	99.5
North Dakota	West Coast Export	15,728	88.4
North Dakota	Great Lakes Export	340	47.4
North Dakota	East Coast Export	8,904	94.4
North Dakota	Washington	653	58.5
North Dakota	Oregon	274	75.3
TOTAL SHIPMENTS		43,560	
STORAGE		(27,492)	
TOTAL COST =	$65,885,822		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	5,354	60.6
Idaho	Arizona	460	69.0
Idaho	West Coast Export	60	61.0
Idaho	Nevada	140	35.9
TOTAL SHIPMENTS		6,014	
STORAGE		(0)	
Utah	Arizona	12	33.2
STORAGE		(0)	
Montana	West Coast Export	14,652	68.8
STORAGE		(0)	
Wyoming	Colorado	49	18.5
STORAGE		(0)	
South Dakota	Colorado	452	46.8
South Dakota	New Mexico	270	68.7
South Dakota	Nebraska	341	28.3
South Dakota	Kansas	532	40.6
South Dakota	Oklahoma	589	48.3
South Dakota	Texas	2,770	69.5
South Dakota	Region 2	3,709	48.0
South Dakota	Region 3	2,847	75.6
South Dakota	Region 4	5,964	54.8
South Dakota	Region 5	2,206	64.8
TOTAL SHIPMENTS		19,680	
STORAGE		(0)	
Region 1	Great Lakes Export	4,949	18.9
Region 1	Gulf Export	4,692	30.3
TOTAL SHIPMENTS		9,641	
STORAGE		(0)	
North Dakota	Oregon	288	75.3
North Dakota	Washington	663	58.5
North Dakota	Region 4	590	67.3
North Dakota	Region 6	2,767	98.9
North Dakota	Region 7	9,042	75.2
North Dakota	Region 8	2,657	93.9
North Dakota	Region 9	3,491	99.5
North Dakota	West Coast Export	9,488	88.4
North Dakota	Great Lakes Export	419	47.4
North Dakota	East Coast Export	8,904	94.4
TOTAL SHIPMENTS		38,309	
STORAGE		(32,746)	
TOTAL COST =	$61,155,798		

SECTION D

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

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	5,935	59.1
STORAGE		(0)	
Utah	Arizona	62	66.8
STORAGE		(0)	
Montana	California	192	102.5
Montana	Arizona	462	117.2
Montana	West Coast Export	11,957	65.0
Montana	Nevada	144	82.4
TOTAL SHIPMENTS		12,755	
STORAGE		(6,524)	
South Dakota	Colorado	629	53.5
South Dakota	Nebraska	485	40.0
South Dakota	Kansas	748	59.7
South Dakota	Texas	3,526	58.4
South Dakota	Region 5	2,929	58.8
South Dakota	Region 9	877	64.6
South Dakota	Gulf Export	6,653	50.7
TOTAL SHIPMENTS		15,847	
STORAGE		(0)	
Region 1	Region 2	5,045	12.0
Region 1	Region 4	3,605	24.2
TOTAL SHIPMENTS		8,650	
STORAGE		(0)	
North Dakota	Oklahoma	815	46.4
North Dakota	Region 3	3,643	66.6
North Dakota	Region 4	5,272	92.0
North Dakota	Region 6	3,719	127.0
North Dakota	Region 7	12,156	69.5
North Dakota	Region 8	3,425	122.0
North Dakota	Region 9	3,368	80.0
North Dakota	Great Lakes Export	7,701	44.5
North Dakota	East Coast Export	23,762	95.5
TOTAL SHIPMENTS		63,861	
STORAGE		(3,227)	
TOTAL COST =	$77,111,985		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	6,692	59.1
Idaho	New Mexico	280	83.3
Idaho	West Coast Export	718	44.6
Idaho	Oregon	376	39.4
Idaho	Nevada	174	47.0
TOTAL SHIPMENTS		8,240	
STORAGE		(0)	
Utah	Arizona	4	66.8
STORAGE		(0)	
Montana	Arizona	578	117.2
Montana	West Coast Export	18,601	65.0
Montana	Washington	894	51.5
TOTAL SHIPMENTS		20,073	
STORAGE		(0)	
Wyoming	New Mexico	68	53.2
STORAGE		(0)	

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Colorado	652	53.5
South Dakota	Nebraska	473	40.0
South Dakota	Kansas	734	59.7
South Dakota	Texas	3,649	58.4
South Dakota	Region 2	559	69.0
South Dakota	Region 5	2,965	58.8
South Dakota	Region 6	2,006	117.0
South Dakota	Region 9	4,488	64.6
South Dakota	Gulf Export	6,428	50.7
TOTAL SHIPMENTS		21,954	
STORAGE		(0)	
Region 1	Region 2	4,460	12.0
Region 1	Region 4	8,854	24.2
TOTAL SHIPMENTS		13,314	
STORAGE		(0)	
North Dakota	Oklahoma	808	46.4
North Dakota	Region 3	3,809	66.6
North Dakota	Region 6	1,717	127.0
North Dakota	Region 7	12,212	69.5
North Dakota	Region 8	3,518	122.0
North Dakota	West Coast Export	23,094	70.0
North Dakota	Great Lakes Export	7,354	44.5
North Dakota	East Coast Export	12,197	95.5
TOTAL SHIPMENTS		64,709	
STORAGE		(32,622)	
TOTAL COST =	$83,216,961		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	7,324	59.1
Idaho	New Mexico	300	83.3
Idaho	West Coast Export	29	44.6
Idaho	Oregon	395	39.4
Idaho	Nevada	191	47.0
TOTAL SHIPMENTS		8,239	
STORAGE		(0)	
Utah	Arizona	16	66.8
STORAGE		(0)	
Montana	Arizona	629	117.2
Montana	West Coast Export	18,527	65.0
Montana	Washington	908	51.5
TOTAL SHIPMENTS		20,064	
STORAGE		(0)	
Wyoming	New Mexico	68	53.2
STORAGE		(0)	
South Dakota	Colorado	685	53.5
South Dakota	Nebraska	467	40.0
South Dakota	Kansas	727	59.7
South Dakota	Texas	3,789	58.4
South Dakota	Region 2	853	69.0
South Dakota	Region 5	3,022	58.8
South Dakota	Region 6	2,531	117.0
South Dakota	Region 8	3,640	112.0

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Region 9	4,782	64.6
South Dakota	Gulf Export	6,428	50.7
TOTAL SHIPMENTS		26,924	
STORAGE		(0)	
Region 1	Region 2	4,228	12.0
Region 1	Region 4	8,979	24.2
TOTAL SHIPMENTS		13,207	
STORAGE		(0)	
North Dakota	Oklahoma	806	46.4
North Dakota	Region 3	3,900	66.6
North Dakota	Region 6	1,260	127.0
North Dakota	Region 7	12,386	69.5
North Dakota	West Coast Export	14,595	70.0
North Dakota	Great Lakes Export	7,354	44.5
North Dakota	East Coast Export	12,197	95.5
TOTAL SHIPMENTS		52,498	
STORAGE		(44,838)	
TOTAL COST =	$77,911,163		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	5,267	54.5
Idaho	Arizona	524	61.5
Idaho	Nevada	144	34.3
TOTAL SHIPMENTS		5,935	
STORAGE		(0)	
Utah	California	62	45.6
STORAGE		(0)	
Montana	California	798	71.6
Montana	Colorado	581	42.9
Montana	New Mexico	337	62.3
Montana	Region 9	4,245	63.2
Montana	West Coast Export	11,957	50.2
Montana	Washington	920	38.8
Montana	Oregon	440	52.0
TOTAL SHIPMENTS		19,278	
STORAGE		(1,361)	
Wyoming	Denver	48	10.1
STORAGE		(0)	
South Dakota	Nebraska	485	28.1
South Dakota	Kansas	748	38.2
South Dakota	Oklahoma	815	44.7
South Dakota	Region 4	8,877	50.0
South Dakota	Region 7	1,497	57.4
South Dakota	Region 8	3,425	70.6
TOTAL SHIPMENTS		15,847	
STORAGE		(0)	
Region 1	Texas	3,526	29.8
Region 1	Great Lakes Export	5,124	13.8
TOTAL SHIPMENTS		8,650	
STORAGE		(0)	

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TABLE 27. LEAST-COST DISTRIBUTION OF WHEAT - HARD RED SPRING, 1965, MODEL III, PHASE I, RATE SYSTEM II - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
North Dakota	Region 2	5,045	46.0
North Dakota	Region 3	3,643	56.1
North Dakota	Region 5	2,929	64.2
North Dakota	Region 6	3,719	84.4
North Dakota	Region 7	10,659	65.5
North Dakota	Great Lakes Export	2,577	34.6
North Dakota	East Coast Export	23,762	68.9
North Dakota	Gulf Export	6,653	56.1
TOTAL SHIPMENTS		58,987	
STORAGE		(8,390)	
TOTAL COST =	$60,441,930		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	6,688	54.5
Idaho	Arizona	582	61.5
Idaho	West Coast Export	420	44.6
Idaho	Nevada	174	34.3
Idaho	Oregon	376	44.6
TOTAL SHIPMENTS		8,240	
STORAGE		(0)	
Utah	California	4	45.6
STORAGE		(0)	
Montana	West Coast Export	19,179	50.2
Montana	Washington	894	38.8
TOTAL SHIPMENTS		20,073	
STORAGE		(0)	
Wyoming	Colorado	68	10.1
STORAGE		(0)	
South Dakota	Colorado	584	43.2
South Dakota	New Mexico	348	61.3
South Dakota	Nebraska	473	28.1
South Dakota	Kansas	734	38.2
South Dakota	Oklahoma	808	44.7
South Dakota	Region 4	8,854	50.0
South Dakota	Region 7	6,635	57.4
South Dakota	Region 8	3,518	70.6
TOTAL SHIPMENTS		21,954	
STORAGE		(0)	
Region 1	Texas	3,649	29.8
Region 1	Region 5	2,311	30.2
Region 1	Great Lakes Export	7,354	13.8
TOTAL SHIPMENTS		13,314	
STORAGE		(0)	
North Dakota	Region 2	5,019	46.0
North Dakota	Region 3	3,809	56.1
North Dakota	Region 5	654	64.2
North Dakota	Region 6	3,723	84.4
North Dakota	Region 7	5,577	65.5
North Dakota	Region 8	4,488	70.0
North Dakota	West Coast Export	22,814	64.5
North Dakota	East Coast Export	12,197	68.9
North Dakota	Gulf Export	6,428	56.1
TOTAL SHIPMENTS		64,709	
STORAGE		(32,622)	
TOTAL COST =	$69,627,304		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	7,308	54.5
Idaho	Arizona	645	61.5
Idaho	Nevada	191	34.3
TOTAL SHIPMENTS		8,144	
STORAGE		(0)	
Utah	California	16	45.6
STORAGE		(0)	
Montana	West Coast Export	18,856	50.2
Montana	Washington	908	38.8
TOTAL SHIPMENTS		19,764	
STORAGE		(0)	
Wyoming	Colorado	68	10.1
STORAGE		(0)	
South Dakota	Colorado	617	43.2
South Dakota	New Mexico	368	61.3
South Dakota	Nebraska	467	28.1
South Dakota	Kansas	727	38.2
South Dakota	Oklahoma	806	44.7
South Dakota	Region 4	8,979	50.0
South Dakota	Region 7	11,320	57.4
South Dakota	Region 8	3,640	70.6
TOTAL SHIPMENTS		26,924	
STORAGE		(0)	
Region 1	Texas	3,789	29.8
Region 1	Region 5	2,064	30.2
Region 1	Great Lakes Export	7,354	13.8
TOTAL SHIPMENTS		13,207	
STORAGE		(0)	
North Dakota	Region 2	5,081	46.0
North Dakota	Region 3	3,900	56.1
North Dakota	Region 5	958	64.2
North Dakota	Region 6	3,791	84.4
North Dakota	Region 7	1,066	65.5
North Dakota	Region 9	4,782	70.0
North Dakota	West Coast Export	14,295	64.5
North Dakota	East Coast Export	12,197	68.9
North Dakota	Gulf Export	6,428	56.1
TOTAL SHIPMENTS		52,498	
STORAGE		(44,838)	
TOTAL COST =	$64,615,747		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	5,791	53.0
Idaho	Nevada	144	28.2
TOTAL SHIPMENTS		5,935	
STORAGE		(0)	
Utah	California	62	45.0
STORAGE		(0)	
Montana	California	274	71.5
Montana	Arizona	524	78.9
Montanaa	Colorado	629	40.3
Montana	West Coast Export	11,957	51.4
Montana	Washington	920	37.8

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Montana	Oregon	440	51.4
TOTAL SHIPMENTS		14,744	
STORAGE		(5,895)	
Wyoming	New Mexico	48	37.2
STORAGE		(0)	
South Dakota	New Mexico	289	60.9
South Dakota	Nebraska	485	26.9
South Dakota	Kansas	748	37.3
South Dakota	Oklahoma	815	44.0
South Dakota	Texas	3,526	61.5
South Dakota	Region 7	6,559	54.7
South Dakota	Region 8	3,425	69.3
TOTAL SHIPMENTS		15,847	
STORAGE		(0)	
Region 1	Region 2	5,045	12.0
Region 1	Region 9	3,605	36.0
TOTAL SHIPMENTS		8,650	
STORAGE		(0)	
North Dakota	Region 3	3,643	55.0
North Dakota	Region 4	8,877	57.1
North Dakota	Region 5	2,929	63.1
North Dakota	Region 6	3,719	82.8
North Dakota	Region 7	5,597	64.1
North Dakota	Region 9	640	68.9
North Dakota	Great Lakes Export	7,701	33.5
North Dakota	East Coast Export	23,762	67.5
North Dakota	Gulf Export	6,653	45.0
TOTAL SHIPMENTS		63,521	
STORAGE		(3,856)	
TOTAL COST =	$59,311,843		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	6,692	53.0
Idaho	Arizona	578	61.1
Idaho	West Coast Export	420	44.6
Idaho	Oregon	376	44.6
Idaho	Nevada	174	28.2
TOTAL SHIPMENTS		8,240	
STORAGE		(0)	
Montana	West Coast Export	19,179	51.4
Montana	Washington	894	37.8
TOTAL SHIPMENTS		20,073	
STORAGE		(0)	
Wyoming	Colorado	68	10.1
STORAGE		(0)	
South Dakota	Colorado	584	42.3
South Dakota	New Mexico	348	60.9
South Dakota	Nebraska	473	26.9
South Dakota	Kansas	734	37.3
South Dakota	Oklahoma	808	44.0
South Dakota	Texas	3,649	61.5
South Dakota	Region 7	11,840	54.7

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TABLE 31. LEAST-COST DISTRIBUTION OF WHEAT - HARD RED SPRING, 1970, MODEL III, PHASE I, RATE SYSTEM III - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
South Dakota	Region 8	3,518	69.3
TOTAL SHIPMENTS		21,954	
STORAGE		(0)	
Region 1	Region 2	5,019	12.0
Region 1	Region 3	3,809	22.1
Region 1	Region 9	4,486	36.0
TOTAL SHIPMENTS		13,314	
STORAGE		(0)	
North Dakota	Region 4	8,854	57.1
North Dakota	Region 5	2,965	63.1
North Dakota	Region 6	3,723	82.8
North Dakota	Region 7	372	64.1
North Dakota	Region 9	2	68.9
North Dakota	West Coast Export	22,814	64.4
North Dakota	Great Lakes Export	7,354	33.5
North Dakota	East Coast Export	12,197	67.5
North Dakota	Gulf Export	6,428	45.0
TOTAL SHIPMENTS		64,709	
STORAGE		(32,622)	
TOTAL COST =	$68,472,429		

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

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Idaho	California	7,324	53.0
Idaho	Arizona	629	61.1
Idaho	Oregon	95	44.6
Idaho	Nevada	191	28.2
TOTAL SHIPMENTS		8,239	
STORAGE		(0)	
Utah	Arizona	16	52.4
STORAGE		(0)	
Montana	West Coast Export	18,856	51.4
Montana	Washington	908	37.8
Montana	Oregon	300	51.4
TOTAL SHIPMENTS		20,064	
STORAGE		(0)	
Wyoming	Colorado	68	10.1
STORAGE		(0)	
South Dakota	Colorado	617	42.3
South Dakota	New Mexico	368	60.9
South Dakota	Nebraska	467	26.9
South Dakota	Kansas	727	37.3
South Dakota	Oklahoma	806	44.0
South Dakota	Texas	3,789	61.5
South Dakota	Region 4	333	49.2
South Dakota	Region 6	3,791	74.9
South Dakota	Region 7	12,386	54.7
South Dakota	Region 8	3,640	69.3
TOTAL SHIPMENTS		26,924	
STORAGE		(0)	
Region 1	Region 2	5,081	12.0
Region 1	Region 4	3,344	24.2

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TABLE 32. LEAST-COST DISTRIBUTION OF WHEAT - HARD RED SPRING, 1975, MODEL III, PHASE I, RATE SYSTEM III - continued

Origin	Destination	Shipment	Rate
		000 cwt.	cents per cwt.
Region 1	Region 9	4,782	36.0
TOTAL SHIPMENTS		13,207	
STORAGE		(0)	
North Dakota	Region 3	3,900	55.0
North Dakota	Region 4	5,302	57.1
North Dakota	Region 5	3,022	63.1
North Dakota	West Coast Export	14,295	64.4
North Dakota	Great Lakes Export	7,354	33.5
North Dakota	East Coast Export	12,197	67.5
North Dakota	Gulf Export	6,428	45.0
TOTAL SHIPMENTS		52,498	
STORAGE		(44,838)	
TOTAL COST =	$63,405,125		

SUMMARY AND CONCLUSIONS

The largest market outlet for North Dakota hard red spring wheat-grain appears to be the export market under an optimum or least-cost distribution system (Sections A, B, C, and D; Tables 3-32). This is true regardless of the location of flour mills, rate system, and time period of analysis (Tables 33, 34, 35). The West Coast export market, in particular, accounts for a very large share in the years 1970 and 1975.

The largest market outlet for North Dakota hard red spring wheat-flour appears to be the Western and Southwestern domestic markets under a least-cost distribution system. The present locations and demands of the flour mills provided the largest Western and Southwestern markets for hard red spring wheat-flour. The rate system used had no effect on the size of these flour outlets (Table 33).

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	59,009
	1970	49,775
	1975	31,201
II	1965	58,827
	1970	49,775
	1975	31,201
III	1965	59,009
	1970	49,775
	1975	31,201

Under Rate System I, North Dakota's market share of wheat-grain showed a considerable change when changing locations and demands of flour mills (Table 34). In 1965 the largest market share occurred when locating the mills in the production areas. In 1970 and 1975, the largest market share occurred when locating mills in the flour consuming areas.

Under Rate System II, in which the rail rates were based on fully distributed costs, North Dakota's market share of wheat-grain reacted quite similarly (Table 35). The market share increased when locating flour mills in flour consuming areas in 1970 and 1975 based on projected data.

Overall, North Dakota's market share of wheat-grain and wheat-flour is the greatest in 1965 under Rate Systems I and IV (existing rail rates) when flour mills are located in the wheat producing areas. North

Dakota's market share is the greatest when under either Rate Systems I or II and when flour mills are located in the flour consuming areas for the years 1970 and 1975.

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	59,009	49,775	31,201
	Model I, Phase II	1,904	834	1,927
		60,913	50,609	33,128
in wheat producing areas	Model II, Phase I	66,909	59,677	52,483
in flour consuming areas	Model III, Phase I	64,150	64,709	52,498

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	58,827	49,775	31,201
	Model I, Phase II	1,904	834	1,927
		60,731	50,609	33,128
in wheat producing areas	Model II, Phase I	63,250	59,677	52,483
in flour consuming areas	Model III, Phase I	58,987	64,709	52,498

In looking at total distribution costs for all United States hard red spring wheat and flour, it was found that in 1965 the least-cost distribution occurred when flour mills were located in production areas and shipments of flour were based on Rate System V while export shipments were based on Rate System II. This was also true for 1970. In 1975 the least-cost distribution occurred under the existing flour mill locations and demands and under Rate Systems II and V. However, the total distribution cost when flour mills are located in production areas for that year was slightly more than when mills are located in existing areas.

The conclusion can be simply explained. It costs less to ship flour than wheat when basing rail rates on costs. But it is more costly to ship flour than wheat when using existing rail rates.

In summary, the least-cost distribution for 1965 was when flour mills are located in wheat producing areas and rail rates for wheat-grain and wheat-flour are based on fully distributed costs. This would also give North Dakota its largest market share (Table 36).

For least-cost distribution in 1970, flour mills should be located in wheat producing areas, and rail rates for wheat-grain should be based on fully distributed costs. However, North Dakota would gain the largest share of the market when flour mills are located in wheat-flour consuming areas.

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

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 36. TOTAL DISTRIBUTION COST ANALYSIS OF UNITED STATES HARD RED SPRING WHEAT 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	60,816,763	48,849,895	66,028,874	55,675,742	53,691,541	44,362,877
	--	(47,344,055)[a]	--	(54,482,480)	--	(45,316,005)
Phase II	20,233,970	14,945,427	20,188,635	14,792,509	21,098,770	15,430,645
	81,050,703	63,795,322	86,217,509	70,468,251	74,790,311	59,793,522
Model II						
Phase I	79,668,398	56,946,151	86,656,198	65,885,882	81,879,487	61,155,798
Model III						
Phase I	77,111,985	60,441,930	83,216,961	69,627,304	77,911,163	64,615,747
	--	(59,311,843)	--	(68,472,429)	--	(63,405,125)

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