



The economics of marketing high protein hard red spring wheat in the North Great Plains region of the United States
by John A Parfett

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics
Montana State University
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Abstract:

The following dissertation is an attempt to focus attention on the individual and social economic problems relating to marketing high protein hard spring wheat.

The introductory chapter outlines the purpose of observing, assembling, classifying and analyzing information of economic significance to individuals, social segments and consumers. Particular emphasis is devoted to producer problems in performing the segregative and allocative function in the market place, The relation of economic theory to price as a function of supply of and demand for hard red spring wheat is contained in Chapter Two, which consists of three parts. Part I relates to the theory of supply of high protein hard red spring wheat; Part II presents those factors which are assumed to affect the elasticity of and changes in the demand schedule; and Part III combines the theoretical assumptions of supply and demand and their relation to protein premiums. Substantiation for particular phases of the theoretical assumptions is found interspersed with theory. Included in Chapter Two are the references to the results of previous theoretical and empirical investigations. Results of tabulations of secondary data contained in the appendix have been mainly associated with Part III, Chapter III pertains to theory of sampling and practical applications of sampling in determining supplies of milling classes of wheat.

Results of the investigation and implications directed toward future research are summarized in Chapter IV.

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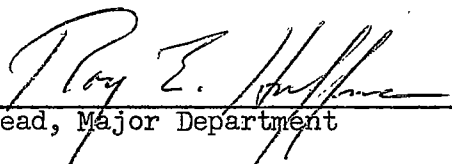
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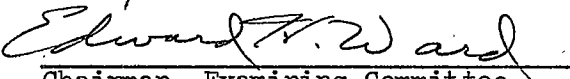
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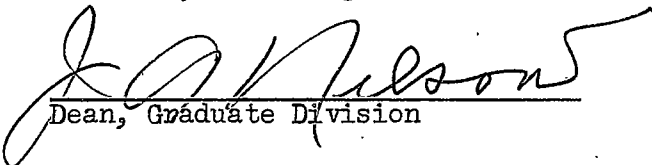
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ABSTRACT

The following dissertation is an attempt to focus attention on the individual and social economic problems relating to marketing high protein hard spring wheat.

The introductory chapter outlines the purpose of observing, assembling, classifying and analyzing information of economic significance to individuals, social segments and consumers. Particular emphasis is devoted to producer problems in performing the segregative and allocative function in the market place.

The relation of economic theory to price as a function of supply of and demand for hard red spring wheat is contained in Chapter Two, which consists of three parts. Part I relates to the theory of supply of high protein hard red spring wheat; Part II presents those factors which are assumed to affect the elasticity of and changes in the demand schedule; and Part III combines the theoretical assumptions of supply and demand and their relation to protein premiums. Substantiation for particular phases of the theoretical assumptions is found interspersed with theory. Included in Chapter Two are the references to the results of previous theoretical and empirical investigations. Results of tabulations of secondary data contained in the appendix have been mainly associated with Part III.

Chapter III pertains to theory of sampling and practical applications of sampling in determining supplies of milling classes of wheat.

Results of the investigation and implications directed toward future research are summarized in Chapter IV.

Chapter I.

INTRODUCTION

Part I. - The ProblemInitiation of Inquiry.

Since 1925 additional payment in the form of protein premiums have been paid to producers of hard red spring wheat in the Northern Great Plains area of the United States. In Montana protein premiums added about \$10 million additional income to farmers for the year 1951. If protein premium values were considered separate from wheat, wheat protein would be the fifth largest crop produced in the State of Montana, exceeded only by wheat, cattle, sheep and dairy. ^{1/} In economic terminology, any payment for a commodity or service is the function of the supply of that commodity or service in relation to the demand for it. Protein premiums become a measure designed to allocate the scarce commodity; high protein wheat. In some years there appears to be very little or no premium, while in other years the premium for protein in hard red spring wheat reaches substantial amounts. Premium fluctuations are not confined to stable amounts within the marketing year but vary from day to day and month to month. Both the variations in and the level of premiums are accompanied by economic problems related to the segments of society performing the function of marketing high protein hard red spring wheat.

^{1/} H. R. Stucky, Looking Ahead With Montana Farmers and Ranchers, Montana Extension Service, Montana State College, Bozeman, Montana, Folder 22, September 1, 1952.

The Problem Statement

The function of the research upon which this report is based is to observe, assemble, classify, define and analyze those facts relating to protein premiums as they create problems of economic significance to various segments of society. Particular emphasis is concentrated on the economic problems encountered by producers in their attempts to maximize net revenue in marketing high protein hard red spring wheat. On the basis of the facts compiled and presented in this report it is hoped that further research of a problem solving nature will be conducted at some future date.

Limits of the Study

Economic theory, and the utilization of visual descriptive economic models, serve as a means of explaining the economic conditions surrounding the marketing of high protein hard red spring wheat. It becomes necessary to set limits on the area of the study. The study will be concerned only with the economic aspect of marketing hard red spring wheat of high protein content. Not all of society is necessarily concerned with protein premiums unless they feel that there is mal-allocation of resources through the present method of marketing. In describing the marketing of hard red spring wheat containing high per cent protein, it is necessary to outline the geographic area in which the particular class of wheat is produced as well as the area in which this particular class is marketed and consumed. Reasons must be outlined why protein premiums are paid and to whom they are paid. Answers to the following questions must be found: What particular qualitative characteristics are represented in the payment

of a premium? Have legal and moral institutions grown out of the marketing of high protein hard red spring wheat and what is their relationship to the problems that confront the producers, and other members of the grain trade attempting to allocate high protein hard red spring wheat?

The Premium:

Hard red spring wheat is one of seven classes of wheat produced in the United States. Further subdivision creates three sub-classes; dark northern spring, northern spring and red spring wheat. Members of the grain industry concerned with the marketing of hard red spring wheat further differentiate the classes and sub-classes on the basis of the protein content into ordinary protein and high protein hard red spring wheat and hard red winter wheat. Ordinary protein hard red spring wheat is generally considered to be wheat of less than 12 per cent protein content. The term "high protein" is reserved for hard red spring and hard red winter wheat classes and sub-classes containing greater than 12 per cent protein. Protein determinations are based on chemical tests of the quantitative characteristics of nitrogen as a measure of the proteins inherent in the wheat. There is an association of the quantity of protein and the quality of the wheat which causes millers to bid premiums for the high protein wheats. Protein premiums are paid on the basis of the per cent protein over 12 per cent and are expressed as an increasing premium for each one-tenth or one-half per cent protein over 12 per cent. A typical bid for high protein wheat would be: 1 cent for each one-tenth of one per cent protein over 12 per cent, up to 15 per cent then $1\frac{1}{2}$ cents for each one-tenth of one per cent protein from 15 per cent protein up to

16 per cent protein, then one cent for each one-tenth of one per cent over 16 per cent protein.

The Marketing Segments:

Marketing hard red spring wheat of high protein content is considered to start with the producer. From the producer the wheat generally goes to the country elevator where it is accumulated for shipment. Commission firms and brokers may play an important role in further marketing of the wheat or it may go direct from the country elevator to a miller or terminal elevator. Speculators on the commodity exchange may contribute by assuming risk of ownership through price changes in the time lapse between producer marketing and milling of the wheat. Millers buy the high protein wheat for specific milling and blending purposes as a service to the commercial bakers. Bakers are also a service organization to the extent that they attempt to maximize consumer satisfaction by baking bread which meets with consumer's desire.

The area of study is mainly confined to the description of economic problems related to marketing that are associated with producers, elevator operators, commission firms, and millers. Particular reference is made to the problems of producers. The impact of premiums for high protein hard red spring wheat is assumed to be insignificant in relation to the consumer section of society. Protein premiums are a payment for a supplementary product which constitutes only an infinitesimal portion of consumers income. Bread purchases represent only a small portion of the consumer food purchases, and wheat flour is only one of many ingredients utilized in the production of bread. One estimate of the value of the

wheat which went into the production of a loaf of bread shows that in 1951 the producer only received 2.85 cents for the wheat that is required to produce the loaf. ^{1/} On the basis of this estimate and the fact that protein premium for 15 per cent protein hard red spring wheat was about 10 per cent of the value of the wheat, the value of the protein in the loaf of bread would be about one-third of a cent for each loaf of bread.

From the standpoint of the producer, if premiums are ten per cent of the value of the wheat, the payment represents a considerable portion of the producer's gross income. If the cost of wheat is 10 per cent higher to the miller because of the additional increment of a protein premium, it constitutes a significant cost to the miller's cost of production of flour and must be taken into account. Commission firms assume very little risk of price fluctuations in performing their function of bringing buyer and seller together for specific lots of wheat. Line elevator operators and terminal operators are not able to hedge the premium along with the base price of the wheat and therefore are obliged to receive a portion of the premium offered by the miller to cover their cost of risk associated with the rise and fall of premiums over time.

Some aspects of marketing which impinge on the welfare of society are included throughout the following chapters. Questions concerning society's interest in the production of high protein hard red spring wheat are related to the political aspects of the problem. Should producers

^{1/} National Federation of Grain Cooperatives, "Congress Told Farmers Receives 2.8 Cents of 16 Cent Loaf of Bread", Grain Quarterly, (Reprint from the Evening Star, Washington, D.C., April 27, 1951). Summer 1951, p.70.

receive a larger portion of the premium? Will society benefit by a net gain through some other allocation of factor inputs than the present allocation of inputs utilized in the production of high protein hard red spring wheat? Can the present factor inputs be utilized more efficiently in terms of production of a greater amount of high protein wheat than is presently being produced? Will some other allocation of premiums among wheat marketing segments of society increase total welfare in terms of greater national product? These questions are related to what changes might be made to increase the welfare of society. However, the complete answers to these questions are related to a hierarchy of economic goals beyond the scope of the present investigation.

Wheat Quality in Relation to Premiums:

For the purpose of conducting an economic study of protein premiums protein content, and quality require limited definition. Some assumptions are necessary regarding the quality that protein represents. To producers, the term "protein premium" signifies high quality wheat; to millers high protein wheat and quality of wheat are not always synonymous terms. Bakers have a different definition of quality depending on the results they expect to obtain through the use of high protein wheat flour. In the introductory phase of the study restrictions on the meaning of quality are presented to avoid confusion and to permit an orderly investigation of protein premiums in relation to economic problems.

The Geographic Area :

Not all wheat producers receive protein premiums for the wheat they sell. Even in the Northern Great Plains there are certain areas in which

it is practically impossible to produce high protein wheat of the hard red spring class. Under certain types of farming techniques, like irrigated production, producers are more concerned with growing high bushel yielding varieties of wheat than with high protein yielding varieties. High protein wheat production is influenced mainly by the environment and is associated with the amount of rainfall and the temperature as well as the soil and the variety of wheat grown. Montana produces the highest protein hard red spring wheat and Northeast Montana is consistently more suitable to the production of high protein wheat than other areas in the State. Millers and elevator operators have long been aware of the importance of establishing supply sources in the high protein producing area of northeastern Montana. (See Table II, Appendix).

It is necessary to know the uses of high protein wheat, and to know the areas both in the States and abroad to which the commodity moves. Geographically, the market is known to be mainly of a domestic nature. Foreign buyers have mainly confined their United States purchases of wheat to the ordinary protein wheat. For this reason it may be assumed that the world price establishes the price of ordinary protein wheat and the millers in the United States establish the premium which will be paid to keep high protein wheat out of foreign consignments. In the latter portion of the introductory chapter the geographic area of supply and demand are given considerable attention.

History of Development of Protein Premiums :

Producers of high protein hard red spring wheat have only recently, within the past thirty years, been faced with the problem of attempting

to market their product in such a way as to gain maximum net income. The conversion of consumer habits, from performing their own bread baking to reliance on commercial bakeries, since the first World War has created a shortage of high protein wheat required by bakers for the production of a uniform quality bread. Actually the premium is a function of increasing technology in bread baking techniques that had its beginning with the first grinding of the wild wheat by primitive man. The historical nature of protein premium development should add to the reader's concept of the problems associated with premiums and for this reason it is added in the first chapter.

The Legal Institution and Customs:

Laws and regulations have been established governing the marketing of high protein wheat. Beyond the Federal Grade Regulations which establish the grade of ordinary protein wheat there are the State regulations which have grown out of the customs associated with the production and marketing of high protein hard red spring wheat. It is important to know the legal limits and the restrictions that they impose on various segments of society associated with the marketing. The influence of protein regulations on private problems of the producers, millers and other members of the grain trade are outlined in the final phase of the introductory chapter.

Part II -- Marketing Problems

Five distinguishable economic groups are concerned with the movement of high protein wheat through the market channels. These groups perform certain functions in segregating, blending, allocating, risk bearing, milling and baking the high protein wheat to meet the demand imposed by consumers. These groups are: (1) producers, (2) elevator operators (country and terminal), (3) commission firms, brokers and speculators, (4) millers, and (5) bakers. The members of each of the groups are presumed to attempt to operate their firms in such a manner that net income will be maximized.

In attempting to maximize net income, each segment and firm is assumed to desire as large a portion of the protein premium as possible. What apparently occurs, is that consumer desire for particular qualitative characteristics creates an increase in price for the bakery product which meets consumer acceptance. The increased price for the product stimulates demand for the type of flour used in the production of the bread. Bakers are thereby compelled by competition to bid against one another to maintain a constant flow of the sometimes scarce flour of specific qualitative characteristics which meets baker's requirements. Miller competition necessitates bidding high protein hard red spring wheat above ordinary wheat in order to attract it out of other trade channels, such as export markets, feed and industrial uses. Speculators assume risk in buying high protein wheat in anticipation of increased prices. Brokers and commission firms provide a service to millers in seeking out buyers and sellers. Terminal operators and country elevator operators purchase and

store high protein wheat, segregate, blend and allocate it as the needs of millers dictate. Producers are at the opposite extreme from consumers in the breakdown of marketing into its specialized functions. After each of the specialized organizations has computed the cardinal costs associated with performing their service to society, the balance of premium reflects to producers. Thus, the price of flour utilized in the production of high protein products may have only a small range of variation from year to year, whereas the range in premiums may vary a considerable portion. It is not appropriate to conclude that the marketing segments gain monopolistic profits in the form of economic rent through the stickiness in price assumed to be associated with flour sales. In some years (when premiums are high) it could be feasibly concluded that millers and bakers realize losses in order to supply their customers with uniform lots of flour or bread. Long run profit maximization may be more applicable to the large scale organizations associated with marketing high protein hard red spring wheat.

There is the individual problem of each specialized industry attempting to gain as large a share of the premium consistent with short or long run profit maximization. Theory relating to the distribution of premiums between millers and producers is reserved for Section III of Chapter II.

Producers:

Producers of high protein hard red spring wheat face the problem of uncertainty and risk in attempting to perform their function in the market. The economic motive for producing and marketing is monetary reward; a return on the land, labor and capital sufficient to maintain or increase

production of the particular commodity. Uncertainty and risk of premium fluctuations creates problems of production as well as marketing for producers of high protein hard red spring wheat.

Within the confines of economic terminology, hard red spring wheat growers produce that supply of wheat which equates the marginal cost of an additional unit of input (land, labor or capital) to the marginal return realized from the additional product. Thus the cost of producing an additional unit is just equal to the price received for it. At this level of production producers maximize net revenue. The implications of the theory in relation to supply of high protein wheat which will come on the market is reserved for Chapter II. It is significant to note here the fact that premiums fluctuate from year to year as well as within the year. Table III, (Appendix,) records the 20 year average premium, by per cent protein, paid to producers in Montana. The premium by years for wheat of 12 per cent to 17 per cent protein is presented in Table IV (Appendix). It will be seen from these tables that yearly average premiums for 15 per cent protein ranged from an average of 3.1 cents in 1934 to 25.5 cents in 1948. In 1952, the premiums for 15 per cent protein averaged 6.4 cents. Producers are also uncertain of the amount the premium will fluctuate from month to month within the crop year. Table V records the mid-month base price and protein premium quoted for 20 years, from 1933 to 1952, inclusive. In 1951 the range in mid-month quotations for 15 per cent protein was from a low of 6 cents in December 1951 to a high of 22 cents in July 1951. Adjusting the production and marketing costs to the price received requires more adequate knowledge of price fluctuations than is presently available

to the producers.

It may be argued by some that the costs of producing high protein hard red spring wheat are covered by the base price received for ordinary protein wheat. Some justification for the argument is found in the nature of cost associated with production in the following statement:

"The foregoing review of literature indicates that precipitation, temperature, and soil, are the chief environmental factors affecting the protein content of wheat". 1/

The question arises as to what portion of the marketing function is or can be performed by the producer and at what cost? Producers perform part of the function of allocation through the methods employed in binning. They may mix high protein hard red spring wheat with low protein hard red spring wheat or they may keep separate bins. Producers may also special bin high protein wheat at the local elevator and ship on consignment. They may or they may not use high protein wheat for seed and feed. It is reasonable to assume that producers could initiate substantial costs in segregating and allocating the high protein wheat produced on their farm. Most of the segregation decision would be required at harvest time. Once the wheat has been segregatively placed in bins it may be mixed to varying protein contents later in the season. With respect to allocation during the market year, producers may market in the Fall or hold wheat for a more timely period. Some knowledge relative to premium fluctuations may guide producers' decisions relative to orderly marketing of the product.

1/ J. Ansel Anderson and William J. Eva; Variation in the Protein Content of Western Canadian Wheat 1927-1938, Board of Grain Commissioners for Canada, Grain Research Laboratory, Winnipeg, Manitoba, Bulletin No. 4, June, 1943, p. 21.

Legal requirements, (page 44) designed to protect producers of high protein wheat, do not adequately reflect premiums to high protein wheat producers in all areas of production. Producers in Montana are paid on the basis of individual protein determinations, whereas producers in North Dakota receive a station average premium. If an individual producer in North Dakota had 16% protein wheat on his farm and the station average protein content was established by elevator operators at 15 per cent, the producer would lose the amount of premium established on the Grain Exchange between 15 per cent and 16 per cent wheat. But some other producer within the station area stands to gain on the basis of station average protein marketing. If a producer had 14 per cent wheat and the station average was 15 per cent, his gain would be the difference in premium between 14 per cent and 15 per cent protein.

One other aspect of the protein premium which is of importance in maximizing individual profit is the factor associated with the qualitative characteristics, in relation to quantitative determination of protein in the wheat. Some varieties of wheat are of poor quality protein, that is, there is not a good correlation between baking quality of flour and protein content. There are some varieties of hard red spring wheat which produce high bushel yields and high protein content but the protein does not have the milling and baking characteristics of other varieties (see "quality", p. 31). Millers tend to pay a premium below what they could pay if only the quality of wheat they desire were allocated to them. Thus, producers of better quality wheat must take less than they might otherwise receive, and producers of poorer quality wheat gain a gratuity to the

extent that they are paid the same premium for an undesired variety of 15 per cent protein as the producer growing the desired variety.

Elevator Operators' Problems.

Elevator operators--terminal or country operator--are able to hedge the risk of price fluctuations of ordinary protein wheat, and thus substantially reduce the marketing risk associated with purchases and sales. In the handling of high protein wheat there is no possibility of hedging against premium changes and elevator operators must bear this risk. The function of blending, storing, and risk bearing constitute costs associated with elevator operators' portion of marketing high protein wheat. Elevator operators mix various grades of wheat to obtain the desired bushel weight and moisture content as well as protein per cent. The facilities of country and terminal operators are far more adequately organized to permit the performance of this function than are the facilities available to producers. Producers generally lack the variety of grades and protein contents of wheat available to elevator operators for making suitable blends to meet various market situations. If a line elevator operator receives an order for a carlot of 15 per cent protein, No. 2 hard red spring wheat, containing 14 per cent moisture, his facilities can be readily utilized to blend from various bins to obtain the desired specifications. Considerable blending knowledge, acquired through practical experience over a number of years, is associated with the satisfactory performance of this function.

The risk and uncertainty of price changes places elevator operators in a speculative position in marketing high protein wheat. To reduce the

risk and uncertainty, it becomes imperative that more adequate knowledge be acquired relative to factors affecting supply of and demand for high protein hard red spring wheat and the consequential effects on premiums. Commission Firms' and Brokers' Problems in Allocating Wheat.

Mill buyers often turn over the problem of acquiring specific quantities of high protein wheat to the commission firm or broker. The allocative function is subject to a fixed charge for bringing buyer and seller together. As such, the Commission firm assumes very little risk in handling the contracts. On rare occasions the commission firm will enter the speculative market by assuming the risk of ownership for a day or two, but it is not common practice.

Millers

The private problem of the miller is similar in economic respect to the private problem of the producer. Millers today attempt to maintain good customer relations through quality control in the product they sell. Storck and Teague sum up the private problem of profit maximization in the following statement:

"For a time the large-scale miller, like many industrialists of a buccaneering era, often prided himself on a 'hard-headed realism' which was really a short-sighted opportunism. In the 80's the miller frequently summarized his economic philosophy in the statement that 'the best miller is the one that makes the most money'. But this slick maxim would soon be superseded by another, less grounded in immediate expediency but more in harmony with the new industrial order then beginning to take shape. This revised rule states that 'the best mill is the one that continues to make the most money'." ^{1/}

^{1/} John Storck and Walter Dorwin Teague, Flour for Man's Bread, Minneapolis, University of Minnesota Press, 1952, p. 325.

The primary function of the miller, as a specialized industry, is to provide the service of grinding the wheat for the baker. Bakers require flour of specific qualitative standards and order partially on the basis of quantitative specifications. There is a rigid limit to the tolerance the baker will allow relative to baking quality. A particular mill order will specify the desired protein content, ash content, color index, pH (a measure of acidity), water absorption capacity and other factors, depending on the type of bread they wish to produce. The following statement by Storck and Teague shows the complexity of the problem confronting millers in attempting to provide the service of grinding flours to bakers' specifications:

"It was not until after 1900 that the expansion of large-scale baking opened up a constantly growing demand for types of flour quite different from those used in the home, flours adapted to high-speed mechanical mixers and to quick, absolutely dependable fermentation. Today approximately three-fifths of the call for American flour comes from bakeries, while another one-sixth arises from institutions and from industrial users, leaving about one-fourth of the demand as the share of the home. From about 1900, as this market began to grow, millers took to calling second-grade flours, formerly 'bakers', by the new name of 'clears'. The modern baker has little use for nondescript flours. Millers, in fact, were increasingly asked to build flours to precise bakery specifications where an excess of otherwise good qualities was just as undesirable as a deficiency; for satisfactory bread an unusually strong flour would make it necessary to change formulas and procedures. The millers also found themselves dealing with highly-price-conscious purchasers, driven by competition and familiar with every known factor in good bread making and therefore able to choose a number of ways of reaching a desired result. As a consequence wheat blending began to play a more important part in American milling." 1/

1/ Ibid, p. 274.

Bakers.

The profit motive is essentially the same for bakers as for other segments of society; in marketing high protein wheat, the method differs. High protein flour and water absorption capacity are compatible characteristics of hard red spring wheat. With a greater number of loaves of bread obtainable from a given quantity of wheat flour, bakers acquire a more favorable competitive position.

Bakers are also keenly aware of the necessity of being consistent in the quality of the bakery products they produce. For this reason, based on the maximizing of profit in the long run, bakers are required to utilize a flour containing specific quantities of protein. Mixing tolerance of the dough produced from high protein hard red spring wheat varieties is a measureable quality. Severe losses may be created through utilization of low protein wheats or high protein wheats which have a tendency to break down under mechanical mixing devices utilized in the mass production of bread.

Consumers.

High protein wheat loses its identity as such in most bakery products. Consumers' tastes are a combination of factors (outlined in Chapter II, p. 65) relating to maximum satisfaction through the utility of the commodity consumed. Protein content is positively correlated with the freshness, volume, and texture of an ordinary loaf of bread, but protein content and loaf discoloration are also positively correlated. Consumers generally react favorably to bakers' advertisements concerning the whiteness of the loaf so it would appear that some favorable characteristics of high protein

wheat flour are off-set by adverse characteristics.

There appears to be very little relationship between desirable characteristics expressed by consumers to the nutritional value imparted into the bread by high protein flour. Ordinary baker's bread requires approximately 11.3 per cent to 12.5 per cent protein flour, produced from a 13.5 per cent wheat. 1/ The demand for higher protein wheat (16 per cent and over) originates with consumer preference for a particular loaf of bread such as the French loaf which requires high protein flour. Ethnic groups create an additional demand for high protein wheat flour (14.25 to 14.50 protein) for the production of unleavened bread. A limited special flour export trade requires a 14.75 per cent and 15 per cent protein wheat which should produce a flour ranging from 13.25 per cent to 13.50 per cent protein. 2/

Social Welfare.

Governmental action has historically been sympathetic to increasing the share of the social product going to farmers. The increased portion of gross national income received by primary producers provides impetus for increased productivity. If social action were to intervene in allocating a minimum premium for high protein wheat producers of this wheat would, theoretically be induced to increase the production, analogous to the present parity pricing and its consequential effect on the production of corn, ordinary wheat, and cotton.

1/ Personal correspondence with Henry O. Putnam, Northwest Crop Improvement Association, 408 Flour Exchange, Minneapolis 15, Minnesota, May 5, 1953.

2/ Ibid.

If the premium to producers is not sufficient to induce further production of high protein hard red spring wheat, and if premiums are regarded as strictly a supplemental price to the base price for wheat, and if cost of production of high protein are mainly gratuitous, then producers may gain an increment of social product in the form of economic rent (an additional profit above normal returns to land, labor and capital) through the receipt of a compulsory minimum protein premium. Further, if the economic rent did not induce increased productivity, or if the absence of a premium did not reduce the amount of high protein premium coming on the market, millers would not be required to pay premiums in order to receive high protein wheat, or they could pay any amount up to the profit they would gain through the use of high protein hard red spring wheat. Social welfare would not be increased under the foregoing assumptions if producers were made better off in terms of increased satisfaction by the fixing of a minimum premium to them.

Reder defines economic welfare as:

"Welfare increases (decreases) whenever one or more individuals become more (less) satisfied without any other individuals becoming less (more) satisfied."^{1/}

With Reder's definition applied to the above assumptions, economic welfare would not be increased through the distribution of premiums among marketing segments. Millers would lose that portion of economic rent which producers would derive, and the amount of high protein wheat avail-

^{1/} Melvin Warren Reder, Studies in the Theory of Welfare Economics, New York, Columbia University Press, 1947, pp. 14 and 17.

able to consumers would neither be increased or decreased. 1/

It is not impractical to assume that, given a fixed amount of wheat for the crop year, producers could increase the amount of high protein wheat which enters the market by special binning techniques, feeding and seeding low protein wheat and marketing the high protein wheat. If the market operates within the concept of monopolistic control, millers would not purchase as large a quantity as would be purchased under conditions of perfect competition. Society would lose a portion of high protein wheat in terms of mal-allocation (it may be seeded, or fed to hogs).

1/ Theory of economic rent under assumptions of imperfect competition is presented in Chapter II, Section III.

Part III -- Wheat Quality and Protein PremiumsProducers.

To most producers of high protein hard red spring wheat protein content is assumed to be the indicator of quality. The assumption that the quantitative measure is also a qualitative measure is economically valid for producers because there is no difference in the premium for different varieties within the hard red spring wheat class. For example, the price quotations for protein and also the base price for Thatcher variety and for Spinkota variety are the same even though Spinkota is not a recommended variety because it produces fine granulated, weak flour and a poor loaf of bread. 1/

In referring to quality it is important to define the term within limits according to the segment of society specifically concerned. For economic analysis, price is a measure of utility, and the term "quality" may reasonably be considered analogous to the term "protein content" when we analyze the individual problem of the producer, particularly with reference to his attempt to maximize net income in the short run. There are indications that the producer segment is becoming more aware of the long run advantages of fitting their production planning to the needs of the miller and baker in the production of a differentiated product. Recent attempts to organize crop improvement associations in the hard red spring wheat area of the United States are meeting with favorable producer re-

1/ J. Allen Clark and B. B. Bayles, Distribution of the Varieties and Classes of Wheat in the United States in 1949, U.S.D.A., Washington, D.C., Circular No. 861, March, 1951, p. 49.

sponse. Some producers feel that the continued production of varieties that are high yielding but have poor milling and baking quality is creating a reduction in the favorable competitive position of the hard red spring wheat class of wheat.

Millers.

Protein premiums, as an economic measure designed to allocate high protein wheat through the marketing channels are based on the quantitative test for nitrogen. This test is known as the Kjeldahl test and is a fairly accurate measure of the crude protein contained in a sample of wheat. 1/ The relationship of protein content with baking quality has been studied for hard red spring wheat.

"In studying this phase of the question, Larmour (1930) concluded that correlation coefficients for wheat protein and quality, as measured by the bromate baking method, were in practically all cases sufficiently high to warrant concluding that the relation is significant enough to justify the commercial use of the protein test as a factor in the classification of hard red spring wheat." 2/

In later studies, the same author concluded that it seemed unlikely that a single standard baking procedure which would reveal the true strength of a series of flours can ever be devised. Fisher 3/ concluded that a strong flour which will produce good bread over a long period is less subject to

1/ C. H. Bailey, Protein Surveys of American Hard Spring and Soft Winter Wheats, University of Minnesota, Agricultural Experiment Station, Tech. Bul. 147, June, 1941, p. 5.

2/ T. R. Aitken and W. F. Geddes, The Behaviour of Strong Flours of Widely Varying Protein Content when Subjected to Normal and Severe Baking Procedures, Board of Grain Commissioners, Grain Research Laboratory, Winnipeg, Canada, Reprinted from Cereal Chemistry, Vol. XI, No. 5, Sept., 1934, p. 487.

3/ Ibid, p. 488.

fermentation tolerances and will withstand more overmixing when combining with other ingredients, and is therefore more suitable to bakers using mass production techniques. Aitken and Geddes studied the correlation between loaf volume and protein content and found the correlation to range between 29.44 and 59.25 depending on the malt and bromate treatment. Analysis of variance showed that the various regressions due to different levels of bromate were not significantly different. 1/ They concluded that when testing a series of flours of similar protein character where gas production was not a limiting factor, the 0.001 per cent bromate formula, in particular, yielded volumes which were essentially a measure of the protein content.

Prior to purchase the miller has only the grade, established by Federal Grade Standard, 2/ which sets the limits of test weight, damaged kernels, moisture, foreign matter, and wheats of other classes, and the additional increment of quality reflected by the protein content expressed as a percentage. There are many other factors which generally bear a relationship to the quality of flour that can be produced from the wheat. Among the more important factors taken into consideration by the miller when he is able to test a sample of the wheat which he has purchased are the following: flour yield, ash content, diastatic activity, gassing

1/ T. R. Aitken and W. F. Geddes, The Relation Between Protein Content and Strength of Gluten-enriched Flours, Board of Grain Commissioners, Grain Research Laboratory, Winnipeg, Canada, (Reprinted from Cereal Chemistry, Vol. XVI, No. 2, March, 1939, p. 229).

2/ Grain Branch, Handbook of Official Grain Standard of the United States, U.S.D.A., Production and Marketing Administration, U.S. Govt. Printing Office, Washington, 1950.

power, pigment content, vitamin content, mixing tolerance, absorption capacity, and baking tests which reveal the crumb structure and texture of the loaf.

Each miller may possibly have a different definition of quality based on the findings of the individual tests and his weighting based on judgment of the relative merits of each test performed. Aitken and Anderson conducted a study in which they hoped to ascertain the suitability of new varieties by tests performed simultaneously by 20 collaborating chemists in Canada, United States and Great Britain. There was a general lack of agreement among the cereal chemists as to the value of the 7 hard red spring wheat varieties submitted with respect to over-all quality. They concluded the results of their findings with the following statement:

"Several explanations are offered which may account for the variations in opinion found, and among these are; the use the collaborator intends to make of the wheat; the properties given most weight in assessing over-all quality; the volume of testing done; the interpretation of the data; and the principles underlying comparisons. On the other hand, some collaborators have opposite opinions on specific qualities of the same variety that are difficult to understand.

The results of the investigation show that cereal chemists hold different opinions on what constitutes bread-making quality and on how this should be measured. The difficulties of reaching decisions on the merits of new varieties are all too apparent". 1/

The time factor must be taken into consideration in marketing high protein hard red spring wheat, and for this reason it is not appropriate to conduct the various tests employed by millers prior to the time the

1/ T. R. Aitken and J. Ansel Anderson, Conflicting Opinions on the Quality of Bread Wheats, Grain Research Laboratory, Board of Grain Commissioners for Canada, Winnipeg, Manitoba, April, 1947, p. 18.

