An analysis of the optimal allocation of resources under the provisions of the l977 Food and Agricultural Act
by Duane Allen Griffith

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Applied Economics
Montana State University

Abstract:
This study evaluates the impact of the 1977 Food and Agriculture Act on the allocation of resources of dryland grain farms in Montana. Typical farm sizes were determined and used as representative farms in this analysis.

Implementation of the 1977 Food and Agriculture Act created many possible options for Montana grain producers. These options were included in a linear programming model which determined the optimal allocation of resources under provisions of the 1977 Food and Agriculture Act. Activities were also included to allow for nonparticipation if this proved to be the most profitable allocation of resources.

The resource base for each representative farm included: total cropable acres including summer fallow, the farm’s assigned normal crop acreage, the farm's assigned program yields for wheat and barley and the acreages of wheat and barley harvested for grain in 1977.

Several factors affect the allocation of resources to competing alternatives within the Farm Program and to activities outside of the Farm Program. These factors include expected prices and yields, normal crop acreage relative to total crop acreage, willingness to plant more acreage than assigned normal crop acres and assigned program yields relative to expected yields. These factors were varied to determine their impact on allocation of resources to program and nonprogram activities for the representative farms.

Results indicate the uniqueness of each case with respect to expected prices and yields, program yields and the expressed willingness of producers to deviate from traditional crops and cultural practices. This uniqueness makes generalizations difficult to draw, and points out the need for analysis of individual farms in order to determine optimal cropping systems under the provisions of the Food and Agriculture Act of 1977.

The work done in this thesis served as the base from which MSU Agricultural Economists developed a decision model available to individual farmers via the AGNET computer system.

STATEMENT OF PERMISSION TO COPY

In presenting this thesis in partial fulfillment of the requirements for an advance degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature Duane Griffith

Date June 5, 1979

AN ANALYSIS OF THE OPTIMAL ALLOCATION OF
RESOURCES UNDER THE PROVISIONS OF THE
1977 FOOD AND AGRICULTURAL ACT

by

DUANE ALLEN GRIFFITH

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Applied Economics

Approved:

M. S. Stauber Jr.
Chairperson, Graduate Committee

R. Clyde Greer
Head, Major Department

Henry L Parsons
Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

May, 1979

ACKNOWLEDGMENTS

I wish to express my gratitude to the members of my thesis committee, Dr. Martin S. Stauber, Dr. LeRoy Luft, Dr. John Marsh and Dr. Roger Brownson. I would especially like to thank Dr. Stauber for his guidance and extra effort in helping complete this thesis and Dr. Luft for time to work on my thesis during the working hours.

My deepest debt of gratitude is to my wife, Deanna. She has spent many evenings at home caring for our two little girls, Amy Jo and Brandy Lynne. She has typed all of the drafts and has lent immeasurable support while working on this study. A special thanks to all of these people.

TABLE OF CONTENTS

TABLE OF CONTENTS

Continued

TABLE OF CONTENTS

Continued

LIST OF TABLES

LIST OF APPENDIX TABLES

ABSTRACT

This study evaluates the impact of the 1977 Food and Agriculture Act on the allocation of resources of dryland grain farms in Montana. Typical farm sizes were determined and used as representative farms in this analysis.

Implementation of the 1977 Food and Agriculture Act created many possible options for Montana grain producers. These options were included in a linear programming model which determined the optimal allocation of resources under provisions of the 1977 Food and Agriculture Act. Activities were also included to allow for nonparticipation if this proved to be the most profitable allocation of resources.

The resource base for each representative farm included: total cropable acres including summer fallow, the farm's assigned normal crop acreage, the farm's assigned program yields for wheat and barley and the acreages of wheat and barley harvested for grain in 1977.

Several factors affect the allocation of resources to competing alternatives within the Farm Program and to activities outside of the Farm Program. These factors include expected prices and yields, normal crop acreage relative to total crop acreage, willingness to plant more acreage than assigned normal crop acres and assigned program yields relative to expected yields. These factors were varied to determine their impact on allocation of resources to program and nonprogram activities for the representative farms.

Results indicate the uniqueness of each case with respect to expected prices and yields, program yields and the expressed willingness of producers to deviate from traditional crops and cultural practices. This uniqueness makes generalizations difficult to draw, and points out the need for analysis of individual farms in order to determine optimal cropping systems under the provisions of the Food and Agriculture Act of 1977.

The work done in this thesis served as the base from which MSU Agricultural Economists developed a decision model available to individual farmers via the AGNET computer system.

INTRODUCTION

Wheat and barley are the major cash crops grown in Montana. Due to continued large crops and mounting stocks of these grains, the United States government developed and implemented a farm program designed to restrict supply of these crops and thereby boost the farm incomes in 1978 and beyond. This program, called "The Food and Agriculture Act of 1977", will remain in effect for a four year period.

Although government programs with similar objectives have been common in agriculture in the past, the Food and Agriculture Act of 1977 has new features which pose significant decision-making problems for Montana grain producers. These decision-making problems are associated with the flexibility the new farm program allows grain producers in determining their cropping patterns. This flexibility allows the producer to tailor his cropping enterprises to current market forces, his resource base, and personal preferences. This flexibility also dictates that a producer seeking to maximize profits examine many cropping alternatives.

OBJECTIVES

The major objective of this study is to develop a linear programming model which will aid individual Montana dryland grain producers in selecting optimal cropping patterns under the regulations of The Food and Agriculture Act of 1977 (Farm Program).

This study has three secondary objectives. 1) To derive general conclusions concerning the impact resource bases, in combination with enterprise returns, have on the selection and profitability of various options under the new Farm Program. 2) To determine what factors will have significant impact on a producer's decision to comply or not comply with the Farm Program. 3) To develop the decision model in a format easily adapted to AGNET, a computer based agricultural information system. This will make the decision model readily available to producers confronted with decisions regarding compliance with the Farm Program.

There are many different ways in which cropping alternatives can be evaluated. Preparation of several different complete budgets which analyze the costs and benefits associated with alternative cropping patterns is one way. Preparation of several partial budgets which analyze alternative cropping patterns is also feasible. The task of calculating complete or partial budgets to analyze the possible alternatives available to producers can become complex and does not assure an optimal allocation of resources. A more efficient method of optimizing the income from cropping alternatives is through the use of linear programming.

The use of linear programming requires the specification of an objective function, the set of activities producers may participate in and restrictions on use of resources. The objective function used in this study maximizes returns over variable costs and resource restrictions are limits placed on the use of the resource base for each representative farm. Many of the restrictions placed on representative farms arise from the rules producers must follow to comply with the Farm Program.

When using linear programming a decision must be made with respect to the complexity and detail of the model. A relatively simple linear programming model, emphasizing the constraints government program compliance places on the use of resources, was sufficient to accomplish the objectives of this study.

Two decision periods are relevant to this analysis. One decision period is before fall crops are planted and the other before spring crops are planted. The linear programming model for the fall decision period provides a profit maximizing solution utilizing the information provided at that time. However, as input and output prices change and more information becomes available through time on expected crop yields or as the rules of the Farm Program are modified, a different cropping system may result in profit maximization when spring planting decisions are made. This study concentrates on the fall planting period but a model for the spring planting period is presented and explained also[1/].

1/ See Appendix A for a detailed listing of the spring and fall decision models and an explanation of the differences between the spring and fall decision models.

The data for the linear programming model is presented using a representative farm approach. Three sizes of farms with respect to acres of cropland were established based on information gathered at a series of meetings with Montana grain producers. Enterprise cost studies developed by the Cooperative Extension Service in 1978 were also utilized.

THE FARM PROGRAM

The Food and Agriculture Act of 1977 brought with it a new farm program. This program was designed and implemented in an effort to reduce the planted acreage of selected feed and food grains while providing an acceptable level of farm income through price supports and direct payments. To achieve this goal, the authors of the Farm Program employed some new concepts while retaining old ones.

A discussion of the Farm Program will prove useful before getting into the actual analysis of the Farm Program cropping options. This discussion will be presented in two parts. The first section is a discussion of the general aspects of the Farm Program. This section also describes the resource base for each of the representative farms used in analyzing the Farm Program. The second section is a discussion of the rules for complying with the Farm Program when producing the major dryland program crops in Montana.

THE FARM PROGRAM IN GENERAL

One of the new elements of this Farm Program is the concept of normal crop acres (NCA). Closely associated with NCA are NCA crops. NCA crops are crops that require or use up an acre, plus the set-aside requirement, if any, of NCA for every acre of the particular crop planted.

The Agricultural Stabilization and Conservation Service (ASCS) County Committee was given the task of assigning each grain producer in their county an NCA base for his operation. To do this, the ASCS has to determine which crops grown in Montana were to be designated as NCA crops. This list of crops includes wheat, barley, corn, oats, rye, sugar beets, flax, grain sorghum, sunflowers and dry edible beans. To derive the NCA for each producer, the ASCS County Committee used the sum of NCA crops the producer has planted in 1977 plus any volunteer acreages of NCA crops harvested for grain as reported by the producer. The NCA each producer received may not have been the simple sum of acreages of NCA crops he reported in 1977. After receiving the reported NCA crops and their planted acreages, the ASCS County Committee reviewed each producer's report and made revisions to allow for special situations which would affect reported NCA. These situations include producers who farm in an odd-even rotation or had acreage they were prevented from planting in 1977. Besides the adjustments stated above, other adjustments could be made if the situation warranted[2/]. The NCA adjustment process for individual producers is limited to plus or minus one percent of the county NCA over the four year period from 1977-1981. There are exemptions and provisions for adjusting producer's NCA's if the one percent limit is exceeded[3/].

2/ United States Department of Agriculture, Agricultural Stabilization and Conservation Service, Feed Grain, Rice, Upland Cotton and Wheat Programs Handbook, Revision Three, February 8, 1978, Montana Notice 5-PA (Rev. 3) Par. 27.

3/ USDA, ASCS, Montana Notice 5-Pa (Rev. 3) Par. 27 Idem.

The NCA was also split between the NCA crops which the producer normally grew. For example, if a producer received an NCA of 1,000 acres in total, it would be split into the acreages of NCA crops he normally grew. This may have been 500 acres of wheat and 500 acres of barley or any other combination of acreages of NCA crops.

The particular crop mix a producer reported is important because this crop mix influences the amount of acres he could plant under various options of the Farm Program.

After receiving NCA notices, producers had a fifteen day appeal period during which they could present arguments for revisions of their total NCA or the crop mix, of which their NCA was composed. The NCA producers received after adjustment by the County ASCS Committee and appeals by the producer serves as a base for that farm from 1977 through the 1981 production periods.

Program Yields

Another task allocated to the ASCS County Committee was to assign program yields to each producer who grew wheat and/or barley. The State ASCS Committee provided each county with a program yield for that county based on historic yields obtained from the Economics, Statistics and Cooperative Service (ESCS). The base period used for obtaining the county program yield was 1974 through 1976. Historic yields, for each NCA crop which required a program yield, were averaged to obtain an initial county yield. The initial county yield was adjusted through established procedures to arrive at final program yields for each county[4/]. A complete list of program yields by county and by crop is given in the Appendix[5/].

When assigning individual producer's program yields the ASCS County Committee considered a particular producers operation with respect to other producers in that county as well as the program yields assigned to that county by the State ASCS Committee. Whenever an upward adjustment was made to an individuals program yields, this dictated a downward adjustment in another individuals program yields for the same crop. These offsetting adjustments were necessary to maintain the county program yields assigned by the State ASCS Committee.

It should be noted there are four NCA crops which have program yields associated with them in Montana (wheat, barley, corn, grain sorghum), but only two of these four were used in this study. Corn and grain sorghum are raised by only a few producers in Montana so these crops were not considered in this study.

Resource Base

The combination of four items: acres of NCA, program yield, crop mix and total cropland make up the resource base of the representative farms used in the analysis. There are obviously other

---

4/ USDA, ASCS, Montana Notice 5-Pa-105, Ibid.

5/ See Appendix C for a complete list of program yields assigned to all counties in Montana.

factors important in the production of small grains, but of these four items, three are designated for individual farms by the County ASCS Committee and they determine not only the options available to a producer, but also to some extent, the possible benefits the producer can receive by participating in the program. The fourth factor, total cropland, is considered because of its' possible impact on the producer's willingness to participate in the Farm Program. Factors of production not included in this study have a bearing on revenues a producer will receive from the farming enterprise but have little to do with benefits he can receive from growing crops in compliance with the Farm Program. Therefore, only acres of NCA, program yield, crop mix, and total cropland are included as important characteristics of the representative farms.

Offsetting Compliance

Producers who lease farmland in addition to their own operations must meet offsetting compliance regulations imposed by the Farm Program. If a producer participates in the Farm Program by growing NCA crops on his owned NCA acreage and meets all of the program provisions, the program specifies he is not able to overplant the NCA associated with the land he leases if he plants crops which have a set-aside associated with them. The producer is able to overplant the NCA on land he leases if he grows crops which have no set-aside, even though they may be NCA crops such as oats or rye[6/]. The producer is also eligible to receive any program benefits associated with these non set-aside NCA crops.

Producers planting an NCA crop requiring set-aside on leased land do not have to make voluntary reductions nor meet set-aside requirements. The wheat or barley planted on the leased land under these conditions will not qualitfy for deficiency payments, disaster payments, Commodity Credit Corporation loans, or the Reserve Program. Wheat or barley on the leasee's owned land will qualify for all of these provisions if program requirements are met.

These rules apply to producers who operate more than two farms while owning both, as well as producers who own one farm and lease another. A problem encountered here is the definition of a farm. If a producer owns two different parcels of land and they are close together, within the same county, and farmed with the same machinery, the ASCS County Committee considers the operation to be one farm and the off-setting compliance rules would not apply.

6/ Denny, Virgil et al., Gallatin County Agricultural Stabilization and Conservation Newsletter, February 1978, p. 1.

Cross Compliance

Cross compliance provisions of the Farm Program state that producers who wish to receive program benefits from growing one NCA crop must then grow all NCA crops in compliance with program rules[7/]. This means producers who wish to grow wheat and receive program benefits can not grow barley outside of the Farm Program. This holds for any combination of NCA crops which can be grown.

Deficiency Payments

Deficiency payments were designed to support prices at an "socially acceptable" level to be determined through the legislative process. Deficiency payments are based on the target price and loan rate mechanism provided by the Farm Program. The deficiency payment is the difference between the larger of the national average loan rate or national average market price during the first five months of the marketing year and the target price for the crop in question[8/]. The national average market price is a weighted price from 200 locations throughout the United States taken over the first five months of the marketing year (June-October). The larger the national average market price the smaller the deficiency payment and if the national

7/ United States Department of Agriculture, Agricultural Stabilization and Conservation Service, ASCS Commodity Fact Sheet 1978 Feed Grain Program (Washington: Government Printing Office, 1978) p. 4.

8/ USDA, ASCS, ASCS Commodity Fact Sheet 1978 Feed Grain Program, Ibid., p. 4.

average market price reaches or exceeds the target price then there will be no deficiency payments.

The amount of deficiency payment a producer received depends upon the program yield he has for wheat and barley, the number of acres he has planted to wheat or barley, the option he chooses to participate in, and the final determination of the allocation factor (K-factor) for partial deficiency payment options. The producer may choose to grow wheat or barley for either full or partial deficiency payments.

The effects of program yield and the amount of NCA are fairly obvious but a discussion of full or partial deficiency payments may be useful. Producers of wheat or barley, who wish to receive full deficiency payments must make voluntary acreage reductions and meet set-aside requirements, as explained later. This guarantees target price protection on 100% of the planted acreage harvested for grain. Target price protection is the payment of deficiency payments to assure producers of receiving \$3.40 per bushel for wheat or \$2.25 per bushel for barley.

Producers who chose the partial deficiency payment option will receive full target price protection on 80 to 100 percent of their acres planted for harvest as grain. The exact percentage of planted acreage guaranteed target price protection depends on a ratio called the K-factor.

The K-factor is calculated by dividing National Program Acreage (NPA) of either food or feed grains by the acreage of food or feed grains actually harvested. The Secretary of Agriculture determines each year the NPA for both food and feed grains by calculating the amount of food and feed grains needed to meet domestic and export needs, less imports, plus any desired adjustments in carryover stocks. For 1978, this acreage has been determined as 58.1 million acres for food grains and 88.7 million acres for feed grains. After harvest is completed the acreage actually harvested of both food and feed grains will be summed and these acreages will be divided into their respective national program acreages. The resulting factor, the K-factor, is then multiplied by the producer's harvested acreage to determine the percent of his acreage which will receive full target price protection under the partial deficiency payment options. The lower limit on this ratio is 80 percent and the upper limit is 100 percent.

The Farm Program also provides for prorating deficiency payments for producers who make voluntary reductions from their 1977 planted acreage but do not make the required 20% reduction to meet requirements for full deficiency payments[9/]. This adjustment process was intended

---

9/ United States Department of Agriculture, Agricultural Stabilization and Conservation Service, Feed Grain, Rice, Upland Cotton and Wheat Program Handbook, Revision Three, February 8, 1978, Montana Notice 5-Pa (Rev. 3) Par. 139.

to treat those producers who partially complied on an equitable basis relative to those who fully complied. Prorating the deficiency payments was not justified in this analysis because of the additional number of situations that would be necessary to show the impact this might have.

The deficiency payment, for the purposes of this study, was adjusted to reflect the historic different in United States wheat and barley prices and Montana wheat and barley prices. The previous ten years United States all wheat and barley prices, as reported in the Wheat Situation Report[10/], were used as an indicator of the national average market price. Since June through October is the relevant period in determining the national average market price, the same period was used to determine relationships between the United States all wheat price and the Montana all wheat price; the United States barley price and the Montana barley price. The difference in Montana all wheat price and Montana winter wheat price was also determined using the same data and time period. The differences between United States average all wheat price and Montana average all wheat price; the Montana average all wheat price and the Montana average winter wheat price was assumed to be additive.

10/ United States Department of Agriculture, Economic Research Service, Wheat Situation Report, WS-203, through WS-241.

These differences were summed to attain a difference of approximately $.15 per bushel with the United States all wheat price being higher than the Montana winter wheat price. This same $.15 relationship holds true for the United States barley price and the Montana barley price. This $.15 adjustment means Montana producers will not receive deficiency payments if Montana prices have reached $3.25 for wheat for $2.10 for barley. Using this $.15 per bushel differential as an indicator, when Montana winter wheat prices reach $3.25 and barley prices reach $2.10, then the United States wheat price should be $3.40 and barley prices should be $2.25 per bushel which would eliminate all deficiency payments.

Payment Limitations

Associated with deficiency and disaster payments are maximum limits on the payment any one producer may receive. For the 1978 crop year the maximum payment producers may receive for any one crop or combination of crops is $40,000. In 1979, it will be $45,000 and for 1980 and 1981, $50,000. Payments which are exempt from these limits include prevented planting and low yield disaster payments. Income received as loans or purchases of farm commodities by the ASCS are also exempt from payment limitations.

The ASCS will make payments on leased acreage where crops or proceeds are divided according to terms of the lease, in the same proportion as the crops or proceeds are divided unless the ASCS County

Committee receives written notice that payments will be shared in some other manner.

Disaster Payments

Farm Program provisions include payment for disasters of two types: low yield and prevented plantings. The provisions for these payments are not carried through the full four year period of the Farm Program as are the rest of the program's provisions. Legislative authority ends for these payments in 1979 with the intention of replacing this coverage by a new crop insurance program which is still in the development stage. Eligible producers prevented from planting wheat or barley due to flood, drought, or other natural disaster beyond the producer's control will receive payment on the smaller of 1) acreage intended to be planted, or 2) the amount the 1977 acreage for harvest exceeds the 1978 acreage. The payment calculation for prevented plantings is 75% of the program yield times 33 1/3 percent of the target price.

Low yield payment will be made to producers if the total quantity harvested is less than potential production obtained by multiplying 60% of the Farm Program yield times acreage planted for harvest. The low yield payment is calculated as 50% of the target price times the deficiency in yields below the 60% level.

The Farm Program does not allow doubling up of payments to producers. For example, producers who receive either low yield or prevented planting payments on bushels below the calculated level can not receive deficiency payments on the same bushels on which they received the disaster payments.

Set-aside

To be in compliance with rules of the Farm Program when growing wheat or barley, producers must set-aside a specified amount of land for each acre of wheat or barley they plant for harvest as grain. Planted acreage not harvested for grain because of a disaster must also be included for calculation of set-aside. There are no set-aside requirements for prevented plantings. Before land is eligible to be used as set-aside it must have been: 1) tilled in one or more of the previous three years in the production of a crop for other than hay or pasture, 2) determined by the County Committee (COC) to have been devoted in all of the previous three years to a hay crop used as hay, pasture, green chop or silage that was in a normal rotation pattern with a small grain or row crop, or 3) designated as set-aside in any one of the previous three years for which a set-aside program was in effect and was eligible when designated[11/].

11/ USDA, ASCS, Montana Notice 5-Pa (Rev. 3) Par. 41 op. cit.

If land meets the three requirements stated above then the following land is also eligible for use as set-aside: 1) land which will promote highway safety or will improve highway scenery, 2) small or irregular areas of cropland along streams or drainage ditches devoted to vegetative cover which can be used as a filter strip to reduce siltation of the stream or ditch. Land which is not eligible for use as set-aside includes: 1) land which is designated as set-aside under any other program, 2) land for which a prevented planting, low yield, or deficiency payment is made in the same calendar year, 3) turn areas, drainage ditches, sod waterways which were constructed before the fall of the year the set-aside is needed, and 4) wet low-lying areas, droughty knobs or banks, and areas with small size or irregular slope. Farm program regulations list other ineligible tracts of land but they would have very limited application for Montana[12/].

Approved cover and uses of set-aside include: annual, biennial or perennial grasses and legumes, including volunteer stands, other than weeds, which meet criteria set forth by the State Committee (STC)[13/] and small grains including volunteer stands other than weeds

---

12/ USDA, ASCS, Montana Notice 5-Pa (Rev.3) Par. 43. op. cit.

13/ Ibid.

which meet criteria set forth by the STC. These stands must be clipped to prevent seed formation. Trees or shrubs planted for erosion control, shelterbelts, or other forestry purposes or for wildlife habitat during the current year or fall of the preceeding year are eligible. Planting for wildlife food plots is also an approved practice given certain conditions are met[14/]. Acreage of crops destroyed by natural causes may be substituted for set-aside already designated if the proper conditions are met[15/].

Set-aside can not be grazed during the six-month growing period of May through October but grazing is permitted from November 1 through April 30th in Montana. The Secretary of Agriculture does have authority to allow emergency grazing of set-aside during the summer months.

The Secretary of Agriculture is required by law to announce the amounts of set-aside, if any, for wheat by August 15th and for feed grains by November 15th of the year prior to the year of harvest.

Although set-aside can be maintained several different ways, the most common method Montana producers will use will be stubble mulch. Stubble mulch is ground which was cropped the previous year and worked only slightly in the current year to control weeds. The

---

14/ USDA, ASCS, Montana Notice 5-Pa (Rev. 3) Par. 43. op. cit.

15/ Ibid.

cover left after a minimum of tillage operations provides protection against wind and water erosion while still conserving moisture and controlling weeds. The ASCS has established guidelines for the minimum residue required on stubble mulch to meet set-aside requirements and has developed guidelines for the number of machinery operations which will leave at least the minimum residue requirement[16/].

Producers may also plant crops approved by the ASCS for Agricultural Conservation Program (ACP) cost sharing to be used as set-aside. Crops planted under the ACP cost sharing program must be left in for a period of five years.

The most restrictive factor on the use of set-aside acreage is the programs' provision of not allowing any type of harvesting from the set-aside. When annual grasses or forage crops are used to satisfy set-aside requirements, they must be clipped and not grazed nor used for hay. Hay or grass which is clipped can not be baled for use as feed at a later date. When the ACP cost sharing program is used, the producer must not harvest the set-aside in any way during the first year of the program. After the first year of stand establishment, the producer can designate other acreage to meet set-aside requirements, if any, in the following years and then harvest crops he established under the ACP cost sharing program.

16/ USDA, ASCS, Montana Notice 5-Pa-112, op. cit.

The earliest date that any set-aside cover can be plowed down in preparation for fall seeding is August first.

Certification and Compliance

Producers who participate in the Farm Program must sign up at their local ASCS office by May first, in Montana, and at that time, state how they intend to comply. This is only a statement of intentions and not meant to be binding. By July 15th, producers must then certify they have complied with the rules of the Farm Program. The cropping pattern producers used when certifying does not have to be the same cropping pattern as their original stated intentions during the early sign up period. Signing up by the first of May only insures the producer will receive benefits the Farm Program offers while allowing additional time for him to make the final compliance decision. His stated intentions at sign-up time are also a check to see if what he plans to do will satisfy the regulations of the program. If conditions warrant, during any given year, the State ASCS Committee has the authority to change the date for the final sign-up period and also the date for certification. This allows flexibility within states which have climatic conditions which warrant consideration. It also allows for increased levels of participation through additional sign-ups.

FARM PROGRAM RULES WITH RESPECT TO PROGRAM CROPS IN MONTANA

The second section of this chapter is a discussion of the regulations of the Farm Program as they apply to specific crops. Only those crops and alternatives which fit Montana conditions are discussed here.

Wheat

Wheat is a program crop which requires a 20 percent voluntary reduction from the 1977 wheat base and .2 of an acre of set-aside for every acre harvested for grain. The voluntary reduction insures the producer of target price protection on 100% of his wheat acres harvested for grain. If the producer wishes to be in the program but does not wish to or cannot participate at the full deficiency payment level, he may participate under the partial deficiency payment option of the wheat program. Under the partial deficiency payment option, producers do not have to make voluntary reduction from their 1977 wheat base. Producers only need to meet the set-aside requirements which are 20 percent of the acres planted for harvest as grain.

For some producers, the partial deficiency payment option is their only available option if they want to grow wheat. This is the case if in 1977 the producer did not grow any wheat. Producers with no 1977 wheat base have no base from which they can make a voluntary reduction of 20 percent and therefore, can only participate in the partial deficiency payment option.

Spring wheat requires the same 20 percent set-aside as winter wheat and, of course, if the producer wishes to receive the full deficiency payments he must also make a voluntary 20 percent reduction from his 1977 wheat base. If producers plant some spring wheat and some winter wheat, the voluntary 20 percent reduction may be allocated in any manner between spring wheat and winter wheat.

If a producer overplanted his wheat base and wishes to be in the wheat program under the full deficiency payment option he can come into compliance by cutting wheat for hay. This allows producers to intentionally overplant in anticipation of cutting grain for hay or staying out of the program. There are two restrictions, with respect to time, which are imposed on cutting grain for hay. The producer must cut his wheat for hay before the 15th of July. This is the date for certifying he has complied with program rules. The second restriction placed on cutting grain for hay is that it must be cut before it reaches the early dough stage of development. Wheat cut for hay does not require an acre of NCA for every acre of wheat to be cut for hay nor does the producer have to designate set-aside acres for wheat he intends to harvest as hay.

There is considerable flexibility with regard to the final date and stage in which wheat cut for hay must be harvested. The State Committee has authority to change the final date for cutting wheat for hay as climatic conditions in the state change. When grain is left in beyond July 15th, it has more opportunity to mature past the early dough stage but it is still acceptable to be cut for hay if climatic conditions caused the extension of the compliance date.

Provisions under the wheat program include an option to graze or cut wheat for hay or silage during the summer months and receive payments. The previous discussion on cutting wheat for hay to comply with regulations of the program did not provide the producer with any type of payment. The acres producers designate to be cut for hay or grazed for payment cannot be the same acreage they intend to cut for hay in order to comply with acreage limitations of the program. The payment rate producers receive for wheat acreage, in this option, is the greater of $.50 or the deficiency payment times the producers program yield. Producers can elect to take a partial payment of $.25 times their program yield times the acreage they designate to be cut for hay or grazed at sign-up time.

The number of acres producers can harvest under this option of the program is limited. Producers may graze or cut for hay or silage up to 40 percent of their combined acreage of wheat and feed grains but the acreage designated for haying or grazing may be no greater than the amount of wheat planted. Producers may graze or cut for hay or silage at least 50 acres if this acreage is greater than 40 percent of their wheat and feed grain acreage.

Barley

Barley is one of several crops which come under the general heading of feed grains in the Farm Program. The feed grains considered in the Farm Program include corn, grain sorghum, barley and oats. Of these, barley and oats are the only crops considered in this study. Grain sorghum and corn are grown in Montana but only in minor amounts relative to barley and, therefore, are not considered.

There are several options producers may participate in when growing barley. These options parallel those of the wheat program closely.

To receive full deficiency payments for barley, producers must make a 20 percent reduction from the number of acres they planted to barley in 1977. In addition, they must set-aside one-tenth of an acre for every acre they plant for harvest as grain. Doing these two things, along with meeting requirements on other program crops, will assure the producer 100 percent of target price protection on his barley acreage. Producers may also participate in an additional diversion option while growing barley under the full deficiency payment option.

Barley may also be grown for partial deficiency payment. Partial deficiency payments, as explained earlier, are full deficiency payments on a portion of the planted acreage as determined by the K-factor. An additional diversion option can also be utilized if the producer chooses the partial deficiency payment option.

For partial deficiency payments, the Farm Program requires the producer to set-aside one-tenth acre for every acre planted for harvest as grain. The additional diversion option allows the producer to meet the requirements for full or partial deficiency payments, as stated above, plus set-aside an additional one-tenth of an acre for every acre he plants for harvest as grain. He then can receive regular deficiency payments plus a payment of $.12 times his program barley yield times the acres of barley planted for harvest as grain. If producers grow barley under this option, they may receive an advance payment of $.06 per bushel times their barley program yield times the acreage they have planted to barley for harvest as grain under the additional diversion option. The payment rate for the additional diversion option is the same whether the producer is growing barley for full deficiency payments or partial deficiency payments.

Barley can be cut for hay to allow the producer to comply with limitations on acreage harvested for grain. Barley cut for hay must be cut before July 15th. Barley acreage cut for hay does not count against the producer's NCA nor does he have to maintain set-aside for that acreage. Barley acreage cut for hay does not contribute to the number of acres producers can hay or graze under the wheat haying or grazing option of the Farm Program while barley harvested for grain does.

Other NCA Crops

Provisions of the Farm Program consider other NCA crops on a limited basis. Oats and rye, for example, are not given target price protection although the Secretary of Agriculture has authority to establish this protection. Since there is no target price for oats or rye, producers will not receive deficiency payments for growing these crops. Producers are not required to maintain any set-aside for planting oats or rye, but acreage planted to these crops count against the producers' NCA.

Oats and rye can also be cut for hay, if cut before July 15th, to allow the producer to comply with acreage limitations of the Farm Program. As with wheat and barley, oats and rye cut for hay do not contribute to the acreage a producer can designate as being in the wheat haying or grazing option. Oats cut for grain does not contribute to the possible acreage allowed under the wheat haying or grazing option.

Nonprogram Crops

Nonprogram crops are crops which the Farm Program does not consider as NCA crops and are not restricted in any way. Nonprogram crops may be grown along with program crops on unused acres of NCA or summer fallow and in addition to the NCA assigned to each producer. Some of the nonprogram crops in Montana are: safflower, sorghum grown for hay, mustard, rape, forage crops, speltz, triticale, and small grains cut for hay.

METHODOLOGY

A discussion of the methods used to collect data and determine the profit maximizing solution for representative farms is presented in this chapter. Farms, which are representative of Montana dryland grain producers, were established with major consideration given to size in acres and crop mix. Irrigated farming operations were not considered in this study. Costs of production studies completed by the Cooperative Extension Service provided cost of production estimates for each of the crops considered. These estimates combined with expected prices, program and expected yields, acres of NCA and cropping patterns in 1977, provide the necessary data for the linear programming model.

SOURCE OF DATA

Crop Production Costs

Data used to construct the enterprise budgets were obtained from farmer panels in selected areas throughout Montana. In each area the County Agent assembled a group of producers which were representative of the typical dryland farm in that area. The farmer panel provided concensus information on the types of crops grown, cropping patterns, quantity and type of inputs used in production, quantity and size of a typical machinery complement along with machinery performance rates, the costs of inputs used in production of the specified crops, yields timing of machinery operations and an inventory of buildings for the farm size established as typical for the area.

The information provided by the farmer panel on costs of producing the selected crops was organized so it could be processed by the Oklahoma State University budget generator to arrive at cost of production estimates for each enterprise considered in each area. These cost estimates were separated into fixed costs and variable costs. The variable costs for a particular enterprise from each of the selected areas were then averaged to arrive at an average variable cost of production for selected crops in Montana.

The dryland grain production areas are represented by Enterprise Cost Studies for McCone County, Roosevelt County, Valley County, Fergus County, Chouteau County, Hill County, Glacier County, Gallatin County, Northern Yellowstone, Stillwater and Golden Valley Counties, Pondera County, Sheridan-Daniels Counties, and the Pryor-Duck Creek-Beartooth area of South Central Montana[17/].

The average variable costs for each crop used in this study are presented in Table 1. Cost estimates for wheat, barley and fallow were obtained by computing a simple average of the variable costs estimated for each county. The safflower variable costs were obtained

---

17/ Luft, LeRoy D., Schaefer, Jerry, Griffith, Duane Enterprise Costs for Dryland Crops in Montana, See Cooperative Extension Service Bulletins 1176, 1178, 1179, 1181, 1185, 1133R, 1136R, 1138R, 1139R, 1140R, 1142R.

Table 1. Average Per Acre Variable Costs for Selected Crops in Montana, 1977-78[a].

Average Variable Costs	Winter Wheat	Spring Wheat	Barley	Fallow	Oats	Safflower
After Fallow	$30.00	$24.00	$25.00	$ 7.40	$24.00	$28.75
Recrop	$34.00	$28.00	$29.00	-	$28.00	$32.75

a/ See Appendix B for a detailed breakdown of the variable costs presented here.

from Roosevelt County and were assumed to be typical for the entire state. The variable costs for oats were obtained by adjusting the state average variable costs for barley[18/]. The variable costs for grain hay were based on an adjusted variable cost of wheat and barley for grain. The variable costs of harvesting wheat and barley for grain were subtracted from the variable costs of either wheat or barley, respectively and replaced by the variable costs of cutting the grain for hay. The hay yield for a particular crop was derived directly from the expected grain yield of that crop[19/].

Recrop variable costs were obtained for each of the crops by adjustments for added fertilizer applications and the added machinery and tractor costs necessary on recropped acres. It was assumed an additional $3.00 per acre of fertilizer was applied on recrop acreage and $1.00 of additional machine costs were incurred to make the variable costs of recrop $4.00 above the variable costs of fallow as shown in Table 1.

Level of Technology

The level of technology assumed for this study was that which is

---

18/ See Appendix B for a detailed breakdown of the variable costs of each crop.

19/ Shaw, Art et al., Harvesting Grain for Hay as a Means of Compliance With The Farm Program in 1978, Montana State University Staff Paper in Economics, # 78-5.

expected to prevail for the duration of the Farm Program. This level of technology is described by the fertilizer management practices, machinery usage and cultural practices used by the majority of grain producers in Montana at this time.

Technology and management go hand in hand as management in large part is the ability to implement the current state of the arts with respect to technology. An average to above average level of management is assumed for this study. Management fees were not charged to any of the crop enterprises when the variable costs of producing the selected enterprise were computed.

Time Frame

The time frame of the Farm Program dictates return over variable costs be considered for the profit maximization criterion. The decision period encompasses only one production year which is too short for major fixed resources to be varied. Resources which were assumed to be fixed in this study were: management, machinery and equipment, farm buildings and storage facilities and land.

Representative Farms

To establish representative farms it was necessary to look at typical crop mixes throughout the state. The enterprise cost studies provided information on the types of crops grown and mix of crops. The cropping pattern that is important for this study is not the specific percentage of winter wheat, spring wheat, barley and other crops, but only the percentage of wheat, regardless of type, relative to barley. Table 2 shows the combined acreage of winter wheat and spring wheat are approximately 80 percent of planted acres and barley is approximately 20 percent of planted acres. Fallowed land is nearly always 50 percent of total acres. These crop mixes are the basis for establishing the 1977 normal crop acres which influence the acreages a producer may plant under the various options of the Farm Program.

The values, shown in Table 2, for state averages were rounded to 80 percent wheat and 20 percent barley with respect to planted acres and 50 percent summer fallow with respect to total acres. These percentages were used to establish the 1977 NCA base for each representative farm size. For example, if the normal crop acres were specified at 600 by the ASCS in 1977, then the wheat base would be 480 acres and the barley base would be 120 acres.

The linear programming algorithm then uses 480 and 120 acres of wheat and barley base to determine the most profitable allocation of resources under the rules of the Farm Program.

Acres of cropable land, assigned NCA, 1977 crop mix and program yield make up the resource base of each representative farm. To complete the economic analysis, variations of the basic farms were developed and analyzed using linear programming. Variations included:

Table 2. Land Use Patterns for Small Grains in Selected Areas of Montana[a]. Based on Cost of Production Studies Conducted by The Montana Cooperative Extension Service.

		Wheat and Barley as a Percent of Planted Acres		
County	Fallowed land as % of total land	Wheat	Barley	Other
McCone	50	100	15(alternate)	
Roosevelt	50	95	5	
Valley	50	75	25	
Fergus	42	70	30(recrop	
Chouteau	50	80	20	
Hill	50	80	20	
Glacier	50	40	60	
Gallatin	50	70	30	
Northern Yellowstone, Stillwater & Golden Valley	50	90	10	
Pryor, Duck Creek and Beartooth area of South Central Montana	50	90	10	
Pondera	47.5	45	45	.10
Sheridan-Daniels	45	100(12% recrop)	5(alternate)	
State Averages	48.71	77.92	21.75	

a/ Rotation is crop-fallow unless specified otherwise.

1) changes in the basic cropping pattern to see how changing the resource base affects the optimal solutions, 2) changes in the expected yields relative to program yields, and 3) changes in the expected market price structure. Variation of market price and expected yields in relation to program yields indicated the effect these variables had on the profitability of program participation.

Crop Mix

As the crop mix changes within a given farm size, the most profitable solution may change due to the nature of the set-aside requirements. The set-aside requirement on wheat is 20 percent while the set-aside on barley is only 10 percent. As the crop mix changes, more or less land may be required to be set-aside, this may change the profitability of participating in the wheat or barley program or the Farm Program in general. In the extreme case of going from a 1977 crop base of both wheat and barley to a 1977 crop base of only wheat or only barley, some of the options which were available under the wheat and barley crop mix are eliminated. Variations of the crop mix analyzed in this study are presented in Table 3.

Program Yields

When assigning program yields to the various crops the ASCS did not distinguish between winter wheat yields and spring wheat yields, even though there is typically a differential in their respective yields on individual farms.

The expected yields used in this study for winter wheat and spring wheat were set in relation to each other, based on historical relationships[20/]. The expected yields for barley and oats were also set in relation to each other based on historic yields.

In this study program wheat yields ranged from 22 bushels per acre to 38 bushels per acre. Expected winter wheat after fallow yields ranged from 22 to 42 bushels per acre and recrop winter wheat yields ranged from 16 to 36 bushels per acre. Spring wheat yields ranged from 16 to 36 bushels per acre on fallow and recrop spring wheat yields ranges from 10 to 30 bushels per acre. Fallow and recrop yields for wheat vary in a fixed relationship. Spring wheat after fallow yields were always six bushels per acre less than winter wheat yields after fallow. Recrop winter wheat yields were six bushels less than winter wheat after fallow. Recrop spring wheat yields were six bushels less than spring wheat after fallow yields. A similar relationship was established between barley and oats. Expected yield for oats after fallow was always four bushels per acre more than barley after fallow. Recrop barley yields were six bushels less than barley after fallow yields and recrop oat yields were six bushels less than yields for oats after fallow.

20/ United States Department of Agriculture, Montana Crop and Livestock Reporting Service, Danield L. Herbert et al., Montana Agricultural Statistics, Volumes 11 through 16.

Table 3. Variations In Cropping Patterns Used To Analyze The Profitability Of Participation In The Farm Program.

Cropping Pattern	Wheat as % of Planted Acres	Barley as % of Planted Acres	Summer Fallow as % of Total Acres
Basic Crop Mix	80	20	50
Variation 1	100	0	50
Variation 2	67	33	50
Variation 3	40	60	50
Variation 4	0	100	50
Variation 5	The 80 percent wheat and 20 percent barley crop mix was used to determine the effects special situations may have on the profitability of participating in The Farm Program.		

Program barley yields ranged from 32 bushels per acre to 48 bushels per acre. Associated with any program barley yield is an expected barley yield for both fallow and recrop. Barley after fallow yields ranged from 32 to 52 bushels per acre and recrop barley yields ranged from 26 to 46 bushels per acre.

Oats after fallow ranged from 36 to 56 bushels per acre and recrop oats ranged from 30 to 50 bushels per acre.

These yield relationhips between wheat, barley and oats were maintained throughout this study except where it was deemed necessary to vary these relationships in order to examine special cases.

Prices and price ranges for NCA and non-NCA crops used in this study are shown in Table 4. The lower end of both the winter wheat and spring wheat price range was $2.25 which is ten cents below the national average loan rate of $2.35 for wheat. The average loan rate for all counties in Montana is $2.27 (excluding any premiums or deductions)[21/]. This figure was rounded to $2.25 and used as the lower limit for Montana prices. The upper limit for the market price of winter wheat was the target price of $3.40. With the price structure used in this study a price of $3.40 per bushel for winter

---

21/ United States Department of Agriculture, Agricultural Stabilization and Conservation Service, Commodity Credit Corporation Loans and Purchases 1977 Wheat, Form 30-150, (Rev. 2).

Table 4. Price Ranges for NCA and Non-NCA Crops Used in Analyzing The 1977 Food and Agriculture Act.

	Price Range NCA Crops Per Bushel				Price of Non-NCA Crop Per Ton
	Winter Wheat	Spring Wheat	Barley	Oats	Safflower
Price Range	($2.25-3.40)	($2.25-3.70)	($1.50-2.25)	($1.00-1.40)	($150)

wheat gives a price of $3.70 per bushel for spring wheat. The upper and lower limits on the market price of barley were established in a similar manner. The average loan rate for oats in Montana is approximately $1.00 per bushel, this was used as the lower limit for the price of oats. There is no target price for oats so the upper bound was set by the highest mid-month market price, as reported by the SRS, from January though June of 1978. This price was $1.40 per bushel.

The price of safflower was not varied. Market price existing at the time of this analysis were used. The stability associated with prices of safflower is due to the growing arrangements in Montana. Most of the safflower is grown under contract which results in relatively stable market prices.

Variables such as acres of recrop available for spring seeding, acres of summer fallow required, minimum number of acres seeded to winter wheat, and the number of acres of non-program and program crops a producer would be willing to plant were changed during the analysis. Changes in these variations affect the profit maximizing solutions and program participation.

ACTIVITIES

The decision model associated with the fall planting period was used in this analysis. The spring decision model is presented and explained in Appendix A.

Options included in the fall decision model for growing NCA crops under provisions of the Farm Program were: growing program barley, growing program winter wheat, growing program spring wheat, growing other NCA crops other than wheat or barley, and growing forage crops.

These options were broken down into activities which allowed the linear programming algorithm to select one or a combination of activities which produced the maximum profit for each representative farm.

The activities for each cropping option were specified by the rules of the Farm Program. Each activity or combination of activities was designed to allow the participation in any of the options the Farm Program provides. Each option has different levels of benefits and/or costs associated with it. Activities were included to allow all possible combinations of NCA and non-NCA crops to be grown and to allow growing these crops under the regulations of the Farm Program or outside of the Farm Program. For example, winter wheat can be grown on stubble or on summer fallowed ground, for full deficiency payments or for partial deficiency payments, and can be cut for hay from land previously cropped or summer fallowed. Combinations of these possible options yield six different winter wheat activities. All of the possible options under both the wheat and barley programs were discussed in Chapter Two so they will not be repeated here.

Other NCA crops may be grown along with wheat and barley. Two activities allow for growing other NCA crops on either stubble or summer fallowed ground. In Montana, crops which fall under the catagory of other NCA crops are corn, oats, rye, sugar beets, flax, grain sorghum, sunflowers and dry edible beans. For the purpose of this study, oats was the only other NCA crop considered. Only one of the other NCA crops was considered due to the lack of explicit resource constraints other than for land. The absence of explicit physical resource constraints on a NCA crop such as oats means that it will be limited only by the amount of NCA available. Therefore, consideration of more than one NCA crop other than wheat or barley would be unnecessary as the most profitable crop will enter the solution to the limit of NCA.

Non-NCA crops may also be grown along with the NCA crops. Some of the possible non-NCA crops which could be grown are safflower, mustard, rape, speltz and triticale. There are many other non-NCA crops which could be grown in conjunction with program crops, but for the purpose of this study only safflower was considered. Again, due to the lack of explicit resource constraints it is necessary to consider only one of these crop alternatives.

Activities which allowed for required amounts of summer fallow and stubble mulch were included and assigned objective function values stated as the negative of returns over variable costs. The variable costs of summer fallowing were obtained from the cost of production studies in the twelve areas where cost of production estimates were derived and are $7.40 per acre. The costs of stubble mulch was assigned a $7.50 variable cost so the decision model would not select all stubble mulch over summer fallow. An activity was also included to allow double summer fallowing. This activity also had -$7.40 as the objective function value. Stubble mulch qualifies as set-aside while summer fallow does not.

In combination, these activities allow a profit maximizing solution while meeting all the requirements of the Farm Program for each situation analyzed with the representative farms.

One of the most difficult questions producers must answer is whether to participate or not in the program. If the cost of set-aside becomes too high in terms of foregone production from the set-aside acreage, the producer would maximize profits by staying out of the program. This option is allowed for by providing nonprogram activites, for growing wheat, barley or other NCA and non-NCA crops on either summer fallow or recrop acreage.

Participation in the Farm Program has some insurance and income stabilizing aspects not included in the decision model. Only producers who participate in the Farm Program are eligible to receive disaster payments, Commodity Credit Corporation loans, or are eligible to participate in the Reserve program. For any given situation on each representative farm, these three items have no readily available quantitative value which could be used for an objective function value. Therefore, they were not included in the decision model and their affects on "profit maximization" are not considered.

Participants in the Farm Program also benefit from reduced price risk. The program provided for a wheat price of \$3.40 per bushel and a barley price of \$2.25 per bushel by raising market prices to that level through reduced supplies or by transfers of income through deficiency payments. The value of this risk reduction, through supported prices, is not readily quantifiable using a representative farm approach and is not included in the decision model. The value of these factors must be considered before the final decision is made on whether to comply or not comply with the Farm Program. This is especially true for cases which are marginal in favor of staying out of the Farm Program.

RESULTS AND CONCLUSIONS

Producers faced with the questions of how they should comply with the Farm Program, or if they should comply, must consider many important economic factors. However, there are some general conclusions which can be deduced.

Given the nature of the Farm Program, and the means it uses to control production, it becomes costly to participate in the program when market prices are increasing. As prices rise the value of foregone production increases. The same relationship holds true for expected yields. As the expected yields increase for wheat or barley, which constant price, the producer foregoes a larger total revenue by participating in the Farm Program. As price and yield increase together this effect is compounded.

Producers who are willing to plant more acreage than their assigned NCA will also be more willing to stay out of the program. For example, if a producer had 2,000 total cropable acres with an assigned NCA of 1,000 acres and was willing to plant 1,300 acres he would give up any income received from the set-aside specific to the 1,000 acres and also the 300 acres over his 1,000 of NCA which he is willing to plant. Producers who are willing to do this must look closely at the benefits the program provides to see if they outweigh the costs of participation.

It is also true that certain situations make program participation more attractive to producers. If producers are will to grow non-NCA crops then they are not as restricted by the program regulations as producers who are unwilling to grow non-NCA crops. For example, using the same 2,000 acre farm with 1,000 acres of NCA a producer interested in growing strictly wheat for full deficiency payment could grow 800 acres of wheat. The Farm Program restricts the acreage he can plant even though he may be willing to plant 1,300 acres. In this particular case a producer who is not willing to grow a non-NCA crop will likely double summer fallow 200 acres of his cropland. A producer who is willing to grow a non-NCA crop can plant the 200 acres he would have double summer fallowed and an additional 300 acres of non-NCA crop so he does not lose the income potential of these acres. This makes program participation more attractive.

The uniqueness of each individual farming operation, different expectations of prices and yields, and tastes and preferences with respect to cropping patterns makes it difficult to draw specific conclusions about how producers should participate in the Farm Program, it at all. General conclusions about the factors which influence decisions are helpful and these are presented below.

The prices of the crops used in this study were varied in set relationships based on historic information[22/]. Barley was priced

---

22/ Montana Crop and Livestock Reporting Service, Agricultural Prices, January 1968 - December 1977.

approximately \$.60 less per bushel than winter wheat and winter wheat was priced approximately \$.30 below the price of spring wheat. These relationships were changed in some cases to determine effects of the relative magnitudes of price variables in specific situations.

The basic crop mix influences the options open to the producer and therefore, his optimal allocation of resources. The 1977 crop mixes are used here as a frame of reference in presenting the results of this study.

Based on the cost of production studies used to provide information, the most common cropping pattern in Montana is approximately 80 percent wheat and 20 percent barley. These are percentages of crop relative to the producers planted acres, not total cropable acres. Although cropping patterns affect the level of participation and profitability of the Farm Program the major factor which affects the optimal allocation of resources is the ROVC of the possible activities available to the producer. With the 80 percent wheat and 20 percent barley crop mix all of the activities of the wheat and barley programs are open to the producer.

Returns over variable costs are composed of three components; expected yields, expected prices, and variable costs. As the ROVC for the enterprises increase it become more costly in terms of acres of foregone production (voluntary reductions, set-aside and additional diversion) to comply with the program. A point is reached when it becomes more desirable to stay out of the Farm Program to maximize ROVC from the given resource base.

Enterprise variable costs were held constant in this study because it would take relatively large shifts in variable costs to cause the same effect as small shifts in expected prices and yields. Additionally, constant variable costs aids in the interpretation of results.

Another requirement of the decision model is the specification of wheat and barley prices. Prices must be specified before a calculation of deficiency payments can be made. This requirement also allows for easier interpretation of the results. With the simplifying assumptions of constant variable costs and specified prices, interpretation of results is best accomplished through price and yield relationships. Tables 5 and 6 show the basic situations and optimal solutions to the representative farms which had an 80 percent wheat and 20 percent barley crop mix in 1977.

Some explanation of the information presented in the tables is useful. For example, Table 5 shows basic assumptions and basic solutions for both program and nonprogram cases. Each case is indentified by a letter and a number. The first section of the Table, basic assumptions, list the major assumptions used for each representative farm when providing input to the linear programming decision model. The second section of the tables, optimal solutions, presents the results for each representative farm. For example, using case

Table 5. 1978 Program and Nonprogram Solutions for Representative Farms with an Eighty Percent Wheat and Twenty Percent Barley Crop Mix in 1977[a].

	Nonprogram Solutions					Program Solutions			
Case Code	G9[b]	G15	G17[b]	G20[b]	G21[b]	G11[b]	G12[b]	G14[b]	G16[b]
A. Basic Assumptions									
Expected Selling Price ($)									
Winter Wheat	3.40	3.25	2.85	2.85	3.15	3.10	2.95	3.10	2.65
Spring Wheat	3.70	3.55	3.15	3.15	3.45	3.40	3.25	3.40	2.95
Barley	2.25	2.15	2.20	2.25	2.55	2.00	1.85	2.00	2.00
Expected Fallow Yields									
Winter Wheat	30	30	30	22	22	30	30	30	30
Spring Wheat	24	24	24	16	16	24	24	24	24
Barley	40	40	40	32	32	40	40	40	40
Program Yields									
Wheat	38	30	30	30	30	38	38	30	30
Barley	48	40	40	40	40	48	48	40	40
1977 Wheat Acreage	480	480	480	480	480	480	480	480	480
1977 Barley Acreage	120	120	120	120	120	120	120	120	120
B.) Optimal Solutions									
Acres of Winter Wheat	600	600	200	200	200	500P	500P	500P	500P
Acres of Spring Wheat									
Acres of Barley			400	400	400				
Acres of Summer Fallow	600	600	600	600	600	500	500	500	500
Acres of Stubble Mulch						100	100	100	100
Acres of Winter Wheat for Hay									
Acres of Spring Wheat for Hay									
Acres of Barley for Hay						100	100	100	100
Acres of Winter Wheat for Hay or Grazing									
Total Returns Over Variable Costs ($)	38760	36060	31860	20900	26060	34000	34600	33400	31400
Program Payments ($)	0	0	0	0	0	2850	5700	2250	9000
General Participation Range ($)									
High	2110	2660	370	8	120				
Low						-940	-949.09	-40	-590

a/ The ratio of normal crop acreage to total cropable acres equals .5 for all cases and the K-factor for wheat is equal to 1. for all cases.

b/ A minimum fall seeded acreage of 1/3 of the cropped acres was required.

G11 the optimal allocation of resources includes 500 acres of winter wheat for partial deficiency payment, 500 acres of summer fallow, 100 acres of stubble mulch, and 100 acres of barley for hay. This cropping pattern produces $34,000 of returns over variable costs of which $2,850 are government payments. The -$940.00 under the low general particiation range indicates the producer would only have to be penalized $940.00 and he would stay out of the program. The larger this number is the better the Farm Program looks for the producer. The general participation range is an indication of how close the particular case farm is to being on the border line of being in or staying out of the Farm Program.

As was noted the P behind the 500 acres of winter wheat stood for wheat grown for partial deficiency payments. The letter F stands for full deficiency payment except in one case which is noted later. All of the acreages listed are acres of crop after fallow unless the number of acres is followed by the letter R which denotes recrop.

The one exception where the letter F does not stand for full deficiency payment is case E13 in Table 6. There the letter F stands for summer fallow and R for recrop meaning the 1200 acres of barley was split between fallow and recrop.

The letters AD stand for additional diversion option which is available under the barley program. For example, case E5 in Table 6 shows 232 acres of barley on recrop grown for partial deficiency

Table 6. 1978 Program and Nonprogram Solutions for Representative Farms with an Eighty Percent Wheat and Twenty Percent Crop Mix in 1977[a].

	Nonprogram Solutions						
Case Code	E3[af]	E4[cdef]	E6[af]	E8[a]	E9[a]	E11[a]	E13[bdef]
A.) Basic Assumptions							
Expected Selling Price ($)							
Winter Wheat	2.80	2.80	2.80	3.25	3.10	3.00	2.80
Spring Wheat	3.10	3.10	3.10	3.55	3.40	3.30	3.10
Barley	2.20	2.20	2.20	2.20	0	2.20	2.20
Expected Fallow Yields							
Winter Wheat	30	30	30	30	30	30	30
Spring Wheat	24	24	24	24	24	24	24
Barley	40	40	40	36	0	36	40
Program Yields							
Wheat	30	30	38	30	30	30	38
Barley	40	40	48	40	0	40	48
1977 Wheat Acreage	480	960	480	480	480	480	960
1977 Barley Acreage	120	240	120	120	120	120	240
B.) Optimal Solutions							
Acres of Winter Wheat				600	600	600	F
Acres of Spring Wheat							1200R
Acres of Barley	600	1200R	600				
Acres of Summer Fallow	600	0	600	600	600	600	0
Acres of Stubble Mulch							
Acres of Winter Wheat for Hay							
Acres of Spring Wheat for Hay							
Acres of Barley for Hay							
Acres of Wheat for Hay or Grazing							
Total Returns Over Variable Costs ($)	33360	54960	33360	36060	33360	31560	59088
Program Payments ($)	0	0	0	0	0	0	0
General Participation Range ($)							
High	1810	489.23	160	4960	3010	1960	5700
Low							

a/ The ratio of normal crop acreage to total cropable acres equals .5.

b/ The ratio of normal crop acreage to total cropable acres equals .8.

c/ The ratio of normal crop acreage to total cropable acres equals 1.

d/ Inputs into this representative farm allowed NCA crops other than wheat or barley to be grown.

e/ Inputs into this representative farm allowed Non-NCA crops to be grown.

f/ The K-factor for wheat was set at .8 in the representative farm.

Table 6. Continued.

Case Code	Program Solutions E2[cde]	E5[cdef]	E7[af]	E10[a]	E12[a]
A.) Basic Assumptions					
Expected Selling Price ($)					
Winter Wheat	2.30	2.60	2.80	2.95	2.60
Spring Wheat	2.60	2.90	3.10	3.25	2.90
Barley	1.70	2.00	2.20	0	1.60
Expected Fallow Yields					
Winter Wheat	30	30	30	30	30
Spring Wheat	24	24	24	24	24
Barley	40	40	36	0	40
Program Yields					
Wheat	30	38	30	30	30
Barley	40	48	40	0	40
1977 Wheat Acreage	960	960	480	480	3000
1977 Barley Acreage	240	240	120	120	600
B.) Optimal Solutions					
Acres of Winter Wheat	824P-R	768F-R	384F	500P	2500P
Acres of Spring Wheat					
Acres of Barley	192F-R	232P-AD-R	116P-AD		
Acres of Summer Fallow	0	0	500	500	2500
Acres of Stubble Mulch	184	200	100	100	500
Acres of Winter Wheat for Hay			100	100	
Acres of Spring Wheat for Hay					
Acres of Barley for Hay					500
Acres of Wheat for Hay or Grazing					
Total Returns Over Variable Costs ($)	48558.40	50817.13	30114	31100	148250
Program Payments ($)	26940	21458	5714	4500	40000
General Participation Range ($)					
High					
Low	-13640	-1029.60	-2034	-440	-26450

a/ The ratio of normal crop acreage to total cropable acres equals .5.

b/ The ratio of normal crop acreage to total cropable acres equals .81.

c/ The ratio of normal crop acreage to total cropable acres equals 1.

d/ Inputs into this representative farm allowed NCA crops other than wheat or barley to be grown.

e/ Inputs into this representative farm allowed Non-NCA crops to be grown.

f/ The K-factor for wheat was set at .8 in the representative farm.

payment under the additional diversion option.

Eighty Percent Wheat and Twenty Percent Barley Crop Mix in 1977

Using the established price and yield relationships with price levels of barley at $2.20, winter wheat at $2.80, and spring wheat at $3.10 and with expected fallow yields equal to mean program yields for wheat and barley in Montana, results from Table 5 and 6 show producers should consider staying out of the Farm Program. With these price levels and yield relationships it becomes marginally better in terms of maximizing returns over variable costs to stay out of the Farm Program and grow barley after fallow.

With the same price levels, barley at $2.20, winter wheat at $2.80, spring wheat at $3.10, and expected yields for wheat and barley equal to the lower limit of program yields, it is also marginally more profitable to stay out of the Farm Program and grow barley on previously fallowed ground. These results, are shown in Table 5. Program yields in these cases remained at their mean levels of 30 bushels for wheat and 40 bushels for barley. With low expected yields and average program yields a program solution seems highly probable.

Staying out of the program with low expected yields, average program yields and price relationships as shownin Table 5 indicates the deficiency payments received at average program yields, zero for barley, $13.50 per acre for wheat, are not enough to overcome the low expected yields. Sensitivity analysis shows the per acre deficiency payments need increase only a small amount before they would be attractive enough to hold resources in the Farm Program, given the low expected yields. This per acre increase in deficiency payments needed to hold resources in the Farm Program can come from increases in program yields, relative to expected yields assuming price levels are held constant.

Given the price and yield relationships shown in Table 5 and 6 the decision model chooses nonprogram barley grown on previously fallowed ground as the most profitable allocation of resources. For a variety of reasons, Montana producers may not wish to devote their entire acreage to barley. Therefore, restriction was introduced to force a minimum number of fall seeded acres to enter the solution. It was a means of forcing diversification. In the nonprogram solutions the decision model still allocated resources to nonprogram barley on fallowed ground after the minimum fall seeded acreage requirement was fulfilled. In this analysis the minimum required fall seeded acreage was always filled with winter wheat. Introduction of the minimum fall seeding requirement caused a slight reduction in the value of the objective function in the nonprogram solutions and had no effect on the program solutions.

The question arises as to what price and/or yield relationships must exist before the decision model will choose a nonprogram solution in favor of wheat rather than barley.

Table 6 shows that a reduction in the expected yield of barley, to 36 bushels with the price of barley held at $2.20, winter wheat at $2.80 and spring wheat at $3.10 per bushel, was not enough to cause a nonprogram solution in favor of wheat. Case E7 and E11 indicate that not only do expected barley yields have to be reduced but the price of winter wheat must be increased to approximately $3.00 per bushel before a nonprogram solution in favor of wheat is achieved. This indicates that producers should consider staying out of the Farm Program if the price of winter wheat approaches $3.00 per bushel and their operations are similar to those presented in Tables 5 and 6.

With price and yield relationships as shown in Tables 5 and 6, in cases G11, G12, G16, E5, and E7, the decision model allocates resources to winter wheat for partial deficiency payment if the K-factor is one and to winter wheat for full deficiency payment and barley for partial deficiency payment under the additional diversion option if the K-factor for wheat is .8. With a K-factor for wheat of 1., case E2 in Table 6 shows that as prices fall and per acre deficiency payments rise the optimal allocation of resources changes from all partial deficiency payment wheat to a mix of partial deficiency payment wheat and full deficiency payment barley.

Although expected wheat price was varied to achieve a nonprogram wheat solution, the decision model only has ROVC as an indication of profitability and opportunity cost. Expected yields and/or variable costs could have been varied to achieve the ROVC level achieved by varying price. The same solutions would have resulted. With this in mind there is considerable flexibility in the interpretation of the results thus far.

For example, with barley at $2.00 per bushel, winter wheat at $2.80 per bushel and spring wheat at $3.10 per bushel the expected yield for winter wheat need increase by only 3 bushels per acre to achieve a nonprogram solution in favor of winter wheat. Although this is not shown in the tables the results are easily calculated for any case. Variation in expected yields will be discussed later. Many possible combinations of the three components of ROVC will yield the same ROVC for any enterprise and these results should be interpretated within the rigid price and yield structure used in this analysis.

Winter wheat dominated spring wheat when using the initial price and yield structure of wheat and barley. Before the spring wheat would enter the solution the ROVC from growing spring wheat had to exceed that of winter wheat. With the specified price and yield structure used in this study a two bushel per acre expected yield increase in spring wheat yields, all other things remaining constant, shifted spring wheat on fallow to the decision model's choice over winter wheat. This is shown in Table 7 which pertains to a two-thirds wheat and one-third barley crop mix, but holds true for all crop mixes.

In the spring wheat producing areas of Montana this small improved yield of spring wheat relative to winter wheat is highly probable. For these producers the best use of their resources, when spring wheat price is approximately \$3.10, is to stay out of the Farm Program and grow spring wheat on fallow.

With improved spring wheat yields, relative to winter wheat, and a spring wheat price below \$3.10 the decision model allocated resources to growing spring wheat for partial deficiency payment as it did with winter wheat. Because the Farm Program does not distinguish between spring wheat and winter wheat the K-factor effects the allocation of resources to spring wheat production in the same manner as it affected winter wheat. If the K-factor is 1.0 the decision model allocates resources to the production of wheat for partial deficiency payment. If it is .8 the decision model allocates resources to the production of wheat for full deficiency payments plus barley for partial deficiency payments under the additional diversion option.

Although three farm sizes were used initially only the representative farms with 1200 total cropable acres are presented here. Due to the linearity assumptions it does not matter how many acres the

Table 7. 1978 Program and Nonprogram Solutions for Representative Farms with a Two-Thirds Wheat and One-Third Barley Crop Mix in 1977[a].

	Nonprogram Solutions			Program Solutions		
Case Code	S4	S6	S7	S1[bc]	S3[bc]	S5
A.) Basic Assumptions						
Expected Selling Price ($)						
Winter Wheat	2.80	2.70	2.75	2.35	2.35	2.60
Spring Wheat	3.10	3.00	3.05	2.60	2.60	2.90
Barley	2.20	2.10	2.15	1.70	1.70	2.00
Expected Fallow Yields						
Winter Wheat	30	22	22	34	32	22
Spring Wheat	24	16	16	30	34	16
Barley	40	32	32	44	48	32
Program Yields						
Wheat	30	30	30	30	38	30
Barley	40	40	40	40	48	40
1977 Wheat Acreage	400	400	400	400	400	400
1977 Barley Acreage	200	200	200	200	200	200
B.) Optimal Solutions						
Acres of Winter Wheat						340P
Acres of Spring Wheat				400P	400P	
Acres of Barley	600	600	600			160F-AD
Acres of Summer Fallow	600	600	600	420	420	500
Acres of Stubble Mulch				80	80	100
Acres of Winter Wheat for Hay				200	200	
Acres of Spring Wheat for Hay						
Acres of Barley for Hay				100F	100R	100
Acres of Winter Wheat for Hay or Grazing				120	120	
Total Returns Over Variable Costs ($)	33360	20880	21840	45032	55236	20696
Program Payments ($)	0	0	0	14040	17784	8358
General Participation Range ($)						
High	00.00	210	00.00			
Low				-12406	-15718	-1240

a/ The ratio of normal crop acres to total cropable acreage equals .5 for all cases and the K-factor for wheat is equal to 1. for all cases.

b/ Inputs in this representative farm allowed Non-NCA crops to be grown.

c/ A minimum fall seeded acreage of 1/3 of the cropped acres was required.

producer has to work with. When the ratio of normal crop acres to total cropped acres equals .5 the same general solutions will hold for all farm sizes. There are exceptions to this when the number of NCA acres grow so large the $40,000 payment limitation is exhausted or as the ratio of NCA to TCA changes. These situations will be discussed later.

Two-Thirds Wheat and One-Third Barley Crop Mix and 40 Percent Wheat and 60 Percent Barley Crop Mix

The percentage of wheat relative to barley influences what the producer can grow under the regulations of the Farm Program. As the crop mix shifts from wheat to barley it becomes less costly, in terms of set-aside, to comply with the Farm Program. This is due to the relative magnitudes of the set-aside requirements of wheat and barley. Wheat requires a 20 percent set-aside and barley only a 10 percent set-aside. Producers do not receive the benefits of a reduced set-aside unless barley is a viable program solution. Otherwise, even at high percentages of barley in the crop mix, it may be just as costly to comply with the Farm Program if wheat is the optimal program solution.

Tables 7 and 8 show that changes in crop mix do not have much, if any, effect on the optimal solutions for the representative farms. This is due to the fact that winter wheat for partial deficiency payment

Table 8. 1978 Program and Nonprogram Solutions for Representative Farms with a Forty Percent Wheat and Sixty Percent Barley Crop Mix in 1977[a].

	Nonprogram Solutions		Program Solutions	
Case Code	G80	G82	G81[b]	G85
A.) Basic Assumptions				
Expected Selling Price ($)				
Winter Wheat	2.85	2.80	2.70	2.65
Spring Wheat	3.15	3.10	3.00	2.95
Barley	2.25	2.20	2.10	2.05
Expected Fallow Yields				
Winter Wheat	30	34	30	22
Spring Wheat	24	28	24	16
Barley	40	44	40	32
Program Yields				
Wheat	30	30	30	30
Barley	40	40	40	40
1977 Wheat Acreage	240	240	240	240
1977 Barley Acreage	360	360	360	360
B.) Optimal Solutions				
Acres of Winter Wheat			500P	500P
Acres of Spring Wheat				
Acres of Barley	600	600		
Acres of Summer Fallow	600	600	500	500
Acres of Stubble Mulch			100	100
Acres of Winter Wheat for Hay				
Acres of Spring Wheat for Hay				
Acres of Barley for Hay			100	100
Acres of Winter Wheat for Hay or Grazing				
Total Returns Over Variable Costs ($)	34560	38640	31400	31400
Program Payments ($)	0	0	8250	9000
General Participation Range ($)				
High	604	168		
Low			-556	-1640

a/ The ratio of normal crop acres to total cropable acreage is equal to .5 for all cases and the K-factor for wheat is equal to 1. for all cases.

b/ A minimum fall seeded acreage of 1/3 of the cropped acres was required.

remains the decision model's choice at the price and yield levels used. Because barley is not an optimal program solution at the price and yield levels shown, it is not any less costly to comply with the Farm Program.

Tables 7 and 8 show, in general the optimal soltuions for representative farms with two-thirds wheat and one-third barley and 40 percent wheat and 60 percent barley are the same as for farms with 80 percent wheat and 20 percent barley.

To achieve a nonprogram solution with the two-thirds wheat and 40 percent wheat crop mixes and using the established price and yield relationships the price levels had to reach $2.20 per bushel for barley, $2.80 for winter wheat, and $3.10 for spring wheat. At these price levels, and mean expected yields, the optimal allocation of resources is nonprogram barley after fallow.
When expected selling price falls below these levels, while maintaining their relative positions, Tables 7 and 8 show that wheat for partial deficiency payment was the most profitable allocation of resources. As with the 80-20 crop mix this depends on the value of the K-factor. With a K-factor of 1.0 the partial deficiency payment wheat option is most attractive. With a K-factor of .8, wheat for full deficiency payment is most attractive.

Tables 7 and 8 also show that as expected yields fall relative to program yields, the price levels can also fall and nonprogram solutions are still attractive. Cases S6, S7 and G85 show that as expected yields fall, price levels can fall approximately $.10 per bushel and allocation of resources still goes to nonprogram barley after fallow. As long as yields and prices were reduced in set relationhips the crops remain in the same relative relationship and nonprogram solutions maximize ROVC.

Using the lower limit if expected yields and normal program yields it could be expected that deficiency payments would be enough to hold resources in the program. However, this is not the case. Sensetivity analysis indicates there need be only a slight increase in per acre deficiency payments to make the decision model allocate resources to program activities. With low expected yields and prices the program yield could increase to bring about the necessary increase in per acre deficiency payments to pull resources into the Farm Program.

<u>100 Percent Barley in 1977</u>

Results for the representative farms with a 100 percent barley base in 1977 are shown in Table 9.

Producers with a 100 percent barley base do not have option of growing wheat for full deficiency payment. This does not effect the results though as the optimal allocation of resources are the same as the previous crop mixes.

Table 9. 1978 Program and Nonprogram Solutions for Representative Farms with a Zero Wheat and One Hundred Percent Barley Crop Mix in 1977[a].

	Nonprogram Solutions		Program Solutions		
Case Code	G51	G53[b]	G50	G60	G61[b]
A.) Basic Assumptions					
Expected Selling Price ($)					
Winter Wheat	2.75	2.80	2.60	2.65	2.70
Spring Wheat	3.05	3.10	2.90	2.95	3.00
Barley	2.15	2.20	2.00	2.05	2.10
Expected Fallow Yields					
Winter Wheat	30	30	30	30	30
Spring Wheat	24	24	24	24	24
Barley	40	40	40	40	40
Program Yields					
Wheat	30	30	30	30	30
Barley	40	40	40	40	40
1977 Wheat Acreage	0	0	0	0	0
1977 Barley Acreage	600	600	600	600	600
B.) Optimal Solutions					
Acres of Winter Wheat		200	500P	500P	500P
Acres of Spring Wheat					
Acres of Barley	600	400			
Acres of Summer Fallow	600	600	500	500	500
Acres of Stubble Mulch			100	100	100
Acres of Winter Wheat for Hay					
Acres of Spring Wheat for Hay					
Acres of Barley for Hay			100	100	100
Acres of Winter Wheat for Hay or Grazing					
Total Returns Over Variable Costs ($)	32160	31560	31400	31400	31400
Program Payments ($)	0	0	9750	9000	8250
General Participation Range ($)					
High	760	70			
Low			-990	-590	-210

a/ The ratio of normal crop acreage to total cropable acres equals .5 for all cases and the K-factor for wheat is equal to 1. for all cases.

b/ A minimum fall seeded acreage of 1/3 of the cropped acres was required.

As the price of barley approaches $2.20 per bushel, within the specified price relationship, the decision model allocates resources to nonprogram barley after fallow. With lower prices, the decision model allocates resources to winter wheat for partial deficiency payments.

Producers who did not have a wheat base were not eligible for the full deficiency payment wheat option. With a K-factor of 1.0, as in the bases in Table 9, this had no effect on results. Maintaining the approximate prices and yields shown in Table 9 but reducing the K-factor to .8 for wheat the decision model allocates resources to barley after fallow for partial deficiency payment plus additional diversion payments. If prices or yields were such that non-participation maximizes ROVC it does not matter what the K-factor is.

<u>100 Percent Wheat in 1977</u>

Table 10 shows the results from the representative farms which had a 100 percent wheat base in 1977. Results show with normal expected yields and price levels similar to those used in the previous tables, the decision model still allocates resources to the production of nonprogram barley after fallow when the price of barley reaches $2.20 per bushel. Below this price level, maintaining relative prices, resources are allocated to the production of winter wheat for partial deficiency payments, the same results obtained in the previous crop mixes.

Table 10. 1978 Program and Nonprogram Solutions for Representative Farms with a One Hundred Percent Wheat and a Zero Percent Barley Crop Mix in 1977[a].

	Nonprogram Solutions	Program Solutions	
Case Code	G32[b]	G30[b]	G31[b]
A.) Basic Assumptions			
Expected Selling Price ($)			
Winter Wheat	2.80	2.60	2.75
Spring Wheat	3.10	2.90	3.05
Barley	2.20	2.00	2.15
Expected Fallow Yields			
Winter Wheat	30	30	30
Spring Wheat	24	24	24
Barley	40	40	40
Program Yields			
Wheat	30	30	30
Barley	40	40	40
1977 Wheat Acreage	600	600	600
1977 Barley Acreage	0	0	0
B.) Optimal Solutions			
Acres of Winter Wheat	200	500P	500P
Acres of Spring Wheat			
Acres of Barley	400		
Acres of Summer Fallow	600	500	500
Acres of Stubble Mulch		100	100
Acres of Winter Wheat for Hay			
Acres of Spring Wheat for Hay			
Acres of Barley for Hay		100	100
Acres of Winter Wheat for Hay or Grazing			
Total Returns Over Variable Costs ($)	31560	31400	31400
Program Payments ($)	0	9750	7500
General Participation Range ($)			
High	70		
Low		-1390	-940

a/ The ratio of normal crop acres to total cropable acreage equals .5 for all cases and the K-factor for wheat is equal to 1. for all cases.

b/ A minimum fall seeded acreage of 1/3 of the total cropped acres was required.

It can be inferred from the previous crop mixes that the 100 percent wheat cases will react in the same way to changes in the K-factor. As with the previous crop mixes, spring wheat did not enter the solution of the representative farms shown in Table 10. Before spring wheat will enter the solution the ROVC for spring wheat must be greater than winter wheat.

Special Cases:

Questions many producers will have with regard to specific items were also analyzed in this study. A few of these questions are: what effect does the $40,000 payment limitation have on my operation?, how will it effect my decisions if I am willing to plant more acres than I have NCA?, what happens as the ratio of normal crop acres to total crop acres approaches one?, what effect will a willingness to plant nonprogram crops such as safflower or mustard have?

At price levels of $1.60 per bushel for barley, $2.60 per bushel for winter wheat and $2.90 per bushel for spring wheat it requires approximately 3,000 acres of NCA to use up the entire $40,000 of program payments. This means that the payment limiations will not be a problem to most Montana producers. Case E12 in Table 6 shows the program payments are used by growing winter wheat for partial deficiency payment with a K-factor of 1. Producers must be even bigger than this before they would be willing to get out of the program due to the payment limitations. Producers must have enough cropable acreage to make up the $40,000 program payment they would lose if they did not participate in the Farm Program. At price levels shown in case E12 of Table 6 and with normal expected and program yields, resources were allocated to the production of 2,500 acres of winter wheat for partial deficiency payment. The $40,000 of program payments were used up with only 2,050 acres of the 2,500 acres intended for harvest as grain.

The question of the $40,000 payment limitation is related to the producers expectations of yields, prices and his variable costs of production. If the combination of these three factors produce a relatively high ROVC from the crop or crops he produces, then he will be able to make up the $40,000 of lost income with fewer acres than other producers. In the example used above the decision model chose winter wheat with a ROVC of $48.00 per acre and barley for hay with a ROVC of $21.00 per acre as the optimal allocation of resources. This produced an objective function value of $148,250. This $148,250 includes $40,000 of deficiency payments at a rate of $19.50 per acre. A producer must be willing to plant approximately 3,100 acres ($148,250 ÷ $48) of winter wheat with an ROVC of $48 per acre to achieve the same ROVC produced by 2,500 acres of winter wheat and 500 acres of barley for hay when complying with the program. Note that 3,100 acres would require 100 acres of recrop wheat and this may not provide the same $48 per acre that winter wheat on fallow did. Hence, he may be required to plant slighly more than 3,100 acres. With this information, a producer then has to look at the risks associated with staying out of the program and assuming price and yield risks versus being in the program and sharing price and yields risks with the government.

The above analysis assumed the producer was willing to plant a nonprogram crop on the unused fallowed acres. The willingness to plant a nonprogram crop, such as safflower or barley for hay, on the 500 acres of unused summer fallow the producer had when planting 2,500 acres of winter wheat enhances participation in the program.

Assume the producer is willing to grow safflower on the 500 acres of unused fallow and he expects yields of 1,000 lbs. per acre at $150 per ton, with variable costs of $28.75. Safflower is still not competitive with crops such as wheat and barley. This means that when acres of nonprogram crops such as safflower were permitted they were grown on unused summer fallow or on acreage the decision model was given in excess of the NCA on the particular representative farm in question. However, five hundred acres times an ROVC of $46.00 per acre is $23,000 that will be gained by growing safflower. If safflower replaces barley cut for hay then $10,500 will be lost from the barley hay. The producer must then be willing to plant approximately 3,349 acres ($160,750 ÷ $48) before he would be willing to get out of the Farm Program due to the $40,000 payment limitation.

At the specified prices and yield nonprogram crops were not competitive with NCA crops. As long as there is a positive ROVC for non-NCA crops they are a bonus crop. They add additional income to the farming operation when price levels for wheat and barley are low enough to cause program solutions. When price levels are high enough to cause nonprogram solutions these crops were no longer a viable alternative. If safflower yields were 1,000 lbs. per acre which sold for $150 per ton, and variable costs were $28.75 per acre, the price of grain hay would have to reach $50 per ton before it could compete for resources with nonprogram crops which produce returns equal to those of safflower.

Given the components of return over variable costs, price, yield, and variable costs we can see that it also makes a difference how the total ROVC per acre is increased. If price rises to increase ROVC the deficiency payment falls. As the per acre deficiency payment is reduced it will take more total planted acres and NCA to use up the total $40,000 payment limitation. This is not true if expected yields increase or variable costs fall.

Each producer's situation with respect to the $40,000 payment limitation will be unique and he must try to analyze it through the best means available to him. A willingness to plant additional acres to non-NCA crops enhances program participation and a willingness to plant more acres of NCA crops than the producer has NCA makes nonparticipation more attractive.

Due to the linearity assumptions of the decision model, variations in the ratio of NCA to TCA will have no effect on the final solution with respect to whether the producer should get in or stay out of the Farm Program. As the number of NCA acres grows relative to total crop acres, the decision model will simply utilize the additional NCA acreage for the most profitable crop. This, of course, is assuming price and yield levels are such that resources would be allocated to production of program crops and the producer is only willing to plant within his NCA. If prices and/or yields are such that nonprogram solutions would be attained and the producer is willing to plant whatever his ratio of NCA to TCA is, the decision model simply allocates that number of acres to production of crops grown outside of the program.

There are problems with respect to the $40,000 payment limitation if the assumption of planting acreage equal to the ratio value is relaxed. As the ratio of NCA to TCA approaches one, and price and yield levels are such that program solutions are obtained, the producer may not be able to overcome the $40,000 payment limitation by planting more acres outside of the Farm Program. With higher ratios and program solutions, more of the $40,000 possible program payment is used up. As this ratio approaches 1.0 the producer may not have the needed total acres he must plant before he can make up the deficiency payment he would lose by getting out of the program. For the opposite case of having a small ratio of NCA to TCA, the producer may be willing to plant enough of his total cropable acreage to force him out of the program. Here again, the uniqueness of each case is emphasized.

Producers may also ask about the profitability of the wheat haying and grazing program. Since acreage devoted to this activity requires the same set-aside as acreage devoted to wheat for grain, the ROVC from wheat hay in the wheat haying and grazing option of the Farm Program must be competitive with wheat cut for grain. This would require low returns for growing grain because of low expected yields and/or low expected prices or high returns from cutting grain for hay though high prices or yields or a combination of both. Since the hay yields for each type of grain were directly related to the expected grain yield through the use of a formula[23/] for each type of

---

23/ Shaw, Art et al., Harvesting Grain for Hay As A Means of Compliance With The Farm Program In 1978, Department of Agricultural Economics and Economics, Staff Paper # 78-5, Montana State University, June 1978.

grain the hay yield could not be increased relative to the grain yield to give a high ROVC for hay. The variable costs of cutting grain for hay were also held constant. The only way to increase the ROVC of cutting grain for hay was through increases in the price of hay. Two price levels for hay were used in this analysis, $30.00 per ton, and $40.00 per ton. Throughout most of the analysis the price of hay was held at $30.00 per ton. At this price level, cutting wheat hay for payment did not enter program solutions. The exception is shown in Table 7 where a minimum fall seeded acreage was required and returns from growing the crops for grain were low due to low expected prices on all of the crops. The minimum fall seeded acreage requirement was 200 acres, in cases S1 and S3, and the low ROVC from growing winter wheat for grain made the wheat haying and grazing program attractive enough to enter the solution.

Cutting grain for hay was always allowed in each model farm and cutting winter wheat or barley for hay generally entered the solution on the remaining acres of summer fallow exceeding NCA.

SUMMARY

The objectives of this study were to 1) develop a linear programming model which would aid individual Montana dryland grain producers in selecting optimal cropping patterns under the regulations of the Food and Agricultural Act of 1977. 2) To develop the linear programming model in a format easily adapted to AGNET, a computer based agricultural information system, so the linear program can be continuously updated. 3) To derive general conclusions concerning the impact of varying resource bases and product price levels have on relative profitability of various options under the new Farm Program. 4) To determine what factors will have significant impact on a producer's decision to comply or not comply with the Farm Program regulations.

The first two objectives, stated above, have been accomplished. The linear programming package developed has already been adapted to AGNET and has recently been revised to reflect changes in the Farm Program rules for the 1979 crop year.

Information presented in the Results and Conclusions indicate varying the crop mix had little effect on the optimal allocation of resources. Because growing wheat for partial deficiency payment dominated other program solutions, given the price and yield relationships used, changing the crop mix did not effect the optimal allocation of resources.

The Farm Program does not distinguish between winter wheat and spring wheat so the decision model's choice of winter wheat for partial deficiency payment, in program solutions would be replaced by spring wheat for partial deficiency payment, if spring wheat returns over variable costs improve relative to winter wheat. This can be accomplished through expected price and/or yield increases relative to winter wheat. Because the crop mix is important only to program activities changing the crop mix had no effect on nonprogram solutions.

Changing the number of normal crop acres relative to total crop acres did not effect the allocation of resources to a particular cropping option. Due to the linear nature of the decision model any increase or decrease in NCA was simply allocated to the most profitable cropping pattern when price and yields were at levels which caused program solutions.

Problems with increasing the NCA were encountered when the NCA was large enough to use the maximum deficiency payment allowed. When the NCA reached 3,000 acres the entire $40,000 payment limitation was used. At this point producers must consider the alternative of staying out of the program if they have enough acres to make-up the deficiency payment they would lose by not participating in the Farm Program. If the ratio of NCA to TCA is large enough, then the producer may not have enough total cropable acres to make up the deficiency payments he would lose by nonparticipation.

Thoughout most of the analysis, program yields were held at the average level for program yields of all Montana counties. In general, increases in program yields will make program participation more attractive, at any given price level, and decreases in program yields will make program participation less attractive. The question then arises as to what level program yields would have to be before the deficiency payment would be large enough to pull resources into the program that would otherwise not be in the program.

When average program yields were used with low expected yields and price levels such that nonparticipation was marginally better, sensitivity analysis showed that small increases in program yields, everything else held constant, would be enough to pull resources back into participating in the Farm Program. The same is true for cases where normal expected yields were used and program yields were set at the maximum for wheat and barley. Maximum program yield for wheat was 38 bushels per acre and for barley 48 bushels per acre.

The most important factors which influence a producers decision to comply or not comply with the rules of the Farm Program are the prices he expects to receive for his crops and their expected yields.

A review of Tables 5 through 10 indicates the expected price of barley must reach $2.20 per bushel before barley will be grown outside of the Farm Program. When the price of barley falls below this level, everything else remaining constant, the partial deficiency payment wheat option is utilized if the K-factor is one. The full deficiency payment wheat option is utilized if the K-factor for wheat is .8.

Results also show the price of winter wheat must reach $3.00 per bushel, with assumptions as shown, before winter wheat will be grown outside of the Farm Program. Spring wheat will take the place of winter wheat in both program and nonprogram solutions with small changes in the expected price or yield structure which favor spring wheat. When the ROVC for barley is at a level that will not result in a nonprogram solution and the price of winter wheat is below $3.00, the partial deficiency payment wheat option is most attractive with a K-factor for wheat of 1.0. If the K-factor for wheat is lowered to .8 the decision model uses all of the full deficiency payment wheat acreage possible and the remaining NCA is devoted to the production of barley for partial deficiency payments plus additional diversion payments.

Expected yields were held constant throughout most of the analysis because expected yield and expected price are perfect substitutes with respect to influencing ROVC.

Tables 5 through 10 show nonprogram barley was the optimal allocation of resources when the price of barley reaches $2.20. When barley was set at $2.20, winter wheat was set at $2.80 and spring wheat was $3.10 per bushel. With these prices as a base the expected yield of barley was reduced by four bushels per acre to allow winter wheat to come in as a nonprogram crop. The four bushel decrease was not enough to accomplish this. The price of winter wheat had to be increased to $3.00 per bushel to get a nonprogram winter wheat solution. The expected yield of winter wheat could have been increased to achieve a nonprogram solution. The question is then, how much must expected yields increase to get a nonprogram wheat solution if winter wheat prices are held at $2.80? Analysis indicated expected winter wheat yields need be increased only 3 bushels per acre for the decision model to allocate resources to nonprogram winter wheat after fallow. Simple partial budgeting exercises can be used to calculate the expected yields necessary to change the program solutions to nonprogram solutions at any price level. A 2 to 4 bushel increase over average expected yields for wheat, when wheat prices are in the $2.60 to $3.00 range, is enough to allocate resources to production of crops outside of the Farm Program.

The information presented in this study shows there are many possible options and many variables each individual producer must examine to get a thorough analysis of his situation. The results presented here can be used as guidelines for producers who want to know if they should participate in the Farm Program or stay out.

The uniqueness of each producers case warrants an individual analysis. This is possible through the use of AGNET. Any producer can determine the optimal cropping system for his resources by utilizing FARMPROGRAM, which is a linear programming package adapted to the AGNET system. This program is interactive and allows the producer to obtain an optimal cropping system given his resources, costs, tastes and preferences, and expectations. FARMPROGRAM was developed from the models derived in this study.

BIBLIOGRAPHY

Denny, Virgil, et al., Gallatin County Agricultural Stabilization and Conservation Newsletter, February 1978.

Griffith, Duane, Schaefer, Jerry and Luft, LeRoy D., Enterprise Costs For Fallow, Winter Wheat, Spring Wheat, Barley, and Mustard in Glacier County, Bulletin 1181, February 1978.

Griffith, Duane, Schaefer, Jerry, and Luft, LeRoy C., Enterprise Costs For Fallow, Winter Wheat, Spring Wheat, Barley, and Recrop Safflower in Roosevelt County, Bulletin 1179, February 1978.

Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in Chouteau County, Bulletin 1140 Revised, July 1978.

Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in Northern Yellowstone, Stillwater and Golden Valley Counties, Bulletin 1136 Revised, July 1978.

Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in The Pryor, Duck Creek and Beartooth Area of South Central Montana, Bulletin 1137 Revised, July 1978.

Schaefer, Jerry, Griffith, Duane and Luft, LeRoy D., Enterprise Cost For Fallow, Winter Wheat, Spring Wheat and Barley in McCone County, Bulletin 1176, February 1978.

Schaefer, Jerry, Griffith, Duane and Luft, LeRoy D., Enterprise Cost For Fallow, Winter Wheat, Spring Wheat and Barley in Valley County, Bulletin 1178, February 1978.

Schaefer, Jerry, Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in Gallatin County, Bulletin 1139 Revised, April 1978.

Schaefer, Jerry, Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in Hill County, Bulletin 1138 Revised, April 1979.

Schaefer, Jerry, Griffith, Duane and Luft, LeRoy D., Cost of Dryland Crop Production in Fergus County, Bulletin 1142 Revised, May 1978.

Shaw, Art, et al., Harvesting Grain for Hay as a Means of Compliance With The Farm Program in 1978, Montana State University Staff Paper in Economics, No. 78-5.

United States Department of Agriculture, Agricultural Stabilization and Conservation Service, "Feed Grain, Rice, Upland Cotton and Wheat Programs Handbook," Revision Three, February 8, 1978, Montana Notices. This handbook can be located at the State ASCS Office.

United States Department of Agriculture, Agricultural Stabilization and Conservation Service, <u>ASCS Commodity Fact Sheet for the 1978 Feed Grain Program</u>, Washington D. C., Government Printing Office.

United States Department of Agriculture, Economic Research Service, <u>Wheat Situation Report</u>, W.S.-203 through W.S.-241.

United States Department of Agriculture, Montana Crop and Livestock Reporting Service, <u>Montana Agricultural Statistics</u>, Volumes 11 through 16.

United States Department of Agriculture, Agricultural Stabilization and Conservation Service, "Commodity Credit Corporation Loans and Purchases 1977 Wheat," Form 30-150 (Rev. 2).

United States Department of Agriculture, Montana Crop and Livestock Reporting Service, <u>Agricultural Prices</u>, January 1968 through December 1977.

APPENDIX A

APPENDIX A

LINEAR PROGRAMMING MATRIX

Description of Activities and Constraints Included in the Fall Planting Period Matrix. (Matrix appears on Page 91.)

ACTIVITIES

Column #	Description
1.	Right hand side constraints.
2.	Zero, one variable indicating participation in the Farm Program in general.
3.	Zero, one variable indicating participation in the Barley portion of the Farm Program for full deficiency payment.
4.	Zero, one variable indicating participation in the Barley program for full deficiency payments under the additional diversion option.
5.	Zero, one variable indicating participation in the Barley program under the partial deficiency payment option.
6.	Zero, one variable indicating participation in the Barley program under the partial deficiency payment additional diversion option.
7.	Acres of barley after fallow grown for full deficiency payment.

APPENDIX A (Continued)

Column #	Description
8.	Acres of recrop barley grown for full deficiency payment.
9.	Acres of barley after fallow grown for full deficiency payment with additional diversion option.
10.	Acres of recrop barley grown for full deficiency payment with additional diversion option.
11.	Acres of barley after fallow grown for partial deficiency payment.
12.	Acres of recrop barley grown for partial deficiency payment.
13.	Acres of barley after fallow grown for partial deficiency payment with additional diversion option.
14.	Acres of recrop barley grown for partial deficiency payment with additional diversion option.
15.	Receive full deficiency payments for barley.
16.	Receive full deficiency payments plus additional diversion payments for barley.
17.	Receive partial deficiency payments for barley.
18.	Receive partial deficiency payments plus additional diversion payments for barley.

APPENDIX A (Continued)

Column #	Description
19.	Barley after fallow cut for hay.
20.	Recrop barley cut for hay.
21.	Zero, one variable indicating participation in the wheat program for full deficiency payments.
22.	Acres of winter wheat after fallow grown for full deficiency payment.
23.	Acres of recrop winter wheat grown for full deficiency payment.
24.	Acres of winter wheat after fallow grown for partial deficiency payment.
25.	Acres of recrop winter wheat grown for partial deficiency payment.
26.	Receive full deficiency payments for wheat.
27.	Receive partial deficiency payments for wheat.
28.	Acres of spring wheat after fallow grown for full deficiency payment.
29.	Acres of recrop spring wheat grown for full deficiency payment.
30.	Acres of spring wheat after fallow grown for partial deficiency payment.

APPENDIX A (Continued)

Column #	Description
31.	Acres of recrop spring wheat grown for partial deficiency payment.
32.	Acres of winter wheat after fallow cut for hay.
33.	Acres of recrop winter wheat cut for hay.
34.	Receive payment for acres of wheat hay in haying and grazing option of wheat program.
35.	Acres of spring wheat after fallow cut for hay.
36.	Acres of recrop spring wheat cut for hay.
37.	Acres of alternate NCA crops after fallow.
38.	Acres of alternate NCA crops after stubble.
39.	Acres of Non-NCA crops after fallow.
40.	Acres of Non-NCA crops after stubble.
41.	Acres of summer fallow.
42.	Acres of stubble mulch.
43.	Acres of forage crops.
44.	Acres of Nonprogram winter wheat after fallow.
45.	Acres of Nonprogram recrop winter wheat.
46.	Acres of Nonprogram spring wheat after fallow.
47.	Acres of Nonprogram recrop spring wheat.
48.	Acres of Nonprogram barley after fallow.
49.	Acres of Nonprogram recrop barley.

APPENDIX A (Continued)

Column #	Description
50.	Acres of Nonprogram alternate crops after fallow.
51.	Acres of Nonprogram alternate crops after stubble.
52.	Acres of Nonprogram forage crops.
53.	Transfer fallow to forage.
54.	Transfer recrop to forage.
55.	Acres of double summer fallow.

CONSTRAINTS

Row	Description
1	Objective Function
2	Maximum number of Normal Crop Acres.
3	Maximum number of acres individual is willing to plant this year.
4	Maximum acres of barley which can be grown for full deficiency payments.
5	Maximum acres of barley which can be grown for full deficiency payments plus additional diversion payments.
6	Maximum acres of barley which can be grown for partial deficiency payment.

APPENDIX A (Continued)

Row	Description
7	Maximum acres of barley which can be grown for partial deficiency payment plus additional diversion payment.
8	Program barley options less than or equal to one.
9	Setaside acres.
10	Maximum program payment.
11	Barley full deficiency payments (balance).
12	Barley full deficiency payments with additional diversion payments (balance).
13	Barley partial deficiency payments (balance).
14	Barley partial deficiency payments with additional diversion payments (balance).
15	Maximum acres of wheat which can be grown for full deficiency payment.
16	Maximum acres of wheat which can be grown for partial deficiency payment.
17	Wheat full deficiency payment (balance).
18	Wheat partial deficiency payment (balance).
19	Maximum acres of wheat cut for hay and payment.
20	Wheat hay payment (balance).
21	Acres of summer fallow available for seeding.

APPENDIX A (Continued)

Row	Description
22	Acres of stubble available for seeding.
23	Acres of summer fallow required.
24	Acres of total cropland.
25	Maximum acres of alternate NCA crops individual is willing to plant.
26	Maximum acres of Non-NCA crops individual is willing to plant.
27	Exclude non program grain hay.
28	Maximum acres individual is willing to seed to forage crop.
29	Maximum acres of stubble available.
30	Minimum acres of winter wheat to be seeded.

Table A1. Fall Linear Programming Matrix. Columns One Through Nine.

ROW	1	2	3	4	5	6	7	8	9
1	.00	.00	.00	.00	.00	.00	78.50	61.00	78.50
2	.00	-600.00	.00	.00	.00	.00	1.10	1.10	1.20
3	600.00	600.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	-96.00	.00	.00	.00	1.00	1.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	1.00
6	.00	.00	.00	.00	-600.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	-120.00	.00	.00	.00
8	1.00	.00	1.00	1.00	1.00	1.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.10	.10	.20
10	40000.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	-1.00	-1.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	-1.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	600.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	-.44	-.44	-.48
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	600.00	.00	.00	.00	.00	.00	1.00	.00	1.00
22	.00	.00	.00	.00	.00	.00	.00	1.00	.00
23	-600.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1200.00	.00	.00	.00	.00	.00	1.00	1.00	1.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	-600.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	600.00	.00	.00	.00	.00	.00	.00	1.00	.00
30	-200.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Columns Ten Through Eighteen.

ROW	COLUMN 10	11	12	13	14	15	16	17	18
1	61.00	78.50	61.00	78.50	61.00	.00	6.24	.00	6.24
2	1.20	1.10	1.10	1.20	1.20	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	1.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	1.10	1.10	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	1.00	1.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.20	.10	.10	.20	.20	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	6.24	.00	6.24
11	.00	.00	.00	.00	.00	1.00	.00	.00	.00
12	-1.00	.00	.00	.00	.00	.00	1.00	.00	.00
13	.00	-1.00	-1.00	.00	.00	.00	.00	1.00	.00
14	.00	.00	.00	-1.00	-1.00	.00	.00	.00	1.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	-.48	-.44	-.44	-.48	-.48	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	.00	1.00	.00	1.00	.00	.00	.00	.00	.00
22	1.00	.00	1.00	.00	1.00	.00	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	.00	1.00	1.00	1.00	.00	.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	1.00	.00	1.00	.00	1.00	.00	.00	.00	.00
30	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Columns Ninetten Through Twenty-Seven.

COLUMN

ROW	19	20	21	22	23	24	25	26	27
1	51.00	38.00	.00	92.40	68.00	92.40	68.00	.00	.00
2	.00	.00	.00	1.20	1.20	1.20	1.20	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.20	.20	.20	.20	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	-384.00	1.00	1.00	.00	.00	.00	.00
16	.00	.00	600.00	.00	.00	1.20	1.20	.00	.00
17	.00	.00	.00	-1.00	-1.00	.00	.00	1.00	.00
18	.00	.00	.00	.00	.00	-1.00	-1.00	.00	1.00
19	.00	.00	.00	-.48	-.48	-.48	-.48	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	.00	1.00	.00	1.00	.00	.00	.00
22	.00	1.00	.00	.00	1.00	.00	1.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	.00	1.00	1.00	1.00	1.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	1.00	.00	.00	1.00	.00	1.00	.00	.00
30	.00	.00	.00	-1.00	.00	-1.00	.00	.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Columns Twenty-Eight Through Thirty-Six.

	COLUMN								
ROW	28	29	30	31	32	33	34	35	36
1	78.00	53.60	78.00	53.60	52.00	35.00	21.00	46.00	29.00
2	1.20	1.20	1.20	1.20	.00	.00	1.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.20	.20	.20	.20	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	21.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	1.20	1.20	.00	.00	.00	.00	.00
17	-1.00	-1.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	-1.00	-1.00	.00	.00	.00	.00	.00
19	-.48	-.48	-.48	-.48	.00	.00	.60	.00	.00
20	.00	.00	.00	.00	-1.00	-1.00	1.00	-1.00	-1.00
21	1.00	.00	1.00	.00	1.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	.00	1.00	1.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	1.00	1.00	.00	1.00	1.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	-1.00	.00	.00	.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Columns Thirty-Seven through Forty-Five.

COLUMN

ROW	37	38	39	40	41	42	43	44	45
1	-20.00	-20.00	-20.00	-20.00	-7.40	-7.50	-20.00	92.40	68.00
2	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	1.00	1.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	-1.00	-1.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	1.00	.00	.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	.00	.00	.00	1.00
23	.00	.00	.00	.00	-1.00	-1.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	1.00	1.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	1.00	.00	.00
29	.00	1.00	.00	1.00	1.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	.00	.00	.00	-1.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Columns Forty-Six Through Fifty-Four.

ROW	COLUMN 46	47	48	49	50	51	52	53	54
1	78.00	53.60	78.50	61.00	-20.00	-20.00	-20.00	.00	.00
2	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	1.00	.00	1.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	1.00	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	1.00	-1.00	-1.00
29	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A1 Continued. Fall Linear Programming Matrix. Column Fifty-Five.

ROW	COLUMN 55
1	-7.40
2	.00
3	.00
4	.00
5	.00
6	.00
7	.00
8	.00
9	.00
10	.00
11	.00
12	.00
13	.00
14	.00
15	.00
16	.00
17	.00
18	.00
19	.00
20	.00
21	1.00
22	.00
23	-1.00
24	1.00
25	.00
26	.00
27	.00
28	.00
29	.00
30	.00

APPENDIX A (Continued)

The spring planting period matrix differs from the fall planting period matrix in the inclusion of two new activities and three new constraints. The activities allow for plowing up winter wheat which was planted on either summer fallow or stubble if this proves to be profitable. The additional constraints list the number of acres of winter wheat planted on summer fallow or stubble and the maximum number of acres of winter wheat that could be plowed up if profitable. The inclusion of these activities and constraints allows the producer, at spring planting time, to plow up his winter wheat and reseed those acres to some other crop if he feels it may be profitable to do so.

LINEAR PROGRAMMING MATRIX

Description of Activities and Constraints Included in the Spring Planting Period Matrix. (Matrix starts on page 106.)

I Activities

Column #	Description
1.	Right hand side constraints.
2.	Zero, one variable indicating participation in the Farm Program in general.
3.	Zero, one variable indicating participation in the Barley portion of the Farm Program for full deficiency payment.

APPENDIX A (Continued)

Column #	Description
4.	Zero, one variable indicating participation in the Barley program for full deficiency payments under the additional diversion option.
5.	Zero, one variable indicating participation in the Barley program under the partial deficiency payment option.
6.	Zero, one variable indicating participation in the Barley program under the partial deficiency payment additional diversion option.
7.	Acres of barley after fallow grown for full deficiency payment.
8.	Acres of recrop barley grown for full deficiency payment.
9.	Acres of barley after fallow grown for full deficiency payment with additional diversion option.
10.	Acres of recrop barley grown for full deficiency payment with additional diversion option.
11.	Acres of barley after fallow grown for partial deficiency payment.

APPENDIX A (Continued)

Column #	Description
12.	Acres of recrop barley grown for partial deficiency payment.
13.	Acres of barley after fallow grown for partial deficiency payment with additional diversion option.
14.	Acres of recrop barley grown for partial deficiency payment with additional diversion option.
15.	Receive full deficiency payments for barley.
16.	Receive full deficiency payments plus additional diversion payments for barley.
17.	Receive partial deficiency payments for barley.
18.	Receive partial deficiency payments plus additional diversion payments for barley.
19.	Barley after fallow cut for hay.
20.	Recreop barley cut for hay.
21.	Zero, one variable indicating participation in the wheat program for full deficiency payments.
22.	Acres of winter wheat after fallow grown for full deficiency payment.
23.	Acres of recrop winter wheat grown for full deficiency payment.

APPENDIX A (Continued)

Column #	Description
24.	Acres of winter wheat after fallow grown for partial deficiency payment.
25.	Acres of recrop winter wheat grown for partial deficiency payment.
26.	Receive full deficiency payments for wheat.
27.	Receive partial deficiency payments for wheat.
28.	Acres of spring wheat after fallow grown for full deficiency payment.
29.	Acres of recrop spring wheat grown for full deficiency payment.
30.	Acres of spring wheat after fallow grown for partial deficiency payment.
31.	Acres of recrop spring wheat grown for partial deficiency payment.
32.	Acres of winter wheat after fallow cut for hay.
33.	Acres of recrop winter wheat cut for hay.
34.	Receive payment for acres of wheat hay in haying and grazing option of wheat program.
35.	Acres of spring wheat after fallow cut for hay.
36.	Acres of recrop spring wheat cut for hay.
37.	Acres of alternate NCA crops after fallow.

APPENDIX A (Continued)

Column #	Description
38.	Acres of alternate NCA crops after stubble.
39.	Acres of Non-NCA crops after fallow.
40.	Acres of Non-NCA crops after stubble.
41.	Acres of summer fallow.
42.	Acres of stubble mulch.
43.	Acres of forage crops.
44.	Acres of Nonprogram winter wheat after fallow.
45.	Acres of Nonprogram recrop winter wheat.
46.	Acres of Nonprogram spring wheat after fallow.
47.	Acres of Nonprogram recrop spring wheat.
48.	Acres of Nonprogram barley after fallow.
49.	Acres of Nonprogram recrop barley.
50.	Acres of Nonprogram alternate crops after fallow.
51.	Acres of Nonprogram alternate crops after stubble.
52.	Acres of Nonprogram forage crops.
53.	Transfer fallow to forage.
54.	Transfer recrop to forage.
55.	Acres of double summer fallow.
56.	Plow up winter wheat planted on summer fallow.
57.	Plow up winter wheat planted on stubble.

APPENDIX A (Continued)

CONSTRAINTS

Row	Description
1	Objective Function
2	Maximum number of Normal Crop Acres.
3	Maximum number of acres individual is willing to plant this year.
4	Maximum acres of barley which can be grown for full deficiency payments.
5	Maximum acres of barley which can be grown for full deficiency payments plus additional diversion payments.
6	Maximum acres of barley which can be grown for partial deficiency payment.
7	Maximum acres of barley which can be grown for partial deficiency payment plus additional diversion payment.
8	Program barley options less than or equal to one.
9	Setaside.
10	Maximum program payment.
11	Barley full deficiency payments (balance).
12	Barley full deficiency payments with additional diversion payments (balance).

APPENDIX A (Continued)

Row	Description
13	Barley partial deficiency payments (balance).
14	Barley partial deficiency payments with additional diversion payments (balance).
15	Maximum acres of wheat which can be grown for full deficiency payment.
16	Maximum acres of wheat which can be grown for partial deficiency payment.
17	Wheat full deficiency payment (balance).
18	Wheat partial deficiency payment (balance).
19	Maximum acres of wheat cut for hay and payment.
20	Wheat hay payment (balance).
21	Acres of summer fallow available for seeding.
22	Acres of stubble available for seeding.
23	Acres of summer fallow required.
24	Acres of total cropland
25	Maximum acres of alternate NCA crops individual is willing to plant.
26	Maximum acres of Non-NCA crops individual is willing to plant.
27	Exclude nonprogram grain hay.

APPENDIX A (Continued)

Row	Description
28	Maximum acres individual is willing to seed to forage crop.
29	Maximum acres of stubble available.
30	Minimum acres of winter wheat to be seeded.
31	Acres of winter wheat planted on summer fallow.
32	Acres of winter wheat planted on stubble.
33	Maximum acres of winter wheat that can be plowed up.

Table A2. Spring Linear Programming Matrix. Columns One Through Nine.

ROW	1	2	3	4	5	6	7	8	9
1	.00	.00	.00	.00	.00	.00	78.50	61.00	78.50
2	.00	-600.00	.00	.00	.00	.00	1.10	1.10	1.20
3	600.00	600.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	-96.00	.00	.00	.00	1.00	1.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	1.00
6	.00	.00	.00	.00	-600.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	-120.00	.00	.00	.00
8	1.00	.00	1.00	1.00	1.00	1.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.10	.10	.20
10	40000.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	-1.00	-1.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	-1.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	600.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	-.44	-.44	-.48
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	600.00	.00	.00	.00	.00	.00	1.00	.00	1.00
22	.00	.00	.00	.00	.00	.00	.00	1.00	.00
23	-600.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1200.00	.00	.00	.00	.00	.00	1.00	1.00	1.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	-600.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	600.00	.00	.00	.00	.00	.00	.00	1.00	.00
30	-200.00	.00	.00	.00	.00	.00	.00	.00	.00
31	200.00	.00	.00	.00	.00	.00	.00	.00	.00
32	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Ten Through Eighteen.

	COLUMN								
ROW	10	11	12	13	14	15	16	17	18
1	61.00	78.50	61.00	78.50	61.00	.00	6.24	.00	6.24
2	1.20	1.10	1.10	1.20	1.20	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	1.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	1.10	1.10	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	1.00	1.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.20	.10	.10	.20	.20	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	6.24	.00	6.24
11	.00	.00	.00	.00	.00	1.00	.00	.00	.00
12	-1.00	.00	.00	.00	.00	.00	1.00	.00	.00
13	.00	-1.00	-1.00	.00	.00	.00	.00	1.00	.00
14	.00	.00	.00	-1.00	-1.00	.00	.00	.00	1.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	-.48	-.44	-.44	-.48	-.48	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	.00	1.00	.00	1.00	.00	.00	.00	.00	.00
22	1.00	.00	1.00	.00	1.00	.00	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	.00	1.00	1.00	1.00	.00	.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	1.00	.00	1.00	.00	1.00	.00	.00	.00	.00
30	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	.00	.00	.00	.00	.00	.00	.00	.00	.00
32	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Nineteen Through Twenty-Seven.

	COLUMN								
ROW	19	20	21	22	23	24	25	26	27
1	51.00	38.00	.00	92.40	68.00	92.40	68.00	.00	.00
2	.00	.00	.00	1.20	1.20	1.20	1.20	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.20	.20	.20	.20	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	-384.00	1.00	1.00	.00	.00	.00	.00
16	.00	.00	600.00	.00	.00	1.20	1.20	.00	.00
17	.00	.00	.00	-1.00	-1.00	.00	.00	1.00	.00
18	.00	.00	.00	.00	.00	-1.00	-1.00	.00	1.00
19	.00	.00	.00	-.48	-.48	-.48	-.48	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	.00	1.00	.00	1.00	.00	.00	.00
22	.00	1.00	.00	.00	1.00	.00	1.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	.00	1.00	1.00	1.00	1.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	1.00	.00	.00	1.00	.00	1.00	.00	.00
30	.00	.00	.00	-1.00	.00	-1.00	.00	.00	.00
31	.00	.00	.00	1.00	.00	1.00	.00	.00	.00
32	.00	.00	.00	.00	1.00	.00	1.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Twenty Eight Through Thirty-Six.

ROW	COLUMN 28	29	30	31	32	33	34	35	36
1	78.00	53.60	78.00	53.60	52.00	35.00	21.00	46.00	29.00
2	1.20	1.20	1.20	1.20	.00	.00	1.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.20	.20	.20	.20	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	21.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	1.20	1.20	.00	.00	.00	.00	.00
17	-1.00	-1.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	-1.00	-1.00	.00	.00	.00	.00	.00
19	-.48	-.48	-.48	-.48	.00	.00	.60	.00	.00
20	.00	.00	.00	.00	-1.00	-1.00	1.00	-1.00	-1.00
21	1.00	.00	1.00	.00	1.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	.00	1.00	1.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	1.00	1.00	.00	1.00	1.00
28	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	-1.00	.00	.00	.00	.00
31	.00	.00	.00	.00	1.00	.00	.00	.00	.00
32	.00	.00	.00	.00	.00	1.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Thirty-Seven Through Forty-Five.

ROW	37	38	39	40	41	42	43	44	45
1	-20.00	-20.00	-20.00	-20.00	-7.40	-7.50	-20.00	92.40	68.00
2	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	1.00	1.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	-1.00	-1.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	1.00	.00	.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	.00	.00	.00	1.00
23	.00	.00	.00	.00	-1.00	-1.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
25	1.00	1.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	1.00	1.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	1.00	.00	.00
29	.00	1.00	.00	1.00	1.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	.00	.00	.00	-1.00	.00
31	.00	.00	.00	.00	.00	.00	.00	1.00	.00
32	.00	.00	.00	.00	.00	.00	.00	.00	1.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Forty-Six Through Fifty-Four.

	COLUMN								
ROW	46	47	48	49	50	51	52	53	54
1	78.00	53.60	78.50	61.00	-20.00	-20.00	-20.00	.00	.00
2	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00	.00
4	.00	.00	.00	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00	.00	.00	.00
16	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.00	.00	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	1.00	.00	1.00	.00	1.00	.00	.00	1.00	.00
22	.00	1.00	.00	1.00	.00	1.00	.00	.00	.00
23	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	.00	.00	.00	.00	1.00	-1.00	-1.00
29	.00	1.00	.00	1.00	.00	1.00	.00	.00	1.00
30	.00	.00	.00	.00	.00	.00	.00	.00	.00
31	.00	.00	.00	.00	.00	.00	.00	.00	.00
32	.00	.00	.00	.00	.00	.00	.00	.00	.00
33	.00	.00	.00	.00	.00	.00	.00	.00	.00

Table A2 Continued. Spring Linear Programming Matrix. Columns Fifty-Five Through Fifty-Seven.

	COLUMN		
ROW	55	56	57
1	-7.40	-6.00	-6.00
2	.00	.00	.00
3	.00	.00	.00
4	.00	.00	.00
5	.00	.00	.00
6	.00	.00	.00
7	.00	.00	.00
8	.00	.00	.00
9	.00	.00	.00
10	.00	.00	.00
11	.00	.00	.00
12	.00	.00	.00
13	.00	.00	.00
14	.00	.00	.00
15	.00	.00	.00
16	.00	.00	.00
17	.00	.00	.00
18	.00	.00	.00
19	.00	.00	.00
20	.00	.00	.00
21	1.00	.00	.00
22	.00	.00	.00
23	-1.00	.00	.00
24	1.00	.00	.00
25	.00	.00	.00
26	.00	.00	.00
27	.00	.00	.00
28	.00	.00	.00
29	.00	.00	.00
30	.00	.00	.00
31	.00	1.00	.00
32	.00	.00	1.00
33	.00	1.00	1.00

APPENDIX B

Variable Costs of Winter Wheat, Spring Wheat, Barley and Summer Fallow for Selected Counties in Montana.

Table B1. Variable Costs for Winter Wheat in Selected Counties from Montana in 1977 and 1978.

Operating Inputs	McCone County	Roosevelt County County	Valley County	Fergus County	Chouteau County	Hill County	Glacier County	Gallatin County	Northern Yellowstone, Stillwater and Golden Valley Counties	Pryor, Duck Creek and Beartooth areas of South Central Montana	Pondera County	Sheridan-Daniels Counties
												(RECROP)
Seed	$ 2.61	$ 3.00	$ 2.90	$ 2.75	$ 3.73	$ 2.28	$ 3.00	$ 3.78	$ 3.75	$ 3.75	$ 3.68	$ 2.75
Nitrogen	1.80	3.60	1.80	8.55	1.20	1.33	2.53	14.00	8.60	8.60	9.00	1.33
Phosphorus	3.22	1.82	3.22	4.64	4.48	4.64	3.92	4.20	3.22	3.22	2.92	6.27
Insecticide	.63	.25		.54	.38	.38			.33	.33		.65
Fargo				5.00				1.00				
2-4-D	1.01	2.25	2.40	2.50	1.00	.75	1.00	2.75	2.75	2.75	2.25	2.00
Tordon	.45											
Crop Insurance	4.20	.75	2.00	6.00	3.50	3.30	2.50		5.50	5.50	3.50	.70
Pickup	1.38	1.35	1.20	.36	.78	.48	.66	.33	.96	.96	1.20	.66
Custom Hire		.38		1.50				1.25	1.50	1.50	1.25	
Machinery	3.38	2.53	2.90	2.44	3.48	3.43	3.44	3.51	3.55	3.55	2.34	3.21
Tractors	1.28	.50	.70	.73	.82	.62	.79	.72	.90	.90	.36	.85
Labor	2.85	2.30	1.96	1.83	2.52	2.15	2.49	2.47	2.80	2.80	1.95	2.29
Miscellaneous Expenses	1.91	1.47	1.80	2.65	1.95	1.75	1.81	2.65	2.63	2.63	2.27	1.90
Interest on Oper. Cap.	.97	.92	.51	1.71	1.12	1.04	.98	.67	1.38	1.38	1.44	1.17
Total Variable Costs/A	$25.69	$21.12	$21.39	$41.20	$24.96	$22.15	$23.12	$37.33	$37.87	$37.87	$33.16	$23.78
Average Variable Costs For All Counties	$29.62											

Table B2. Variable Costs for Spring Wheat in Selected Counties from Montana in 1977 and 1978.

Operating Inputs	McCone County	Roosevelt County	Valley County	Glacier County	Pondera County	Sheridan-Daniels Counties
Seed	$ 2.74	$ 3.15	$ 3.95	$ 3.00	$ 4.00	$ 3.00
Nitrogen	1.80	2.80		2.53	2.20	1.33
Phosphorus	3.22	4.20		3.92	3.92	6.27
Insecticide		.50				.65
Fargo					4.40	
2-4-D	1.01	2.25	2.40	1.00	.75	2.00
Tordon		.45				
Crop Insurance	4.20	.75	2.00	2.50	3.50	.70
Pickup	1.38	1.35	1.20	.66	1.20	.66
Custom Hire		.38				
Machinery	3.49	2.72	3.72	3.57	2.96	3.76
Tractors	1.96	.75	1.05	1.39	.95	1.52
Labor	3.12	2.38	2.33	2.73	2.65	2.73
Miscellaneous Expenses	1.97	1.50	1.77	1.88	2.19	2.00
Interest on Oper. Cap.	.45	.31	.48	.44	.49	.52
Total Variable Costs/A	$25.79	$23.04	$18.90	$23.62	$29.21	$25.14
Average Variable Costs For All Counties	$24.28					

Table B3. Variable Costs for Barley in Selected Counties from Montana in 1977 and 1978.

Operating Inputs	McCone County	Roosevelt County	Valley County	Fergus County	Chouteau County	Hill County	Glacier County	Gallatin County	Northern Yellowstone, Stillwater and Golden Valley Counties	Pryor, Duck Creek and Beartooth areas of South Central Montana	Pondera County	Sheridan-Daniels Counties
				(RECROP)							(MALT)	(RECROP)
Seed	$ 2.85	$ 2.37	$ 4.38	$ 2.75	$ 3.25	$ 2.20	$ 2.34	$ 3.38	$ 5.63	$ 5.63	$ 2.87	$ 2.50
Nitrogen	1.80	2.80		9.88	1.20	.76	2.53	4.20	1.20	1.20	2.60	1.33
Phosphorus	3.22	4.20		4.64	4.48	2.72	3.92	1.40	2.10	2.10	4.76	6.27
Insecticide		.50				.38						.65
Fargo								1.00			4.40	
2-4-D	1.01	2.25	2.40	2.50	1.00	.75	1.00	2.75	2.75	2.75	1.75	2.00
Tordon	.45											
Crop Insurance	4.20	.75	2.00	3.00	3.50	3.30	2.50		5.50	5.50	3.50	
Pickup	1.38	1.35	1.20	.36	.78	.48	.66	.33	.96	.96	1.20	.66
Custom Hire		.38		1.50				1.25				
Machinery	3.97	2.80	4.16	2.87	6.05	3.56	3.57	3.67	3.69	3.69	3.15	3.27
Tractors	1.96	.75	1.05	1.95	2.06	1.07	1.39	1.26	1.48	1.48	.95	1.40
Labor	3.41	2.44	2.53	2.59	3.54	2.36	2.73	2.80	3.08	3.08	2.85	2.58
Miscellaneous Expenses	2.14	1.40	1.86	2.47	2.38	1.70	1.85	2.10	2.25	2.25	2.24	1.90
Interest on Oper. Cap.	.44	.29	.53	.87	.69	.44	.42	.62	.62	.53	.49	.45
Total Variable Costs/A	$26.83	$22.28	$20.11	$35.38	$28.93	$19.72	$22.91	$24.76	$29.26	$29.17	$29.76	$23.01
Average Variable Costs For All Counties	$25.37											

Table B4. Variable Costs for Summer Fallow in Selected Counties from Montana in 1977 and 1978.

Operating Inputs	McCone County	Roosevelt County	Valley County	Fergus County	Chouteau County	Hill County	Glacier County	Gallatin County	Northern Yellowstone, Stillwater and Golden Valley Counties	Pryor, Duck Creek and Beartooth areas of South Central Montana	Pondera County	Sheridan-Daniels Counties
Pickup	$ 1.38	$ 1.35	$ 1.20	$ 1.56	$ .78	$ .48	$ .66	$ .33	$ .96	$ .96	$ 1.20	$ .66
Machinery	.68	.55	1.26	1.02	.82	.59	.42	.76	1.89	.97	.66	.48
Tractors	4.18	2.66	2.84	3.41	3.50	2.25	2.38	2.82	3.84	4.92	2.91	2.22
Labor	1.64	1.49	1.49	2.02	2.11	1.05	.94	1.70	1.84	2.36	1.39	1.30
Miscellaneous Expenses	.84	.58	.71	.81	.72	.50	.51	.65	.97	.97	.62	.50
Interest on Oper. Cap.	.14	.07	.12	.20	.16	.09	.05	.19	.17	.24	.06	.13
Total Variable Costs/A	$ 8.86	$ 6.70	$ 7.62	$ 9.01	$ 8.09	$ 4.97	$ 4.96	$ 6.44	$ 9.67	$10.43	$ 6.84	$ 5.28
Average Variable Costs For All Counties	$ 7.40											

APPENDIX C

Program Yields for Wheat and Barley Assigned to Each County in Montana by the State Agricultural Stabilization and Conservation Service.

Table Cl. County Program Yields for Wheat and Barley in Montana.

County	Wheat	Barley	County	Wheat	Barley
Beaverhead	31.4	52.5	Madison	36.0	46.2
Big Horn	33.5	41.5	Meagher	27.8	37.6
Blaine	37.8	35.4	Mineral	35.2	41.8
Broadwater	29.8	43.6	Missoula	29.7	43.7
Carbon	31.6	50.2	Musselshell	28.4	31.9
Carter	22.9	31.2	Park	26.4	39.9
Cascade	36.3	37.4	Petroleum	28.1	33.1
Chouteau	35.8	37.4	Phillips	26.3	36.4
Custer	26.7	38.1	Pondera	32.3	43.5
Daniels	24.2	32.7	Powder River	30.4	34.6
Dawson	27.4	39.9	Powell	35.9	40.4
Deer Lodge	40.9	43.1	Prairie	29.8	35.6
Fallon	26.6	35.1	Ravalli	32.0	58.1
Fergus	32.2	35.5	Richland	28.4	40.3
Flathead	46.4	54.6	Roosevelt	26.7	35.5
Gallatin	39.4	53.1	Rosebud	29.2	41.5
Garfield	24.7	33.5	Sanders	27.1	40.8
Glacier	30.4	44.0	Sheridan	25.7	35.4
Golden Valley	25.7	30.7	Silver Bow	30.3	46.7
Granite	29.2	44.9	Stillwater	29.8	36.0
Hill	29.5	38.7	Sweet Grass	26.1	42.0
Jefferson	22.4	35.7	Teton	31.3	44.5
Judith Basin	28.1	36.2	Toole	24.4	37.5
Lake	37.3	48.4	Treasure	37.5	51.5
Lewis & Clark	25.3	43.6	Valley	24.3	34.9
Liberty	26.5	36.2	Wheatland	27.1	32.6
Lincoln	37.4	38.8	Wibaux	26.5	36.9
McCone	26.4	37.2	Yellowstone	33.1	47.9
Over All Average	30.03	40.285			

Griffith, Duane Allen
An analysis of the optimal allocation of resources under the provisions of the 1977 Food and Agricultural Act

DATE	ISSUED TO
	Ginger Schmid 703 N Grand 7-1014