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AN ECONOMIC ANALYSIS OF THE IMPACTS OF WEATHER MODIFICATION ON CROP AND LIVESTOCK PRODUCTION IN SOUTHEASTERN SOUTH DAKOTA

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This thesis is approved as a creditable and independent investigation by a condidate for the degree, Master of Science, and is acceptable as meeting (JAMES W. DUNN uirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

> A thesis submitted in partial fulfillment of the requirements for the degree Master of Science, Major in Economics, South Dakota State University

> > 1974 News, Economics Department

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AN ECONOMIC ANALYSIS OF THE IMPACTS OF WEATHER MODIFICATION

1.4

ON CROP AND LIVESTOCK PRODUCTION IN

The author wishes to express his appreciation to Dr. Richard SOUTHEASTERN SOUTH DAKOTA

Rudel and Dr. Wallace Anndarud fur their guidance and assistance throughout this study.

Thanks is also extended to Eilden Verley for her efficient typing and good emplitude ability.

Particular presidents in fair for the parents of the author for their encouragement and response reserving his educational endeavors.

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Thesis Advisor

Date

ACKNOWLEDGEMENTS

The author wishes to express his appreciation to Dr. Richard Rudel and Dr. Wallace Aanderud for their guidance and assistance throughout this study.

Chapter Thanks is also extended to Eileen Verley for her efficient typing and good spelling ability.

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Particular gratitude is felt for the parents of the author 1 for their encouragement and support regarding his educational en- 2 deavors.

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I. Map Showing the Location of the Study Area

Statement of the Broblem

Anticulture is an Amportant part of South Decoma's economy. Therefore, most factors which benefit the predictivity of articulture help the economy of the entire state. Amount Venteries is a study of Brochings County formed that we solitificant dollar is the agricultural economy of the second state of an entire related impact upon the economy of the county. A simple of estimate while a emperied for the state as a whole. The maximum clare of estimates is a directly related to its productivity. It has a second of estimates and is increased it would be expected to aid the economy of the second as a solid be expected to aid the economy of the second as a solid.

Noisture is generalis townshound to be one of the limiting factors in the level of anticative productivity in South Dakara. The addition of extra water armsile results in higher yields, except under special conditions are them such as disease intestations. As a result of this relationship, so torugh conservation practices, and to supply additional measure, chrough conservation programs and, yecently, through a weather modification programs and, ye-

Donald L. Bettering, An Second Analysis of the Brookings Study Area (angualished Marter's Thears, South Dalata State University, Brookings, 1970), p. 41. imately 3.2 cents per acre in 1973.2 INTRODUCTION

The question of interest to those financing this program is, Statement of the Problem enefits which would result from a program of

Agriculture is an important part of South Dakota's economy. Therefore, most factors which benefit the profitability of agriculture help the economy of the entire state. Donald Kettering in a study of Brookings County found that an additional dollar in the agricultural sector resulted in a three dollar total impact upon the economy of the county.¹ A similar effect could be expected for the state as a whole. The profitability of agriculture is directly related to its productivity. If the productivity could be improved it would be expected to aid the economy of the state as a whole.

Moisture is generally considered to be one of the limiting factors in the level of agricultural productivity in South Dakota. The addition of extra water normally results in higher yields, except under special conditions and times such as disease infestations. As a result of this relationship, efforts have been made in the state to better utilize available water, through conservation practices, and to supply additional moisture, through irrigation programs and, recently, through a weather modification program. Weather modification

the En¹Donald L. Kettering, <u>An Economic Analysis of the Brookings</u> <u>Study Area</u> (unpublished Master's Thesis, South Dakota State University, Brookings, 1970), p. 41. is particularly attractive because it is quite inexpensive, approximately 3.2 cents per acre in 1973.²

The question of interest to those financing this program is, what are the economic benefits which would result from a program of weather modification. The answer to this question is made more complex, because a yield increase from added precipitation causes the supply of the crop in question to increase. While the addition to supply resulting from increased production of an individual farmer would be negligible, the addition to supply when a region or a state Sculy Procedure increases production is significant. If demand did not change, this The procedure when for increased supply would result in a lower price, which might possibly programming to an Adding result in lower total revenues or profits. The magnitude of the efgate farm were determined by fect would be related to the price elasticity of demand in the area of and Livestock Reporting a the curve in question and the percentage of national production of Aanderud and Dr. Richard Books, been while the research a Department the good which is produced in the area. South Dakota State University

Objectives of the Study

1. The first objective is to estimate the effect of weather modification upon the profitability of agriculture in the ninth Crop Reporting District of South Dakota. This objective will be met by means of two sub-objectives:

²Effects of Additional Precipitation on Agricultural Production, the Environment, the Economy and Human Society in South Dakota. A Report to the Division of Atmospheric Water Resources Management of the Bureau of Reclamation, United States Department of Interior, Vol. I (Prepared by a special Study Team of the Agricultural Experiment Station, South Dakota State University, Brookings, 1973), p. 117.

water unsered the expensive that e

A. A series of estimates of the profitability of agriculture in the region will be determined considering various sets of possible yield increases.

B. Estimates will also be determined when a lower price results from the increased supply.

2. Divisibility with in American share with Imparty and americans.

2. The second objective will be to examine the findings from the first objective for possible policy implications and for implications that will aid decision makers.

and and aradored in Brandhand, one to

Study Procedure

The procedure used for the study was the application of linear programming to an aggregate farm. The characteristics of this aggregate farm were determined from data compiled by the South Dakota Crop and Livestock Reporting Service, with assistance from Dr. Wallace Aanderud and Dr. Richard Rudel, both with the Economics Department at South Dakota State University.

The method of an aggregate farm approach was used because the desired estimates are of an aggregate nature. The activities were limited to their actual historical limits, in order to obtain results as representative of the actual effects of weather modification as possible. This means that the optimizing allowed was unusually restrictive.

of activities which will optimize a particular objective, e.g. obtain maximum profits within the restrictive framework of certain constraints. By adjusting the resource use and profitability of the various activities, comparable results can be obtained which will yield the desired estimates of profits.

The use of linear programming involves four basic assumptions:³ 1. Additivity and Linearity--separate activities must be additive, i.e. no change in resource requirements per unit or productivity per unit is possible to reflect differences resulting from two activities occuring together or separately. 2. Divisibility--it is assumed that all inputs and outputs can be used and produced in fractional parts. 3. Finiteness--there are not an infinite number of alternatives or restrictions.

4. Single Value Expectations--the values of all parameters Description of the study area are known with certainty, e.g. prices, budgets, available The study area is the ninth free Reporting District of South resources.

Developing a linear programming model involves four basic steps.⁴ These are: (1) state the problem in terms of an objective; (2) determine what information is necessary for solution of the problem; (3) gather the necessary information; (4) put this information in the form of a system of related linear equations and inequalities.

³Earl O. Heady and Wilfred Chandler, <u>Linear Programming Methods</u> (Ames, Iowa: Iowa State University Press, 1966), pp. 17-18.

are also grown

⁴Robert O. Ferguson and Lauren F. Sargent, <u>Linear Programming</u> (New York: McGraw Hill Book Company, Inc., 1958), pp. 9-10.

Dakota Acciculture, 1967-1971, variant pages.

In the explanation of the development of my model, found in this and the following chapter, this progression may be seen.

The use of the aggregate farm method introduces two implicit assumptions. The first assumption is that each producer has the same technical requirements for each activity, e.g. each farmer in the area uses the same amount of fertilizer per acre of corn. The second assumption states each producer has proportional resource restrictions. Obviously, these assumptions do not mirror reality. Variability does exist between producers, both in budgets and in resource restrictions. The goal is that the budgets and resource restrictions used are representative enough to minimize the effect of these variations, therefore yielding reasonable results.

Description of the Study Area

The study area is the ninth Crop Reporting District of South Dakota. The counties in the area are Bon Homme, Charles Mix, Clay, Douglas, Hutchinson, Lincoln, Turner, Union and Yankton counties. A map of the study area is shown in Figure 1.

The major crops of the region are corn, oats, pasture, both native and cropland, alfalfa, soybeans, sorghum and wild hay. Lesser amounts of spring wheat, barley, winter wheat, rye and durum wheat are also grown.

The area engages in various livestock activities, including

⁵South Dakota Crop and Livestock Reporting Service, <u>South</u> Dakota Agriculture, 1967-1971, various pages.





beef cow herds, raising feeder calves, feeding beef cattle, raising and feeding out feeder pigs, raising and feeding lambs, and some dairy activity.⁶

of dem The rainfall in the area ranges from 19 inches to 24 inches. The average annual temperature is 48 degrees.⁷ The growing season is approximately 150-160 days long.⁸

million acres of cropland. The study took advantage of the limited Review of Literature

Investigation of the accalentation, by incorporating at-Investigation of the economic effects of weather modification fects of timeliness of the additional precipitation and price elasis a relatively recent phenomenon. There have been a few relevant timities.

studies which will be discussed.

In a study of the economic impact of weather modification in Montana, Stroup and Townsend used weather records between 1917 and 1970.⁹ These records were altered by using several statistical tech-

least cost alternative. Benefits occurred in power production and ⁶Ibid., various pages. irrigation of forage crops with possible future benefits from fruit.

⁷Economics Department, "South Dakota Agriculture and its Problems," Agricultural Economics Pamphlet 121 (South Dakota State University), p. 4.

South Dakota," Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), p. 3.

⁹Richard L. Stroup and Stuart Townsend, "An Evaluation of the Economic Impacts of Weather Modification in the Great Plains of Montana," Section 5, Economics from Impacts of Induced Rainfall on the Great Plains of Montana, Research Report 42, A Report to the Division of Atmospheric Water Resources Management of the Bureau of Reclamation, United States Department of Interior (Prepared by the Montana Agricultural Experiment Station, Montana State University, Bozeman, 1973). original and adjusted weather data were used to generate expected yields, producing a base and an increased yield. These were used in a linear program to derive net farm income. Price elasticities of demand for the crops were estimated and introduced in a series of steps. The study found that increased rainfall would lead to at least a \$10 million increase in net revenues from about twenty million acres of cropland. The study took advantage of the limited number of crops grown in the area examined, by incorporating effects of timeliness of the additional precipitation and price elasticities.

Rudel, Stockwell and Walsh studied the economic effects of weather modification, used to increase snowfall and therefore runoff, in the Colorado River Basin.¹⁰ They used a benefit cost analysis to study the problem. They found that compared to other proposed methods of augmenting water supplies, weather modification appeared to be a least cost alternative. Benefits occurred in power production and irrigation of forage crops with possible future benefits from fruit and vegetable production. Costs were largely direct costs, these mainly variable, with indirect costs due to snow removal and mine closing expenses.

In a study in Illinois, Changnon and Huff studied potential Menefits of the Bureau of ¹⁰R. K. Rudel, H. J. Stockwell and R. G. Walsh, "Weather Modification: An Economic Alternative for Augmenting Water Supplies," <u>Water Resources Bulletin</u>, 9:1 (February 1973), 116-128. prime

3:1 (1967), 33-43.

benefits of weather modification on agriculture.¹¹ Their approach was a probabilistic one, where with corn and soybeans, probabilities of different magnitudes were assigned to various weather modification plans, and from this, tables of minimum expected profit or loss for each probability were estimated. They found that for any given year weather modification would be beneficial more frequently than detrimental in each of 13 regions but one. For a five year period a substantially higher probability of beneficial results occurred in each area.

¹¹S. A. Changnon, Jr. and F. A. Huff, "Evaluation of Potential Benefits of Weather Modification on Agriculture," A report to the Division of Atmospheric Water Resources Research of the Bureau of Reclamation, United States Department of Interior (Prepared by Illinois State Water Survey, 1971).

¹²Gardener M. Brown, Jr. and C. B. McGuire, "A Socially Optimum Pricing Policy for a Public Water Agency," <u>Water Resources Research</u>, 3:1 (1967), 33-43.

optimim prices to get a delivered price which equals the prospective marginal value of water. These prospective marginal values of water ranged from \$14.50 to \$28.75 per acre-foot for one set of data and \$10.85 to \$25.10 per acre-foot for the other.

Young and Martin studied the value of water in Arizona agriculture through budget studies for a typical farm.¹³ The characteristics of the farm were synthesized through surveys of farms in the area. From this they found the marginal value of water to be \$34 per acre-foot for cotton, \$13 per acre-foot for alfalfa hay, \$20 per acrefoot for sorghum and \$21 per acre-foot for barley. These marginal values were short run and in the longer term an additional \$8 per acre-foot in expenses would have to be covered.

Howe and Easter evaluated the direct and indirect costs and benefits of interbasin water transfers.¹⁴ They attempted to determine what the marginal value of water was in the areas which received the transferred water. They considered the value to agriculture, since it has the lowest values and is the greatest user. They made use of existing studies, including the two mentioned just previously, and added work of their own. They found the marginal value of water

¹³Robert A. Young and William E. Martin, "The Economics of Arizona's Water Pollution," Arizona Review, 16:3 (1967), 9-18.

¹⁴Charles W. Howe and K. William Easter, <u>Interbasin Transfers</u> of Water, Economic Issues and Impacts, (Baltimore: John Hopkins Press, 1971).

to range from \$10 to \$20 per acre-foot and the costs of interbasin transfers were found to be \$50 to \$60 per acre-foot. As a result of this they suggested other means of obtaining additional water, especially the reduction of conveyance losses.

The method of lines: programming maximizes (or minimizes) a linear objective function subject to a number of constraints. The solution provides the combination of activities which produces the maximum value of the objective function (in this case, profit), and satisfies the constraints. Linear programming was used because the agriculture of the area can be described quite accurately as a system of distinct, yet intervelated activities. The data necessary for construction of a linear programming model suitable for the problem was readily available, with minor exceptions, however, this data was better suited to an aggregate approach; rather than an individual enterprise approach. The rajor reason for use of linear programming was that it provided the clearest view possible of the problem, considering the data available.

In order to use linear programming to solve problems, certain assumptions must be made about the real world eiterstion which the model attempts to depict. This chapter presents the assumptions made, and develops the resulting model. These assumptions are of two types, those concerning resource restrictions and these concerning enterprise alternatives.

LESOURCE RESTRICTIONS

The initial values of the resource restrictions are listed in

CHAPTER II

Table I of Appauli 2 A.

ASSUMPTIONS

The size of the fart screeprise was closed at the total acteand

of the study area. This was moved from these called a configure and The method of linear programming maximizes (or minimizes) a native pasture, with 2.517 MAD writes of clinchle crushand past 578,000 linear objective function subject to a number of constraints. The acres of native pastore. an seath latter solution provides the combination of activities which produces the tially limited to the composed : SHE BENGS maximum value of the objective function (in this case, profit), and year pariod 1967-71. Lacer this macriner fee was relaxed, and th satisfies the constraints. Linear programming was used because the acreage of each area was allowed day agriculture of the area can be described quite accurately as a system for the five very period. The many of distinct, yet interrelated activities. The data necessary for con-Pasture was not spin, with only ne. struction of a linear programming model suitable for the problem was ran all managements and the Livestock activities. As when a readily available, with minor exceptions, however, this data was betrequired to supply chase her ter suited to an aggregate approach; rather than an individual enter-Corn was chosen since it is the seein prise approach. The major reason for use of linear programming was inpact upon its total encourse whill be appressing the state that it provided the clearest view possible of the problem, considering Therefore the acrease of core was manufact enaber than the history the data available.

In order to use linear programming to solve problems, certain assumptions must be made about the real world situation which the model attempts to depict. This chapter presents the assumptions made, and develops the resulting model. These assumptions are of two types, those concerning resource restrictions and those concerning enter-

prise alternatives.

I, Area Reports, Part RESOURCE RESTRICTIONS

The initial values of the resource restrictions are listed in

1. Granty Bata Gener-

Table Lof Appendix A. . was allowed in the crop constraints, the resulting solution sculd contain no onte, set this would bardly be as Land

accurate representation of the opini The size of the farm enterprise was fixed at the total acreage in the region. of the study area. This was broken down into tillable cropland and native pasture, with 2,517,000 acres of tillable cropland and 434,000 acres of native pasture.¹⁵ The acreage allowed for each crop was initially limited to the average acreage of that crop grown for the five year period 1967-71. Later this restriction was relaxed, and the acreage of each crop was allowed to range within the historic limits for the five year period. The exception to this restriction was corn. Pasture was not sold, with only as much grown as was required by the livestock activities. As yields increased fewer acres of pasture were required to supply these needs. These acres were converted to corn. Corn was chosen since it is the most common crop of the area and the inpact upon its total acreage would be proportionately smallest. Therefore the acreage of corn was somewhat greater than the histor-Labor Restrictions ical acreage. The five-year period was used to dampen the effects The amount of labor available to the enterprise was not of any one-time fluctuations and still remain a short enough time stricted and therefore assured to be sufficient. Because the data period for technology to remain relatively constant. Since the required to differentiate between operator labor and hired labor was study is an aggregation, a large amount of freedom in the constraints

would detract from the reliability of the estimates obtained. If a

¹⁵U. S. Bureau of the Census, <u>Census of Agriculture</u>, 1969, Vol.
I, Area Reports, Part 19, South Dakota, Section 2, County Data (Washington: Government Printing Office, 1972), various pages.

large amount of freedom was allowed in the crop constraints, the resulting solution would contain no oats, yet this would hardly be an accurate representation of the study area, since oats is a major crop in the region. expenses financed internally and the amount financed by bornowing. In the model, capital is not restricted nor is any Livestock Postrictions

Livestock Restrictions

charge imposed for capital. Is other words, it is assumed that suf-Participation in the various livestock activities was handled ficient internal capital is available for say required financing. similarly to the crops. Initially, the numbers of each type of livestock were fixed at the average amounts actually raised during the the five year period. The data used to compile these averages, as well as the crop acreages, the yields and the prices, was obtained from the annual reports of the South Dakota Crop and Livestock Re-INTERPRISE ALTERNATIVES porting Service. Since the data regarding cattle was rather general, The alternative activities available in the model were reprethe model was allowed to satisfy the cattle constraints through a sentative of those enterprises commonly found on farms in the study variety of alternatives. These alternatives will be discussed later area. A listing of these activities is presented in Table II of in this chapter in the section titled Beef Cattle Activities.

Labor Restrictions

Quaps.

The amount of labor available to the enterprise was not restricted and therefore assumed to be sufficient. Because the data required to differentiate between operator labor and hired labor was not available, no such differentiation was imposed. Rather all labor was assumed to be identical, with no distinction between operator and hired labor and the enterprises were charged \$2.00 per hour for all labor used.

The yield changes attributable to an added 1mch of relatell were ob-

tained from the Agricultural Esgineering and Flast Science Departments

Capital Restrictions University, 16 A range of possible yield in-

A similar situation exists regarding the availability of, and need for, capital. Once again data was not available stating the amount of farm expenses financed internally and the amount financed by borrowing. In the model, capital is not restricted nor is any charge imposed for capital. In other words, it is assumed that sufficient internal capital is available for any required financing.

ious sources with the assistance of Dr. Wallace Aanderud, Extension Other Restrictions

Economist in Farm Management at South Dakota State University, and

Taxes were omitted from the model and no land charge was levied. these are presented in Tables I through XVI in Appendix C. These two assumptions were also necessitated by data limitations.

Harvest Activities

ENTERPRISE ALTERNATIVES

Corn, oats and sorghum were harvested either as grain or silage. The alternative activities available in the model were repre-Since the silage activity most prodominant is corn silage, a maximum sentative of those enterprises commonly found on farms in the study acreage restriction was blaced on this. Because the available data

area. A listing of these activities is presented in Table II of did not indicate screage harvested for silage, the choice of silage

Appendix A.

type was left open after the minimum corn silage requirement was sat-

Crops . For all other crops only the form of harvest generally as-

acciate Crop activities considered were the major crops grown in the

area. The criterion used to determine whether a crop was included Livestock Activities

was the average number of acres grown in the area. If the five year average acreage of a crop was greater than 1,000 acres, then the crop the transmission of the base yields were the five year average yields obsmall size and the base of the difficult associated with tained from the South Dakota Crop and Livestock Reporting Service.

The yield changes attributable to an added inch of rainfall were ob-

tained from the Agricultural Engineering and Plant Science Departments

of South Dakota State University.¹⁶ A range of possible yield increases was used, indicating a minimum, average and maximum expected yield increase. Yield increases are dependent upon the timeliness of the added precipitation and the ability of the farmer to take maximum advantage of the additional moisture. Base yields are listed in Table II-1, while the yield increases are listed in Table II-2.

Representative budgets for these crops were prepared from various sources with the assistance of Dr. Wallace Aanderud, Extension Economist in Farm Management at South Dakota State University, and these are presented in Tables I through XVI in Appendix C.

Harvest Activities

Since the silage activity most predominant is corn silage, a minimum acreage restriction was placed on this. Because the available data did not indicate acreage harvested for silage, the choice of silage type was left open after the minimum corn silage requirement was satisfied. For all other crops only the form of harvest generally associated with that crop was allowed.

Livestock Activities

Livestock activities included beef cattle, hogs and sheep activities. Dairy was not included in the model because its relatively small size was not felt to outweigh the difficulties associated with its inclusion.

¹⁶Effects of Additional Precipitation, op. cit., pp. 4-36.

16

25.70

Crop	ang kanalang kanala	Unit		Yield/Acre
Crop Corn Grain	- Uniter	Bushels	n a star og som en som Av skill store og som	43.81
Oats Grain	Stradilly in A.	Bushels		42.44
Sorghum Grain		Bushels		39.83
Soybeans		Bushels		20.25
Spring Wheat		Bushels		20.72
Winter Wheat	Miles (1973), Ser	Bushels		29.14
Durum Wheat	der all out hay	Bushels		22.29
Ryeum Wheat		Bushels		25.70
Barley	Baracter, Lo	Bushels		33.50
Corn Silage		Tons		7.37
Sorghum Silage	Number	Tons		6.49
Oat Silage		Tons		6.67
Wild Hay		Tons		1.00
Alfalfa Hay		Tons		2.20
Cropland Pasture		AUM		3.75
Native Pasture		AUM		2.25
Native Pasture				9.33

Table II-1: Five Year Average Yields for the Study Area

Source:

duction.

in South Datos,

South Dakota Crop and Livestock Reporting Service, South Dakota Agriculture, 1967-71, various pages.

Water Resources to a terminate the devices of the location. United Stars, and the devices the devices the devices of the devic

Table II-2: Expected Yield Increase from an Added Inch of Precipitation.

Beef cattle operations were divided into several activities. and certain assumptions were made about the characteristics of these Expected Increase Per Acre Cropivities. Beef Unit statist Minimum Average rath Maximum choice between activities was allowed with the only limitations being Corn Grain Bushels 12 2 8 on the number of cows, calves, heifers heavier than 500 pounds and Bushels 1 3 5 Oats Grain steers heavier than 500 pounds. Descriptions of the beef cattle Bushels 2 8 Sorghum Grain 12 activities and the resource requirements were obtained from a recent Soybeans 3 Bushels 1 study by Barvin Johnson on best enterprises engaged in by farmers in 5 Spring Wheat Bushels 1 3 17 part of the area included in this study. Winter Wheat Bushels 1 4 Two beef cow alternatives were offered, one which ratises rev. 1 3 Bushels 5 Durum Wheat placement heifers and one which purchases replacement heifers. Both 3 Bushels 1 5 Rye of these alternatives assumes a 16 per cent replacement rate. In the 5 Bushels 1 Barley activity raising replacements, 20 per cent of the heifer values were 0.34 1.35 Tons 2.02 Corn Silage held back for replacement surposes with 20 per cent of these, or four 0.33 1.30 Sorghum Silage Tons 1.96 per cent of the helfer calves, later culled and transferred to a 0.16 0.47 0.79 Tons Oat Silage Seeding or selling activity. The remaining SU per cant seclefied the 0.05 0.15 0.25 Wild Hay Tons to per con replaces at requirement. The addivity purchasing replace-0.05 0.25 0.50 Tons Alfalfa Hay ment helfers was a separate enterprise. One buil was required per 25 AUM 0.08 0.17 Cropland Pasture 0.34 cows. Raised replacement beifers were assumed to calve at moviears 0.08 0.17 0.33 AUM Native Pasture All costs appociated with the ball and with collatedning the or age.

Source: Effects of Additional Precipitation on Agricultural Production, the Environment, the Economy and Human Society in South Dakota, A Report to the Division of Atmospheric Water Resources Management of the Bureau of Reclamation, United States Department of Interior, Vol. I (Prepared by a special Study Team of the Agricultural Experiment Station, South Dakota State University, Brookings, 1973), p. 4-36. Beef Cattle Activities and crop was assumed, whom 50 per cent of each

Beef cattle operations were divided into several activities, and certain assumptions were made about the characteristics of these activities. Beef cattle statistics were general and a rather free choice between activities was allowed with the only limitations being on the number of cows, calves, heifers heavier than 500 pounds and steers heavier than 500 pounds. Descriptions of the beef cattle activities and the resource requirements were obtained from a recent study by Darwin Johnson on beef enterprises engaged in by farmers in part of the area included in this study.¹⁷

Two beef cow alternatives were offered, one which raises replacement heifers and one which purchases replacement heifers. Both of these alternatives assumes a 16 per cent replacement rate. In the activity raising replacements, 20 per cent of the heifer calves were held back for replacement purposes with 20 per cent of these, or four per cent of the heifer calves, later culled and transferred to a feeding or selling activity. The remaining 80 per cent satisfied the 16 per cent replacement requirement. The activity purchasing replacement heifers was a separate enterprise. One bull was required per 25 cows. Raised replacement heifers were assumed to calve at two years of age. All costs associated with the bull and with maintaining the raised replacements were included in the beef cow activity budgets.

¹⁷Darwin K. Johnson, An Economic Analysis of Selected Beef Enterprise Systems for Southeast South Dakota (unpublished Master's thesis, South Dakota State University, 1973), pp. 26-28. A 92 per cent calf crop was assumed, with 50 per cent of each sex. In the activity purchasing replacements, all of the calves were transferred to other activities. For the activity raising replacements, all of the steer calves and 56.5 per cent of the heifer calves were transferred. Weaning weights were assumed to be 450 pounds for a steer calf and 410 pounds for a heifer calf, with weaning on October 15. out VIII of

There were three other types of beef cattle activities available. Activities These were raised yearlings, feeding calves in drylot and feeding yearlings in drylot.

The activities for raising yearling feeder cattle were divided offer a sourcempter it assume into steers and heifers. The calves used for this could be purchased year, with March and Subscriber again . Warden and the states or could be obtained from the beef cow herd activities. Steer calves vest average of 14.3 gives stand for such west and the state of provide were assumed to weigh 450 pounds at the beginning of the period and feeder pics to be transferred as the feeder all and tother. The big is 650 pounds at the end. Both were wintered from October 15 to April saved from the Barce Determine a traditional loss . The means of main-10 on a ration of corn, or corn equivalents, hay and pasture. At the taining the boar and the conjustment into intelliging in the section end of the period the animals were sold, or transferred to yearling Attyozzi au feeder activities. 18

The activities for feeding calves in drylot were also divided into separate steer and heifer activities. Calves were bought, or obtained from the beef cow activity. Steer calves weighed 450 pounds at the start of the period and were sold at 1,100 pounds, Heifer

calves initially weighed 410 pounds and were sold at 950 pounds.¹⁹

of Agriculture (Nouth Date to be between 181), and the state. 18 Ibid., p. 29.

19_{Ibid}.

The yearling feeder activities were divided into steers and heifers as were the other cattle activities. Similarly, an option to raise or purchase yearlings was allowed. Steers were initially 650 pounds while heifers were 600 pounds. Steers sold at 1,200 pounds and heifers at 1,050 pounds. An annual turnover rate of 1.8 was assumed.²⁰ Budgets for the cattle activities are listed in Tables I sheep Activities through VIII of Appendix D.

Sheep activities were also divided into two boold kypes, a over

HogdActivitiese and a feeder lamb encorprise. A choice of two eve

Two types of hog activities were allowed, a sow herd enterprise and a feeder pig enterprise. The sow herd activity used the concept of a sow unit. It assumed one boar per 25 sows. Two litters per year, with March and September farrowing, were assumed, with the fiveyear average of 14.5 pigs weaned per year per unit, yielding 40 pound feeder pigs to be transferred to the feeder pig activity. One pig is saved from the March litter as a replacement sow. The costs of maintaining the boar and the replacement sow are included in the activity.²¹, may be either sold or transferred to the feeder lamb enter-

prise. The feeder pig activity begins with 40 pound feeder pigs, is either from the sow herd or purchased. The finished butcher hogs -

20 Ibid., pp. 29-30.

21 Wallace G. Aanderud, Myron T. Barber and Merlyn M. Dahl, Guidebook for Planning a Farm or Ranch Business, Extension Circular 633 (rev.), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 94-95.

²³Ibid. pp. 78-79, 82-83, 86-87.

weigh 225 pounds. Half of the pigs were finished for August or September marketing, with the other half finished for February or March marketing. The spring pigs were pastured and the fall pigs were fed in drylot.²² Budgets for these activities are listed in Tables IX and

X of Appendix D. Purchase of Feid and Livestock

Sheep Activities was allowed of eight types of livestock. These were Sheep activities were also divided into two basic types, a ewe herd enterprise and a feeder lamb enterprise. A choice of two ewe herd activities was available with no restrictions limiting the degree of participation in either. In the first of these, replacement rops and Liveston le of ewes were raised, and in the other, replacement ewes were purchased. All crops were allowed to be sold except sliege and pasture. A 20 per cent replacement rate was assumed. In the activity raising replacement ewes, 20.4 per cent of the lambs were retained each year for replacement purposes, with a two per cent death loss. A 120 per process, i.e. cull cours, with a two per cent death loss. A 120 per cent lamb crop was assumed for both with half of these being August vearlings. Hor sales were allowed for butcher bogs and cull sows, and feeders and half May-June feeders. The feeder lambs, weighing 70 aheep sales were allowed for call ewes, feeder lambs and rat lambs. pounds, may be either sold or transferred to the feeder lamb enter-For all livestock sales the units used were hundred weights. prise. One ram was assumed per 35 ewes with the cost of maintaining it included in the enterprise. The cost of maintaining the replacement ewe was also included in the case of the raising replacement ewes Palternative 23 A price decrease was used for cash grain crops The feeder lamb enterprise begins with 70 pound feeder lambs. prices required were not available, they were intervalated using ²²Ibid., pp. 96-99.

23 Ibid., pp. 78-79, 82-83, 86-87.

feeds them in drylot for two months, and sells 100 pound fat lambs. The feeder lambs may either be purchased or obtained from the ewe herd activity.²⁴ Budgets for the sheep activities are listed in Tables XI through XIII of Appendix D.

Purchase of Feed and Livestock

Purchase was allowed of eight types of livestock. These were replacement heifers, steer calves, heifer calves, yearling steers, yearling heifers, feeder pigs, replacement ewes and feeder lambs. In addition the purchase of alfalfa hay and corn was also permitted.

Sale of Crops and Livestock

All crops were allowed to be sold except silage and pasture. Units used were the standard units associated with each crop.

Cattle sale activities occurred at each stage of the production process, i.e. cull cows, calves, yearling feeders, fed calves and fed yearlings. Hog sales were allowed for butcher hogs and cull sows, and sheep sales were allowed for cull ewes, feeder lambs and fat lambs. For all livestock sales the units used were hundred weights.

Prices

Prices used were the five year historical average prices for the period 1967-71. A price decrease was used for cash grain crops to reflect the depressed market price due to increased supply. Where prices required were not available, they were interpolated using

²⁴Ibid., pp. 88-89.

traditional price relationships, via comparison to known prices. Prices used are listed in Table I of Appendix B. In addition, the prices of related products which appear in the budgets are also typical of this period.

In this charge in the second second second second frame the starting provides and ping nodel are growinged. ations of yield in manager and the second second and and lyzed. These finally a start was an analyzed to a start and when the bounds of the device the second in the second states, second as and those obtained when a second to a second a second as a second the second tivilies to radial the methods where the second and the Mine American American Strategy and the second states and the se statistics were grown and the second state while a statistic birds stock revenue, it should be been a strater, formal random . total costs and taken are and taken and and an and the same and an a basis for the analytic basis is a submaniant, adding walks was takkness of them is working the . Gross walks of the second device and an all and the stops produced in the area. SOME Crops and puschast a walker of \$8.00 per too and there is the second of the second state of the second state of Therefore, group value is a contract the addition came for ceipty realized from sale of a star from strates are then then the strategy and dicures for crops inclusion and contained them and the date ference between these the second second second districtions the

estimated profit from crops, CHAPTER III

Livestock revenue is the sum of the livestock related receipts ANALYSIS OF THE RESULTS for the region. This does not include intra-regional sales between

IntroductionLivestock costs is the sum of the costs of operating and in this chapter, the results obtained from the linear programming model are presented. The results obtained from various combinations of yield increases and price changes are compared and analyzed. These findings are divided into two parts, those obtained when the bounds of the activities were fixed at historical averages. and those obtained when these bounds are relaxed, allowing the activities to range to the maximum limits. Total profits is the dif-Nine basic statistics were generated for each situation. These statistics were gross value of crops, crop costs, crop profits, livestock revenue, livestock costs, livestock profits, total revenue, total costs and total profits. Since these statistics were used as TYET CROP ACREAGE RESTRICTIONS a basis for the entire chapter's discussion, rather exact definition of them is worthwhile. in a benchmark against which comparisons could Gross value of crops is the market value of all of the crops produced in the area. This statistic includes the market value of toes some crops not generally sold. For example, silage was given a value of \$8.00 per ton and pasture was given a value of \$4.50 per AUM. Therefore, gross value of crops does not present the actual cash receipts realized from sale of crops. Crop costs are the total expenditures for crops including labor charges. Crop profits is the difference between these two figures. | Grop profits is therefore the

For the base run, total revenue was \$150,239 million and total
estimated profit from crops. Total profits were \$56.768 million.

Livestock revenue is the sum of the livestock related receipts for the region. This does not include intra-regional sales between producers. Livestock costs is the sum of the costs of operating and maintaining the livestock enterprises. This includes implicit as well as explicit costs. Once again \$4.50 per AUM was charged for the pasture fed and \$8.00 per ton for the silage fed.

Total revenue is the total sales of the area to other regions or to sections of this region not represented in the model. Total costs is the sum of the costs of agricultural inputs used in the region, including the \$2.00 labor charge. Total profits is the difference between these two statistics. This profit may therefore be broken down into individual sector profits, helping to identify the recipients of the benefits of weather modification.

FIXED CROP ACREAGE RESTRICTIONS In order to obtain a benchmark against which comparisons could be made, a historic situation was inserted in the model. This base run used the five year average yields and the five year average prices for the area. Acreages for each crop for this entire set of runs were fixed at the five year average number of acres for each crop grown. The numbers of each type of livestock were subject to a similar constraint. Various combinations of assumptions concerning weather modification and its effects were then inserted into the model and these findings were compared to the results from the base run.

For the base run, total revenue was \$150.239 million and total

costs were \$93.471 million. Total profits were \$56.768 million. Livestock revenue was \$100.807 million and gross value of crops was \$97.836 million. This indicated that approximately one half of the crops produced in the region were fed to the region's livestock. Livestock costs were \$81.468 million and crop costs were \$60.408 million. Livestock profits were \$19.339 million and crop profits were \$37.428 million.

In the base run, oat silage was the first preference for feed, followed by corn silage. No sorghum silage was fed and corn silage acreage was at its lower bound. In the choice between feed grains, sorghum and barley were the first two choices, with corn following. No oats were fed. Wild hay was fed before alfalfa hay. Each of these feed preference decisions were caused by minor differences in the feed value per dollar of the crops in question.

Replacement heifers were raised rather than purchased and both steer and heifer calves were fed out. Replacement ewes were purchased rather than raised.

Each of the preferences concerning feed or livestock choices held except where noted. The most important change was that steer calves were not fed as the price of feed grains decreased. The feeding requirement regarding the number of steers being fattened was fulfilled by feeding yearling steers.

The first case involving weather modification assumes that weather modification causes a minimum yield increase. It is further assumed that no price change accompanies the minimum yield increase. The

values obtained from this run, the base run, and a third run assuming the minimum yield increase accompanied by a five cent per bushel price decrease for cash grains, are listed in Table III-1.

The results of the first case showed that total profits increased 6.96 per cent over the base run. The gross value of crops increased 4.31 per cent. This increase, which offset a slight increase in crop costs occurring because fewer acres of pasture were required and corn was grown on these available acres, meant an increase of 10.5 per cent in crop profits. Livestock revenue was unchanged, but livestock costs decreased slightly because more sorghum, barley and wild hay were available, meaning an increase in the feed value per dollar, since these feeds had slight advantages in this respect. Cost decreases were reflected in a slight increase in livestock profits. The application of weather modification in the area resulted in an increase in agricultural profits of \$3.950 million under this set of assumptions.

The next set of assumptions inserted into the model were a minimum yield increase, accompanied by a five cent per bushel price decrease. Decreased prices created a lower opportunity cost for feed grains. The feed requirements used in the model for feeding yearling steers were more feed grain intensive than the requirements used for feeding steer calves, which were silage intensive. The yearling feeder steer enterprise was preferable to the steer feeder calf enterprise and entered instead of it under these assumptions. This substitution required more feed and considerably more capital. These increased

Table III-1: Computer Analyses of Costs and Benefits of Weather Modification with Minimum Yield Increase and Fixed Crop Acreage.

increased 50.9 per cent over the base run. Livestock profits increased 8.89 per cent on lower profi Price Planning Situation us of Statistic Name a slightly as did crop costs, leaving the crop profits slightly lover. Total revenue and tot Dollars (000 omitted) Gross Value of Crops \$ 97,836 \$102,049 \$ 97,883 Crop Costs der this set of asoun-60,408 60,718 60,592 Profits from Crops \$ 37,408 \$ 41,331 \$ 37,291 Livestock Revenue \$100,807 \$100,807 \$143,955 Livestock Costs 81,468 81,421 122,896 Profits from Livestock \$ 19,339 \$ 19.386 \$ 21.059 modification resulted in an average yield increase with no accompany-Total Revenue \$150,239 \$154,499 \$189,967 Total Costs _______ 1.01 _____93,471 ____93,781 131,617 Total Profits \$ 56,768 \$ 60,718 \$ 58,350 1. Historical yields, historical prices.

Minimum yield increase, historical prices.
Minimum yield increase, historical prices minus \$0.05.

leaving total profits 26.2 per cent higher than the base run. All livestock activity choices were the same as those chosen in the base run. This set of assumptions concerning the effects of weather modification resulted in an estimated increase of \$14,897 million in agricultural profits for the area, with most of this increase received

requirements were reflected in higher revenues and costs. Livestock revenue increased 42.8 per cent and livestock costs increased 50.9 per cent over the base run. Livestock profits increased 8.89 per cent on lower profit margins. The gross value of crops increased slightly as did crop costs, leaving the crop profits slightly lower. Total revenue and total costs both increased with livestock revenue and costs, leaving total profits 2.79 per cent higher. Under this set of assumptions, agricultural profits were increased \$1.582 million by weather modification. This profit increase went entirely to the livestock sector, which benefited from cheaper feed prices.

Investo The next set of assumptions considered assumed that weather modification resulted in an average yield increase with no accompanying price decrease. The gross value of crops increased 15.8 per cent, while crop costs increased 1.01 per cent as the increased pasture yield freed additional acres which were switched to corn. These changes meant an increase in crop profits of 39.6 per cent. Livestock costs decreased slightly from the base run while livestock revenues were unchanged. Livestock profits were slightly higher. Total revenue increased 10.3 per cent, and total costs increased slightly, leaving total profits 26.2 per cent higher than the base run. All livestock activity choices were the same as those chosen in the base run. This set of assumptions concerning the effects of weather modification resulted in an estimated increase of \$14.897 million in agricultural profits for the area, with most of this increase received

by the crop producing sector. The results of this run, and the next Modification with Average Yield Increase and Fixed two to be discussed, are presented in Table III-2.

The assumption of an average vield increase was coupled with an assumption of a five cent per bushel price decrease for the next case investigated. Total profits increased 21.2 per cent, while total costs increased 41.1 per cent and total revenue increased 33.6 per cent. These large increases in total costs and revenue were due to the same switch which occurred in the previous case where grain prices fell, with the feeding of steer calves discontinued and the feeding of yearling steers substituted in its place. Livestock revenue rose 42.8 per cent and livestock costs rose 50.8 per cent for this same reason. Livestock profits increased 9.16 per cent over the base run. The 22,644 gross value of crops increased 11.0 per cent and crop costs increased slightly. Crop profits increased 27.6 per cent. The effect of weather modification on the area, under this set of assumptions, was an \$12,058 million increase in agricultural profits. Most of the benefits were received by the crop sector.

For the next run, the price per bushel of cash grains was assumed to decrease ten cents below the five year average price. The average expected yield increase was again used. Total costs, crop costs and livestock revenue were the same as in the previous run, since all activities operated at the same level. Total revenue was 31.7 per cent higher than in the base run and livestock costs were 48.9 per cent higher, increasing livestock profits 17.1 per cent. Gross value of crops increased 6.56 per cent and crop profits were Table III-2: Computer Analyses of Costs and Benefits of Weather Modification with Average Yield Increase and Fixed higher, manual Crop Acreage.

million due ter semante

portionally by fix to maximum	Price Planning Situation			
Statistic Name	a 1 and and	2	3	
The next groups of all of	Dollars	(000 omitte	d)	
Gross Value of Crops	\$113,249	\$108,613	\$104,257	
Crop Costs	61,018	60,897	60,897	
Profits from Crops	\$ 52,231	\$ 47,716	\$ 43,360	
Livestock Revenue	\$100,807	\$143,955	\$143,955	
Livestock Costs	81,374	122,845	121,311	
Profits from Livestock	\$ 19,433	\$ 21,110	\$ 22,644	
Total Revenue	\$165,746	\$200,748	\$197,927	
Total Costs	94,080	131,922	131,922	
Total Profits	\$ 71,665	\$ 68,826	\$ 66,005	

1. Average yield increase, historical prices.

2. Average yield increase, historical prices minus \$0.05.

3. Average yield increase, historical prices minus \$0.10.

creases in livestock profile

The next set of the second the second the second second the second secon

ceived almost antiraly by the two sectors and well when the

Section and the Section

15.9 per cent higher than the base. Total profits were 16.3 percent higher, meaning agricultural profits in the area increased \$9.237 million due to weather modification. This increase was shared proportionally by the livestock and crop sectors, with a slightly greater advantage to the livestock portion of the economy.

The next group of runs with the fixed acreage restrictions assumed that maximum yield increases would accompany the weather modification program. The four runs of this group assumed five-year average prices, and a five, ten and fifteen cent per bushel price decrease, respectively. These results are presented in Table III-3. The first run of this group assumed the maximum yield increase would be accompanied by the five-year average prices with no price 753 decrease. Total profits increased 42.2 per cent over the base run, from \$56.768 million to \$80.720 million. Crop costs increased 1.96 per cent as increased pasture yields freed additional acres for corn. This increase also resulted in a 1.27 per cent increase in total costs. Livestock costs decreased slightly. Gross value of crops increased 25.6 per cent and crop profits increased 63.7 per cent. Livestock profits were slightly higher, because of greater availability of low cost feed. Results based on this set of assumptions were that agricultural profits increased \$23.952 million, with the increase received almost entirely by the crop enterprises and only slight increases in livestock profits.

The next set of assumptions inserted into the model assumed that the maximum yield increase was accompanied by a five cent per Table III-3: Computer Analyses of Costs and Benefits of Weather Modification with Maximum Yield Increase and Fixed Crop Acreage.

PLULLUCIONE SAFETE SECONDES			a construction and the second	n ha sea ann an sea ann an sea
place. This close the	ar naga ang tang tang ta	Price Plannin	ng Situation	vr. over
Statistic Name	, eres 1. Sec. 4	. 2	parent3rt aret	fis 4mm
creased 9,44 mr pents	former success	Dollare (00	00 omitted)	per cent.
Gross Value of Crops	\$122,831	\$177,788	\$113,055	\$108,318
Crop Costs	61,594	61,488	61,483	61,488
Profits from Crops	\$ 61,237	\$ 56,300	\$ 51,567	\$ 46,830
Livestock Revenue	\$100,807	\$143,955	\$143,955	\$143,955
Livestock Costs	81,323	122,791	121,254	119,202
Profits from Livestock	\$ 19,484	\$ 21,164	\$ 22,701	\$ 24,753
Total Revenue	\$175,376	\$209,974	\$206,777	\$204,096
Total Costs	94,657	132,513	132,513	132,513
Total Profits	\$ 80,720	\$ 77,461	\$ 74,264	\$ 71,583

1. Maximum yield increase, historical prices.

2. Maximum yield increase, historical prices minus \$0.05.

3. Maximum yield increase, historical prices minus \$0.10.

4. Maximum yield increase, historical prices minus \$0.15.

crops was 15.6 per cent bilier than the meet and the state produce were

37.9 per cent higher. Total revenue becausers and sor annie, with total profits increasing is a ner cone. The demonstrate in articultural profits due to weather mode section annex conservations and \$17.496

bushel decrease in the price of cash grains. Because the price of feed grains decreased, the feeding of yearling steers became more profitable than feeding steer calves, and entered the solution in its place. This change increased livestock revenue 42.8 per cent over the base, and livestock costs 50.7 per cent. Livestock profits increased 9.44 per cent. Gross value of crops increased 20.4 per cent. This increase, combined with a slight decrease in crop costs, resulted in a 50.5 per cent increase in crop profits. Total costs increased 41.3 per cent, but this increase was offset by a 39.5 per cent increase in total revenue, with a resulting 36.5 per cent rise in total profits. Thus, the effect of weather modification, under this set of assumptions, was a \$20.693 million increase in agricultural profits in the study area, with most of the increase experienced by the crop sector, but with considerable benefits accruing to the livestock sector due to lower feed prices. crease than the crop sector, but with The next case considered assumed that a ten cent per bushel price decrease accompanied the maximum yield increase. Livestock revenue was unchanged from the previous run; however, due to lower feed grain prices, livestock costs decreased 1.25 per cent from the previous run. Livestock profits increased 7.26 per cent over the previous run and 17.4 per cent over the base run. Gross value of crops was 15.6 per cent higher than the base run and crop profits were 37.9 per cent higher. Total revenue increased 37.6 per cent, with total profits increasing 30.8 per cent. The increase in agricultural Relaxed Crop Acrease profits due to weather modification under these assumptions was \$17.496 The second major portion of the analysis allowed the fixed

million. Profits increased most in the crop sector, but the livestock sector also reaped significant benefits.

The maximum price decrease considered was fifteen cents per bushel. Livestock costs were 1.69 per cent lower than when feed grain prices were ten cents below the five-year average. This caused livestock profits to increase 9.04 per cent over the last run and 28.0 per cent over the base run. Gross value of crops increased 10.7 per cent over the base and crop profits increased 25.2 per cent. Total revenue was 35.8 per cent higher than the base run and total profits were 26.1 per cent higher. When the maximum price decrease was assumed, oats were fed rather than corn because the nutrient value per dollar becomes greater due to the higher percentage price decrease. Agricultural profits increased \$14.815 million over the base situation under this set of assumptions, with the livestock sector experiencing a larger percentage increase than the crop sector, but with each receiving considerable benefits from the program.

For the entire set of runs where the acreage constraints for individual crops were fixed at the five year average acreage, weather modification was found to increase profits. As the assumptions regarding the effect of increased supply on price varied, the distribution of these profits between the crop sector and livestock sector varied, with the livestock sector benefiting most when the largest price decreases occurred.

Relaxed Crop Acreage Restrictions

The second major portion of the analysis allowed the fixed

to realize the second set of the second second

constraints upon the acreage of each crop grown to be relaxed, with Modification with Minimum Yield Increase and Varithe number of acres of each crop permitted to be anywhere within the range established during the five-year history period. This relaxation allowed the model to increase the participation of the most profitable activities, at the expense of less profitable activities. Estimates produced in this manner provide for partial reaction by the farmers \$ 97,142 in response to changes in their operating environment. Grop CoThe first group of runs in this portion of the analysis are presented in Table III-4. This table is analogous to Table III-1 with fixed crop restrictions. Once again the first run of the series Livestock Rever was a base run. This run, when compared to the original base run, in-Livestock Cost dicates the effect of more efficient utilization of resources in the Profits from Livestor. 23,197 model, because the producers were allowed to respond to changes in their operating environment. Gross value of crops decreased by 1.22 per cent from the original base. Crop costs decreased by 2.79 per cent, with the net effect being a 1.37 per cent increase in the crop profits. A more substantial difference appeared in the livestock portion of the model. Livestock revenue increased 53.4 per cent and livestock costs increased 63.4 per cent. The result of these two increases was a 11.2 per cent increase in livestock profits. Total revenues increased 29.0 per cent and total costs increased 43.8 per cent, with a 4.67 per cent increase in total profits.

These differences arose for several reasons. The livestock differences are caused by the choice of feeding yearling steers rather than steer calves. In the previous portion of the analysis this

Table III-4: Computer Analyses of Costs and Benefits of Weather Modification with Minimum Yield Increase and Variable Crop Acreage.

STTUDE AGIN THEATHER WE THE FILL	· 你们,你的你们,你们的问题。	a and example of the second	nu sliago
fed to steer calves was not would	Price Pla	anning Situat	to yearl
Statistic Name any what occurres	out trop, this	2 solvage	in 3hip w
faced as alternative more profit	Dollars	(000 omitted)	lage pr
Gross Value of Crops	\$ 96,639	\$101,231	\$ 97,142
Crop Costs and allage to uterranded	58,720	59,365	59,073
Profits from Crops ity yielded to	\$ 37,919	\$ 41,866	\$ 38,069
Livestock Revenue	\$154,631	\$154,631	\$154,631
Some of the activity pres Livestock Costs	133,121	133,123	131,434
Profits from Livestock	\$ 21,510	\$ 21,508	\$ 23,197
Total Revenue	\$193,858	\$198,287	\$195,675
Total Costs	134,438	134,919	134,411
Total Profits	\$ 59,420	\$ 63,368	\$ 61,264

Historical yields, historical prices.
Minimum yield increase, historical prices.
Minimum yield increase, historical prices minus \$0.05.

For this base run, service and wild may mare at their upper bounds, replacing some core screage. The model talks as that, with greater responsiveness to operating conditions, profiles of dericulture in the area could be increased by \$2.002 millions. The possibility for this increase is naturally easier to logant efter the fact them it. switch did not occur until the price of feed grains was decreased by five cents per bushel. However, in these cases fewer acres of oat silage were harvested as the oat acreage decreased, and corn silage fed to steer calves was not worth more than corn grain fed to yearling steers. Basically what occurred was that the oat acreage in this run faced an alternative more profitable than either raising silage or selling oats for grain. Therefore, this choice was more profitable than feeding silage to steer calves. Other changes occurred because the added flexibility yielded increased efficiency, thereby allowing minor profit increases and cost decreases.

Some of the activity preferences displayed in this run were continued throughout every run considered. The model minimized the acreage grown of oats, spring wheat, durum wheat, barley and rye in every run. It chose to maximize the acreage grown of alfalfa, soybeans and winter wheat in every run. However, corn, sorghum and wild hay were grown at various levels, depending upon their relative yields and prices.

sumptions changed. Each activity participated at its maximum level except for the ewe herd activity which remained at its minimum level.

For this base run, sorghum and wild hay were at their upper bounds, replacing some corn acreage. The model tells us that, with greater responsiveness to operating conditions, profits of agriculture in the area could be increased by \$2.652 million. The possiblility for this increase is naturally easier to locate after the fact than it

would be when planting plans were made. The remainder of the runs in this second portion of the analysis will be compared to the run just discussed. This will allow isolation of the effects of weather modification from those caused by more efficient utilization of resources. profile The first set of assumptions considered assumed that the minimum yield increase resulted from the weather modification program, and that no price decrease occurred because of the increase in supply. Gross value of crops increased 4.75 per cent and crop costs increased 1.10 per cent. Crop profits increased 10.4 per cent. The increase in crop costs was due to the switching of those flexible acres of wild hay and sorghum from these crops to corn, with the accompanying increase in expenses, and the additional acreage freed for corn due to increased pasture yields. Livestock revenues did not change as the previous optimum was carried forward. Livestock costs were also unchanged, leaving livestock profits unchanged. Total revenues increased 2.29 per cent, and total costs increased slightly, and total profits increased 6.64 per cent. The estimated effect of weather modification was a \$3.948 million dollar increase in agricultural profits, with the entire increase going to the crop sector, and a slight profit decrease received by the livestock sector.

When the minimum yield increase was accompanied by a five cent decrease, the gross value of crops increased slightly, as did crop costs. This resulted in a small increase in crop profits. Under this set of assumptions, wild hay and sorghum remained at their upper bounds, being slightly more profitable than corn. Livestock revenues

were unchanged, but livestock costs were 1.27 per cent lower, because of lower feed prices. Livestock profits increased accordingly by 7.84 per cent. Total revenue increased slightly and total costs decreased slightly, with the net effect being a 3.10 per cent increase in total profits. This represents a \$1.844 million increase in the agricultural profits of the area with the increase received almost entirely by the livestock sector. Therefore, the recipient of the benefits of weather modification, when the minimum yield increases are assumed, is determined by whether a price decrease accompanies the yield in-

Crease.ock Revenue \$154,631 \$154,631 \$154,631

The next group of three runs assumes that the average yield increase accompanied the weather modification program. The runs assumed the five-year average prices, a five cent per bushel price decrease, and a ten cent per bushel price decrease, respectively. The results of these runs are listed in Table III-5. This table is the counter part of Table III-2.

When the five-year average prices were assumed to accompany the average yield increase, the flexible wild hay and sorghum acres were replaced by corn. This, plus the higher costs on the acres freed by higher pasture yields, resulted in a 2.58 per cent increase in crop costs. Gross value of crops increased 17.0 per cent and crop profits increased 39.4 per cent. Livestock costs increased slightly, causing a small decline in livestock profits. Total revenue increased 8.18 per cent and total costs increased slightly. Total profits rose by 25.0 per cent. The effect of weather modification on

Table III-5: Computer Analyses of Costs and Benefits of Weather Modification with Average Yield Increase and Variable Crop Acreage.

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The cases was strong part	Price 1	Planning Situ	ation
Statistic Name	1	2	3
hay remained as his side	Dollars	s (000 omitte	d)
Gross Value of Crops	\$113,085	\$108,137	\$103,928
Crop Costs	60,237	59,694	59,694
Profits from Crops	\$ 52,848	\$ 48,443	\$ 44,234
Livestock Revenue	\$154,631	\$154,631	\$154,631
Livestock Costs	133,209	131,389	129,749
Profits from Livestock	\$ 21,422	\$ 23,242	\$ 24,882
costs. Total permanent of	Construction April		
Total Revenue	\$209,717	\$206,589	\$204,021
Total Costs	135,447	134,904	134,904
Total Profits	\$ 74,270	\$ 71,685	\$ 69,116

1. Average yield increase, historical prices.

2. Average yield increase, historical prices minus \$0.05.

3. Average yield increase, historical prices minus \$0.10.

change in the cropping part of the second of traps and 7.36 per cent higher than the base and the second between 16.7 per cent. Livestock costs decrement is a second of the block and profits inopensed 15.7 per cent.

een alen assumed ...

agricultural profits in the study area was, under this set of assumptions, a \$14.850 million increase, entirely received by the crop producers.

The next run assumed that a five cent per bushel price decrease accompanied the average yield increase. Under these assumptions, wild hay remained at its lower bound, while sorghum moved to its upper bound. Gross value of crops increased 11.9 per cent over the base, while crop costs increased 1.66 per cent, due to the higher costs of producing an acre of corn, compared to an acre of wild hay or pasture. Crop profits increased 27.8 per cent. Livestock costs decreased 1.30 per cent with the greater amounts of inexpensive feeds available. Livestock profits increased 8.05 per cent because of the decrease in costs. Total revenue was 6.57 per cent higher and total costs were slightly higher. Total profits were higher by 20.6 per cent or an increase of \$12.265 million. Most of the increase in agricultural profits was experienced in the crop sector, with lesser benefits received by the livestock sector due to lower feed grain costs.

The third run assuming an average yield increase also assumed a ten cent price decrease from the five-year average. Crop costs were identical to those of the run just discussed, because there was no change in the cropping pattern. Gross value of crops was 7.54 per cent higher than the base and crop profits increased 16.7 per cent. Livestock costs decreased 2.53 per cent and the livestock profits increased 15.7 per cent. Total revenues were 5.24 per cent higher and total profits increased 16.3 per cent. Agricultural profits increased \$9.696 million with approximately equal percentage increases shared by both sectors.

The last group of runs from this second portion of the analysis assumed the maximum expected yield increase and four different sets of Statistic Name prices. These were historical prices, a five cent per bushel decrease, Dollars (000 omitted) a ten cent per bushel decrease and a fifteen cent per bushel decrease. Gross Value of Crops \$122,833 \$118,240 \$112,894 \$108,038 The results of these runs are presented in Table III-6. This table 60,923 60.,379 60.125 is analogous to Table III-3. Profits from Crops \$ 51,910 \$ 57,317 \$ 52,515 \$ 47,913 When the maximum yields were assumed, sorghum silage became more attractive than corn silage and the corn silage acreage fell to its lower bound. This did not occur when the constraints on acreage were fixed because more acres of oats were grown, and all of the necessary silage was supplied as oat silage. \$219,492 \$216,**527 \$213,031** The first of these runs assumed the five year average price and 136,133 136,133 135,590 135,335 the maximum yield increase. This set of assumptions resulted in wild \$ 83,359 \$ 80,394 \$ 77,441 \$ 74,986 hay and sorghum at their lower bounds, with corn grown on these acres instead. This, plus the higher costs on the acreage freed by higher 1. Maximum yield increase, historical prices. pasture yields, increased crop costs 3.75 per cent over the base. Gross 2. Maximum yield increase, historical prices minus \$0.05. value of crops was 27.1 per cent higher and crop profits were 63.3 3. Maximum yield increase, historical prices minus \$0.10. per cent higher. Livestock costs were slightly higher causing a slight 4. Maximum yield increase, historical prices minus 30.15. decrease in livestock profits. Total revenue was 13.2 per cent higher, total costs increased by 1.26 per cent, and total profits were 40.3 per cent higher. The projected increase in agricultural profits for the area, under this set of assumptions, was \$23.939 million.

When prices were decreased five cents per bushel below their

Table III-6: Computer Analyses of Costs and Benefits of Weather Modification with Maximum Yield Increase and Variin the unit able Crop Acreage. The gross value of crops was higher. Livestock costs decreased Price Planning Situation a 7,29 Statistic Name 1 3 2 4 per cent increase in livestock profits. Total revenue was 11.7 per Dollars (000 omitted) cent higher and total profits were 35.3 per cent middler. The effect Gross Value of Crops \$122,833 \$118,240 \$112,894 \$108.038 of weather modification, under this set of assumptions, was found to Crop Costs 60,923 60,923 60,379 60,125 be a \$20.974 million increase in as cultural prolifs, rec 20 197" ---\$ 61,910 Profits from Crops \$ 57,317 \$ 52,515 \$ 47,913 marily by the crop sector. Livestock Revenue \$154,631 \$154,631 \$154,631 \$154,631 Livestock Costs 133,180 131,552 129,701 127,557 Profits from Livestock \$ 21,451 \$ 23,079 \$ 24,930 \$ 27,074 were 2.83 per cent higher than the base run, and gross value of crops \$219,492 \$216,527 \$213,031 \$210.321 Total Revenue was 16.8 per cent greater. Crop profits were 38.5 per cent higher. 136,133 135,590 136,133 135,335 Total Costs 57 per cent lower, causing an increase in live-\$ 83,359 \$ 80,394 \$ 77.441 \$ 74.986 Total Profits stock profits of 15.9 per cent. Total revenue increased 9.89 per cent as total costs increased slightly. The net effect was a 30.3 per cent 1. Maximum yield increase, historical prices. increase in total profits. The projected increase in agricultural 2. Maximum yield increase, historical prices minus \$0.05. profits from weather modification under this set of assumptions was 3. Maximum yield increase, historical prices minus \$0.10. \$18.021 million, with both sectors receiving major increases, partic-4. Maximum yield increase, historical prices minus \$0.15. ularily the crop sector.

The final run of this group wer prices fifteen tents per bushel below the five-year average. These conditions made it most profitable for wild hay and so when to be at their upper bounds. Crop costs rose by 2.39 per cent and the gross value of crops increased 11.8 per cent.

five-year average, no change from the previous run occurred either in the wild hay or sorghum acreages. The gross value of crops was 22.4 per cent higher than the base and crop profits were 51.2 per cent higher. Livestock costs decreased by 1.20 per cent causing a 7.29 per cent increase in livestock profits. Total revenue was 11.7 per cent higher and total profits were 35.3 per cent higher. The effect of weather modification, under this set of assumptions, was found to be a \$20.974 million increase in agricultural profits, received primarily by the crop sector.

felt by Prices were set at ten cents per bushel below the five-year average prices for the third run assuming maximum yields. Sorghum was at its upper bound and wild hay was at its lower bound. Crop costs were 2.83 per cent higher than the base run, and gross value of crops was 16.8 per cent greater. Crop profits were 38.5 per cent higher. Livestock costs were 2.57 per cent lower, causing an increase in livestock profits of 15.9 per cent. Total revenue increased 9.89 per cent as total costs increased slightly. The net effect was a 30.3 per cent increase in total profits. The projected increase in agricultural profits from weather modification under this set of assumptions was \$18.021 million, with both sectors receiving major increases, particularily the crop sector.

The final run of this group set prices fifteen cents per bushel below the five-year average. These conditions made it most profitable for wild hay and sorghum to be at their upper bounds. Crop costs rose by 2.39 per cent and the gross value of crops increased 11.8 per cent.

Crop profits were 26.4 per cent higher than the base. Livestock costs decreased by 4.18 per cent and livestock profits increased 25.9 per cent. Total revenue increased 8.49 per cent, and total costs increased slightly. The net effect was a 26.1 per cent increase in total profits. Because the nutrient value per dollar for oats increased proportionately more than corn, with the maximum price decrease, oats was fed rather than corn. The projected increase in profits from weather modification, under this set of assumptions, was \$15.566 million, with similar percentage increases felt by each sector.

For each set of assumptions tried, weather modification increased the returns to agriculture in the area. When extra flexibility was introduced into the model, the magnitude of the returns increased. A summary of the increases and other findings, along with their implications are presented in the following chapter.

rye. It is interesting to with their which the subscreek as we with the

wheat, all of the upper borns and bolder when the field market size ment common crops of the tree. Definition definition and a wheel where here is a wheely grown. The three crops which had a ment the tree wheel to be a which where definit sorphum and wild have been tree to be an all which grown he the area. Apparently, but is the tree to be the tree that the best of pearing in the todal. According to the tree to be the tree to be the omics in Fars Management of the tree to be the tree to be the treases are, first, because can be the tree to be tree to be the tree to be treasens are, first, because can be the tree to be tree to be the tree to be

Table IV-1: ProficHAPTER IV from Weather Modification Obtained from Selected Computer Analyses SUPMARY AND CONCLUSIONS

The linear programming analyses of the area showed profit increases over the base run in every case. A summary of these results is given in Table IV-1. The estimated profit increases ranged from \$1.582 million to \$23.952 million with the fixed acreage assumption, and from \$1.844 million to \$23.939 million with the flexible crop acreage restrictions.

When the constraints controlling the level of participation in each activity were relaxed, the model could choose between the activities to a limited degree. The crop activities which were participated in to the maximum allowable extent were alfalfa hay, soybeans. and winter wheat. The crop activities participated in to the minimum allowable extent were oats, spring wheat, durum wheat, barley and rye. It is interesting to note that, with the exception of winter wheat, all of the upper bound activities were in fact among the most common crops of the area. Similarly, those crops which were lower bound activities, with the exception of oats, were not widely grown. The three crops which had variable participation levels were corn, sorghum and wild hay. These three crops are all widely grown in the Apparently, oats is grown for reasons other than those aparea. pearing in the model. According to Dr. Herbert Allen, Professor of Economics in Farm Management at South Dakota State University, two of these reasons are, first, because oats are necessary for certain types of crop

rotation, andTable IV-1: Profit Increases from Weather Nodification Obtained from ficulties with vincer Selected Computer Analyses

crop desp	ite its produces				
Ca feeding h	Yield Increase	Pri Cha	ice inge	Bor Fixed	unds Relaxed
steers.	It is reassuring	the right	n dinet	Do (000	llars omitted)
resentati	Minimum	none		3.950	3.948
bound act	Minimum	minus	\$0.05	1.582	1.844
Th	Average	none		14,897	14,850
ther modi	Average	minus	\$0.05	12,058	12,265
depends o	Average	minus	\$0.10	9,237	9,696
the rainf	Maximum	none		23,952	23,939
stressed.	Maximum	minus	\$0.05	20,693	20,974
faucet, v	Maximum	minus	\$0.10	17,496	18,021
The pract	Maximum	minus	\$0.15	14,815	15,566
prevalent	Base Profit			56,768	59,420
helpful,	the expected stat		THE DECK	WERE THE SHORE	ing the has not

to the timeliness of the cost of the

The second factor is a second back of the second factor is a second back of the second second

49

25 Personal interview

rotation, and second, because of tradition or habit.²⁵ Planting difficulties with winter wheat partly explain its absence as a major crop despite its profitability.

Cattle activities chosen were raising replacement heifers, feeding heifer calves and feeding either steer calves or yearling steers. It is reassuring to note that these activities are also representative of the area's activities. Feeding lambs was an upper bound activity and the eve herd was a lower bound activity.

The choice of which estimate of the profit increase from weather modification, of the eighteen generated, is most appropriate depends on several factors. The first of these is the timeliness of the rainfall increase. The importance of this factor cannot be overstressed. Weather modification must not be considered similar to a faucet, which may be turned on whenever extra moisture is required. The practice requires clouds, and opportunities are not particularly prevalent during dry periods. While extra rainfall is almost always helpful, the expected yield increase which is appropriate is related to the timeliness of the rainfall.

The second factor affecting this choice is which price decrease is appropriate for the supply increase chosen. The magnitude of this price decrease would be determined by the impact on the total nation's supply. This effect would vary considerably from crop to crop. In Table IV-2 is a listing of the percentage of the total U. S. production which was grown in South Dakota for several crops. Because of the

25 Personal interview, March 12, 1974.

as many abèlen de . ?	1970.	en land _e reness	e andre en en el constituentes	en strak kur-
ional supply of any Crop	al an airte	F	ercentage	Provinsi danga 2001 - Dha azo
ternative priCorn		••••	2.50	e posteriorate na
approximate tOats		•	11.26	
Barley.	• • • • • •	• • • • • •	2.96	
the state on Ryet	• • • • • •	• • • • • •	23.29	
products is i Sorghum	• • • • • •	••••	1.29	in the ser
tional farm Soybeans		• • • • •	0.38	
to be 2.7 per Potatoes		• • • • •	0.22	
modification CAll whea	E	Stear - an atable	2.87	The formation and the same state in a state
Durum			4.16	
This would much Winter			1.27	
Other	spring		11.03	
cent. The price elses	La Charles Friday	and state white		
Flaxseed			24.66	
baen estimated at -1.1			心 结晶的软化 國主	
All hay			4.55	
tity increase of Wild h	ay		2.60	
Alfalf	a hay		5.18	

Source: South Dakota Crop and Livestock Reporting Service, South Dakota Agri-Other estimates of culture, 1970, p. 8.

Makota Agriculture, 1970.

Am 1980, Foreign A Ampartment of Agriculture of second a second and second and second Mit., p. 9.

state's position on the western edge of the corn belt, and the eastern

edge of the wheat belt, the state does not concentrate on any one crop

as many states do. This means that the state's impact on total nat-

ional supply of any one crop will be fairly limited. The price change

appropriate varies from crop to crop, and from year to year. The al-

ternative price decreases considered were believed to be sufficient to

approximate the most severe price reduction which might occur.

When considering the impact of an increase in production in compared to irrigation or other water increase allowing the production in

the state on prices, the price elasticity of demand for agricultural products is important. South Dakota's percentage of the value of na-

tional farm production of those crops grown in South Dakota was found

to be 2.7 per cent for 1970.²⁶ The percentage increase from weather

modification considered was less than twenty per cent in every instance.

This would mean an increase in national production of less than 0.54 per

cent. The price elasticity of demand for agricultural products has is therefore desirable to peculate on the state of the

been estimated at -0.2 by Rojko.²⁷ Using this figure with the quan-

tity increase of 0.54 per cent, a price decrease of 2.7 per cent is the dairy sector from the model. The inclusion of dairy could be

obtained. Since the prices used were all below \$1.50 per bushel, ex-

cept for soybeans, this would be at most a four cent price decrease.

Other estimates of elasticity vary from Rojko's in both directions.

Since the quantity increase used for this discussion assumed the

²⁶South Dakota Crop and Livestock Reporting Service, <u>South</u> Dakota Agriculture, 1970, p. 53.

lower ited prices, part of the decrease is the group mector's profits.

27Anthony S. Rojko et al. <u>World Demand Prospects for Grain</u> <u>in 1980</u>, Foreign Agricultural Economic Report No. 75, United States Department of Agriculture, as reported in Stroup and Townsend, op. cit., p. 9. maximum price decrease, the larger price changes used in the model were somewhat pessimistic, if Rojko's estimate is reasonable. The price decreases, in any case, should not be greater than those considered. As mentioned previously, the cost of the weather modification program for South Dakota in fiscal 1973 was approximately 3.2 cents per acre. When this figure is applied to the nine county area, a projected total cost of \$113,200 is obtained. It is this low cost, compared to irrigation or other water increase alternatives, which has made operational weather modification programs technological inputs that producers must consider. Needless to say this figure is considerably smaller than any of the estimates of agricultural profit increase for the area. Even the most pessimistic estimate would cover these costs more than ten times.

yield Certain assumptions were made which deviated from reality. It is therefore desirable to speculate on the effect of these assumptions on the estimates. The first of these assumptions is the exclusion of the dairy sector from the model. The inclusion of dairy would increase costs, revenues and profits, and would use more feed. More silage would be required, leaving less grain available for sale. The effect of these two factors would be a damping of the effect of the price decrease. Each time another sector is added which benefits from lower feed prices, part of the decrease in the crop sector's profits, because of a price decrease, is offset by a profit increase in the new sector. The effect of excluding dairy was therefore viewed as having no negative effect on the findings.

total profits. Since the capital base was not affected greatly by weather modification, the difference between profits with and without weather modification shouldn't be significant, but total profits would be smaller. It should be noted, however, that weather modification might result in higher land values, thereby, having some potential impact on taxes and interest which could decrease the profits for land owners.

yields The most important assumption, with regard to effects on the results, was the assumption that no change occurs in harvesting costs when the yield increases. This is obviously not true. Some changes certainly occur, particularly with the maximum yield increases. One consolation is that the added cost is positively correlated with the yield increase, as is the size of the profit increase.

the of In those cases where large profit increases were estimated, relaxation of this assumption would reduce the size of the projected increase, but not appreciably. The only case where increased harvest costs were significant was the case which yielded the smallest profit increase (a minimum yield increase was assumed to accompany a five cent per bushel price decrease). In that case, the estimated profit increases were \$1.582 million and \$1.844 million. A pessimistic estimate of the cost increase which might accompany this case is \$0.25 per acre, or \$700,000 for the area, based on the budgets used as a basis for those in the model. When this amount is subtracted from the estimated profit increase, the remaining estimated profit increase is

\$800,000, or approximately seven times the estimated cost of the program. This is a marked decrease, even though it does not negate the estimated profitability of the weather modification program by any means. However, this particular example combines three very pessimistic assumptions and should be considered in that light. With any more optimistic assumptions the effect of the assumption in question is lessened considerably. Therefore, it must be concluded that the assumption of no cost increase associated with harvesting higher yields, did not affect appreciably the findings of the study, particularly regarding the attractiveness of a weather modification program. While the profit increases projected would be lower without this assumption, none would be so small that it would barely cover the costs of the program.

The entire field of weather modification is young and all of the effects of it are not entirely clear. The assumptions of this study, particularly the assumption that an additional inch of rain can be supplied, represent a rather elementary approach to the problem. Further research would be useful, i.e. investigating the economic effects of hail suppression, the indirect effects of weather modification, and the economics of a national or a worldwide program. It appears that a national or worldwide program would substantially increase food producing capacity. The effect and size of these supply increases and other interesting possibilities make the topic a likely candidate for considerable additional research in the future.

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APPENDICIES

Appendix A, Table I: Resource Restrictions Cand Initially in the Linear Programming Meddl.

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	Alfalfo is farmer	Acre	0
FL .	Wild May to Maximedia.	Acre	
	Acres Creeland	1090 英语实命地	2317.5
	Acres Bastin	1000 Actes	FR
	Total Acres	1000 Acres	2751, 5
	Replacement bellers Transfer	Hasanet	. 11

		Unit	Initial
Row	Item	Unit	Level
4.1.5	the maintain a first set and a first set and a set of the set of t	restr	
	Marling Scame Transfor	0.12	0
TLAB	Total Labor Transfer	Man-nour	0
CORNLIM	Corn Acreage Limit	1000 Acres	FR
DATLIM	Oat Acreage Limit	1000 Acres	454.1
SWLIM	Spring Wheat Acreage Limit	1000 Acres	24.3
DWLIM	Durum Wheat Acreage Limit	1000 Acres	1.3
WLIM	Winter Wheat Acreage Limit	1000 Acres	12.0
BLIM	Barley Acreage Limit	1000 Acres	16.3
SORGLIM	Sorghum Acreage Limit	1000 Acres	2140.6
RYELIM	Rye Acreage Limit	1000 Acres	1048:0
SOYLIM	Soybeans Acreage Limit	1000 Acres	183.8
ALLIM	Alfalfa Acreage Limit	1000 Acres	202.8
WHLIM	Wild Hay Acreage Limit	1000 Acres	98.2
CRPASLIM	Cropland Pasture Acreage Limit	1000 Acres	398.6
NATPASLM	Native Pasture Acreage Limit	1000 Acres	434.0
CHARV	Corn to Harvest	Acre	24.9
OATHARV	Oats to Harvest	Acre	9
SORGHARV	Sorghum to Harvest	Acre	8
CORNGSUP	Corn Grain Supply	Bushel	17.9
OATGSUP	Oat Grain Supply	Bushel	1124.0
SORGGSUP	Sorghum Grain Supply	Bushel	0
BARSUP	Barley Supply	Bushel	0
CHARLIM	Corn Grain Harvest Limit	1000 Acres	800.0
OHARLIM	Oats Grain Harvest Limit	1000 Acres	404.9
SORHARLM	Sorhgum Grain Harvest Limit	1000 Acres	100.0
CORNSILA	Corn Silage Acreage Limit	1000 Acres	30.0
OATSILA	Oat Silage Acreage Limit	1000 Acres	FR
SORSIL	Sorghum Silage Acreage Limit	1000 Acres	FR
CORNEO	Corn Equivalents	Bushel	0
PAS	Pasture Paster to Parvest	AUM	0
CSTF /JU	Corn Silage to Feed	Ton	0
HAYEO	Hay to Feed with Water Transfer	Ton	0
ALSUP	Alfalfa Supply	Ton	0
HSUP	Wild Hay Supply	Ton	0
AH	Alfalfa to Harvest	Acre	0
UTIM	Wild Hay to Harvest	Acre	0
AC	Acres Cropland	1000 Acres	2317.5
ADIST	Acres Pasture	1000 Acres	FR
TASID	Total Acres	1000 Acres	2751.5
DIC	Delegement Veifers Transfer	Head	0

Appendix A, Table I: Resource Restrictions Used Initially in the Linear Programming Model.

restricted in the selections

*PR indicators a free bound is a amount of these meterials used is not
Appendix A, Table I: (continued) Appendix A, Table II: Activities Included in the Linear Programming

1.1.2.2.4			Little Left.
Rou	Iten	Unit	Level
IITIC	Activity Description	URLE 00	: Neasure
	Yearling Heifers Transfer	CWT	0
Higed L	Yearling Steers Transfer	CHT	0
IC	Heifer Calvas Transfer	CUT	0
LAB	Steer Calves Transfer	CWT Murshes	0
C	Cull Cous Transfer	CWT	0
TICALVES	Fed Heifer Calves Transfer	CUT .	0
SCALVES	Fed Steer Calves Transfer	CWT	• 0
YHY	Fed Yearling Heifers Transfer	CUE Acre	0
SV	Fed Yearling Steers Transfer	CUT Acra	0
SCII	Beef Coy Units	100 Units	2013.0
ST.TM	Steers 5001b+ Linit	100 Head	1048.0
HT.T.	Heifers 5001b+ Linit	100 Head	451.3
3E	Renlacement Etes Transfer	Head Acre	0
ATES	Lamb Transfer	CUT Acre	0
AVE	Cull Fue Transfer	Head Acre	0
ATELTH	Eve Limit	1000 Head	40.0
TT.TM	Larbs Fed Linit	1000 liead	24.0
2D	Feeder Pic Transfer	CUT	0
SOUS	Cull Soy Transfer	Head Acte	0
SOULTH	Soy Lipit	1000 Head	17.0
PFLTM	Pies Fed Lipit	1000 Head	1124.8
OTCOST	Total Cost	Dollar	FR
TOTREV	Total Revenue	Dollar	FR
CROPEN	Crop Costs	Dollar	FR
VALCROP	Gross Value of Crons	Dollar	FR
VSTKCST	Livestock Costs	Dollar	FR
VSTKREV	Livestock Revenue	Dollar	FR
JATER	Water Transfer	Acre-inch	0
HARVIJ	Corn with Water to Harvest	Acre	0
ATHARVW	Oats with Water to Marvest	Acre	0
SORGHARU	Sorghum with Water to Harvest	Acre	0
SULT	Spring Wheat with Water Transfer	Bushel	0
UNT	Durum Wheat with Water Transfer	Bushel	0
ARIT	Winter Mneat with Water Transfer	Bushel	0
BARUT	Barley with Water Transfer	Bushel	0
RYEUT	Rye with Mater Transfer	Bushel	0
SOYUT	Soybeans with Water Transfer	Bushel Bushel	0
CUGSUP	Corn with Water Grain Supply	Bushel Bushel	0
DIGSUP	Oats with Water Grain Supply	Bushel	0
SUCSUP	Sorghum with Water Grain Supply	Bushel	0

*FR indicates a free bound. The amount of these materials used is not restricted in the solution.

Appendix A, Table II: Activities Included in the Linear Programming Model.

Title	Activity Description	Unit of Measure
N SAKAJANAN ANKAN		and the second
Hired Lab	or m liter There is	al (pashels
OATT	自己で「経営」「「東京領域学校の	Nine 18
HLAB	Hired Labor	Man-hour
BART	Barley Troughter	1. A Sector March 18
Cropland	ALLALTA TRACADAT	
IEQ	Wild Hug Transform	The set of the set of the set of the
CORN	Raise Corn	Acre
OAT 1a	Raise Oats	Acre
SW	Raise Spring Wheat	Acre
DU	Raise Durum Wheat	Acre
WEPH	Raise Winter Wheat	Acre
BAR	Raise Barley	Acre
SORG	Raise Sorghum	Acre
RYE	Raise Rye	Acre
Soy	Raise Soybeans	Acre
AL	Raise Alfalfa	Acre
WH	Raise Wild Hay	Acre
CRPAS	Raise Cropland Pasture	Acre
NATPAS	Raise Native Pasture	Acre
Harvest C	rops	
BHC	Buy Belfor Calves	
CORNG	Harvest Corn for Grain	Acre
CORNSIL	Harvest Corn for Silage	Acre
OATG	Harvest Oats for Grain	Acre
OATSIL	Harvest Oats for Silage	Acre
SORGG	Harvest Sorghum for Grain	Acre
SORGSIL	Harvest Sorghum for Silage	Acre
HARAL	Harvest Alfalfa	Acre
HARUH	Harvest Wild Hay	Acre
CVC	Call Variation State	
Purchase	and Sale of Crops	
REALS	Rever Down Low March 11 1988 P. C.	
SELCORN	Sell Corn Grain	Bushel
BUYCORN	Buy Corn Grain	Bushel
SELOAT	Sell Oats Grain	Bushel
SELSORG	Sell Sorghum Grain	Bushel
SELBAR	Sell Barley	Bushel
SELAT	Sell Alfalfa	Ton
BILYAT	Buy Alfalfa	Ton
OUTRD	o 17 III I Vor	Ton

Appendix A, Table II: (continued)

Title Title	Activity Description	Unit of Measure
Crop Tran	sfer and Sale of Sheep	
CORNEQU OATT SORGT BART ALTOFEED HEQ	Corn Grain Transfer Oat Grain Transfer Sorghum Grain Transfer Barley Transfer Alfalfa Transfer Wild Hay Transfer	10 Bushels 10 Bushels 10 Bushels 10 Bushels Ton Ton
Cattle	Sour limit	The States
PURRH RREPH RYS RYH FSC FHC FYS FYH	Beef Cow Unit-Purchased Replacement Beef Cow Unit-Raised Replacement Raise Yearling Steers Raise Yearling Heifers Feed Steer Calves in Drylot Feed Heifer Calves in Drylot Feed Yearling Steers in Drylot Feed Yearling Heifers in Drylot	Unit Unit Head Head Head 1.8 Head 1.8 Head
Purchase	and Sale of Cattle	Avayna Avayna
ESC BHC SSC SHC SFSC SFHC BYS BYH SFYS SFYH SYS SYH BRH SCC Sheep	Buy Steer Calves Buy Heifer Calves Sell Steer Calves Sell Heifer Calves Sell Fed Steer Calves Sell Fed Heifer Calves Buy Yearling Steers Buy Yearling Heifers Sell Fed Yearling Steers Sell Fed Yearling Heifers Sell Yearling Heifers Sell Yearling Heifers Buy Replacement Heifers Sell Cull Cows	CWT CWT CWT CWT CWT CWT CWT CWT CWT CWT
PREPE PURRE FL	Ewe Unit-Raise Replacements Grain Ewe Unit-Purchase Replacements Grain Feed Lambs	Unit Unit Head

Appendix A, Table II: (continued)

Activity Description Title

Unit of Measure

Purchase and Sale of Sheep

SELLAM	Sell Feeder Lambs the Mater	CWTshel
BFL	Buy Feeder Lambs with Water	CWTshel
BRELSORW	Buy Replacement Ewes	CWTshel
SCE BARW	Sell Cull Ewes th Mater	CWTshel
SELSWM	Sell Spring Wheat with Water	Bushal
Hogs	Sell Durup Wheat with Mater	Bushel
SELATIN	Sell Winter Wheat with Water	Bushel
HHELRYEN	Sov Unite with Mater	Unithel
FPIGS	Feed Pigs eans with Water	Headhel

Purchase and Sale of Hogs

BFP	Buy Feeder Pigs ater Transfer	CWT	Bushels
SSATUT	Sell Cull Sows Later Transfer	CWT	Bushels
BARLET	Earley with Vater Transfer	10	Bushels
Cropland	with Water than with Water Transfer	10	Bushels

CORNW	Raise	Corn with Water	Acre
OATW	Raise	Oats with Water	Acre
SWW	Raise	Spring Wheat with Water	Acre foot
DUW	Raise	Durum Wheat with Water	Acre
TAN	Raise	Winter Wheat with Water	Acre
BARW	Raise	Barley with Water	Acre
SORGW	Raise	Sorghum with Water	Acre
RYEV	Raise	Rve with Water	Acre
SOYU	Raise	Sovheans with Water	Acre
ALU	Raise	Alfalfa with Water	Acre
UHU	Raise	Wild Hay with Water	Acre
CRPASIJ	Raise	Cronland Pasture with Water	Acre
NATPASU	Raise	Native Pasture with Water	Acre

Harvest Crops with Water

CODNUC	Varnost	Corn	with	Water	for	Grain	Acre
CUCTI	Harvest	Corn	with	Water	for	Silage	Acre
OATUC	Harwoot	Oate	with	Water	for	Grain	Acre
OLICIT	Harvest	Oate	with	Water	for	Silage	Acre
CODCUC	Harvest	Corch	11177 107	ith Wat	er	for Grain	Acre
SUSTI	Harvest	Sorgh	um W.	ith Wat	er	for Silage	Acre

Appendix A, Table II: (continued)

Title Activity Description Unit of Measure

Sell Crops with Water

SELCORNW	Sel1	Corn Grain with Water	Bushel
SELOATW	Sell	Oats Grain with Water	Bushel
SELSORW	Sell	Sorghum Grain with Water	Bushel
SELBARW	Sel1	Barley with Water	Bushe1
SELSWW	Sell	Spring Wheat with Water	Bushel
SELDWW	Sel1	Durum Wheat with Water	Bushel
SELWW	Sell	Winter Wheat with Water	Bushel
SELRYEW	Sel1	Rye with Water	Bushel
SELSOYW	Sel1	Soybeans with Water	Bushel

Crops with Water Transfer

CORNWT	Corn Grain with Water Transfer	10 Bushels
OATUT	Oat Grain with Water Transfer	10 Bushels
BARLWT	Barley with Water Transfer	10 Bushels
SORWT	Grain Sorghum with Water Transfer	10 Bushels

Buy Water

BUYWAT Buy Water

Acre-foot

Appendix B, Table 1

It.em

e dine ryi d'aut (ri - sejador - i

Corn Grain Oats Grain Soybeans Sorghum Grain Winter Mineat Spring Mineat Durum Mineat Rye Barley Alfalfa Hay Wild Hay

Livestock

Steer Galves Heifer Calves Steer Yearling Factor Heifer Yearling Factor Fed Steer Calves Fed Heifer Lalves Fed Yearling Matters Replacement Latters Cull Coss Butches Hous Feder Pigs Cull Sous Feder Lambs Fat Lambs Replacement Sous Cull Eve

APPENDIX B

Spurce:

Selecter Descionario de la composición de la composición de la composición de la composición de la composición

Appendix B, Table I: Prices Used in the Model.

Item	Unit	Price
Unit Crons		Number
Corn Grain	Bushel	\$ 1.08
Oats Grain	Bushel	0.59
Sovbeans	Bushel	2.54
Sorchum Grain	Bushel	0.92
Winter Wheat	Bushel	1,28
Spring Wheat	Bushel	1.46
Durum Wheat	Bushel	1.42
Rye	Bushel	0.88
Barley	Bushel	0.84
Alfalfa Hay	Ton	25.00
Wild Hay	Ton	18.83
Minus Replacements - Beaf (0.	16 x 191,100)	- 29,630
Steer Calves	cwt	34.44
Heifer Calves	cwt	30.44
Steer Yearling Feeder	cwt	30.44
Heifer Yearling Feeder	cwt	27.44
Fed Steer Calves	cwt	27.94
Fed Heifer Calves	cwt	25.94 00
Fed Yearling Steers	cwt	26.94
Fed Yearling Heifers	cwt	24.94
Replacement Heifers	Head	250.00
Cull Cows	cwt	16.94
Butcher Hogs	nd cwtmatock Reporting Se	19.54
Feeder Pigs	1 cwt 71, waricus pages;	39.08
Cull Sows	cwt Extension Economia	16.50
Feeder Lambs	cwt	23.36
Fat Lambs	cwt	25.36
Replacement Ewes	cwt	24.36
Cull Ewe	cwt	5.86

Amperting free hereine de la contraction de la contraction de la contraction de la contraction de la contraction

Source: South Dakota Crop and Livestock Reporting Service, South Dakota Agriculture, 1967-71, various pages.

Number
620,000
-185,200
- 32,000
-206,550
- 8,690
- 29,630
- 8,000
149,930
104,800
45,130

Appendix B, Table II: Method of Determining Cattle Bounds.

Sources: South Dakota Crop and Livestock Reporting Service, South Dakota Agriculture, 1967-71, various pages; Wallace G. Aanderud, Farm Management Extension Economist, South Dakota State University.

need (an operation of the second s		the second second second
Itom		Cost
Machine Operation	an a	6 5.80
Fixed Machine		7.50
Seed Cost		4.00
Republicide		2.00
Pesticide		1,50
Fertlizer		4.12
Crop insurance		2.50
Labor	ADDENINTY C	6.50
TOTAL	ATTENDIA C	\$33,92
Yield (bushels)		45

Appendix C, Table I: Estimated Costs Per Acre For Corn Grain, 1972.

Selected U. S. Crop Redgets: Yields, Inputs, and Variable Costs, Vol. III, Great Flains Region, ERS 400, United States Bepartment of Agriculture; Wallace G. Aanderud, Merlyn M. Bahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Ensiness," Extension Circular 632 (rev), Cooperative Estimation Service, United States Department of Agriculture (South Bakota State University) Wallace G. Aanderud, Farm Management Extension Poopmaint, 5050.

Item	Cost
Machine Operation	\$ 5.80
Fixed Machine	7.50
Seed Cost	4.00
Herbicide	2.00
Pesticide	1.50
Fertilizer	4.12
Crop Insurance	2.50
Labor	6.50
TOTAL	\$33.92
Yield (bushels)	45

Appendix C, Table I: Estimated Costs Per Acre for Corn Grain, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
PORTCORT	Variable Costs, Vol. III, Great Plains Region, ERS
	459, United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University)
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

Item	Cost
Machine Operation	\$ 4.00
Fixed Machine	9.50
Seed Cost	4.00
Fertilizer	4.12
Herbicide	2.00
Pesticide	1.50
Crop Insurance	2.50
Labor	11.00
TOTAL	\$38.62
Yield (tons)	7.5

Appendix C, Table II: Estimated Costs Per Acre for Corn Silage, 1972.

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Item	Cost
Machine Operation	\$ 2.92
Fixed Machine	5.40
Seed Cost	1.95
Fertilizer	1.86
Pesticide	1.05
Crop Insurance	1.30
Labor	3.82
TOTAL	\$18.30
Yield (bushels)	45

Appendix C, Table III: Estimated Costs Per Acre for Oats Grain, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
	Variable Costs, Vol. III, Great Plains Region, ERS
	459, United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

Item	Cost
Machine Operation	\$ 3.42
Fixed Machine	8.40
Seed Cost	1.95
Fertilizer	1.86
Pesticide	1.05
Crop Insurance	1.30
Labor	9.28
TOTAL	\$27.26
Yield (tons)	6

Appendix C, Table IV: Estimated Costs Per Acre for Oat Silage, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
Senters :	Variable Costs, Vol. III, Great Plains Region, ERS
	459, United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

	and the second
Item	Cost
Machine Operation	\$ 4.50
Fixed Machine	6.00
Seed Cost	1.22
Fertilizer	3.39
Pesticide	2.50
Crop Insurance	1.50
Labor	6.00
TOTAL	\$25.11
Yield (bushels)	40

Appendix C, Table V: Estimated Costs Per Acre for Grain Sorghum, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
	Variable Costs, Vol. III, Great Plains Region, ERS
	459, United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

Item	Cost
Machine Operation	\$ 4.29
Fixed Machine	9.00
Seed Cost	1.22
Fertilizer	3.39
Pesticide	2.50
Crop Insurance	1.50
Labor	10.00
TOTAL	\$31.90
Yield (tons)	7

Appendix C, Table VI: Estimated Costs Per Acre for Sorghum Silage, 1972.

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Item	Cost
Machine Operation	\$ 2.62
Fixed Machine	5.40
Seed Cost	2.83
Fertilizer	1.82
Pesticide	1.00
Crop Insurance	1.10
Labor	3.50
TOTAL	\$18.27
Yield (bushels)	20

Appendix C, Table VII: Estimated Costs Per Acre for Spring Wheat, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
our cool	Variable Costs, Vol. III, Great Plains Region, ERS
	459, United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

Item	Cost
Machine Operation	\$ 3.20
Fixed Machine	5.40
Seed Cost	2.87
Fertilizer	1.88
Pesticide	1.00
Crop Insurance	1.10
Labor	3.50
TOTAL	\$18.95
Yield (bushels)	20

Appendix C, Table VIII: Estimated Costs Per Acre for Durum Wheat, 1972.

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

a. 66 40 100	E AND A AND A AND A
Item	Cost
MACHINE OWNERS TO T	
Machine Operation	\$ 3.05
Fixed Machine	5.40
Seed Cost Fertiliante	2.30
Fertilizer Pesticida	1.27
Pesticide	1.00
Crop Insurance	1.10
Labor	3.50
TOTAL	\$17.62
Yield (bushels)	30

Sourcess	the second s
Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
	Variable Costs, Vol. III, Great Plains Region, ERS
	459. United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-

Item Item	Cost
Machine Operation	\$ 3 . 11
Fixed Machine	5.40
Seed Cost	1.86
Fertilizer	0.88
Pesticide	1.10
Crop Insurance	1.00
Labor	3.42
TOTAL	\$16.77
Yield (bushels)	25

Appendix C, Table X: Estimated Costs Per Acre for Rye, 1972.

Sources:	Selected U. S. Crop Budgets: Yields, Inputs, and
Sourcest	Variable Costs, Vol. III, Great Plains Region, ERS
	459. United States Department of Agriculture;
	Wallace G. Aanderud, Merlyn M. Dahl and John N.
	Maher, "Ten Steps for Planning Your Farm or Ranch
	Business," Extension Circular 632 (rev), Coopera-
	tive Extension Service, United States Department
	of Agriculture (South Dakota State University);
	Wallace G. Aanderud, Farm Management Extension Econ-
	omist, SDSU.

enter fan de skelen beste de skelen de skelen geskier op ste	and the second
Item	Cost
Machine Operation	\$ 3.09
Fixed Machine	5.40
Seed Cost	1.50
Fertilizer	1.76
Pesticide	1.20
Crop Insurance	1.45
Labor	3.50
TOTAL.	\$17.90
Yield (bushels)	30

Appendix C, Table XI: Estimated Costs Per Acre for Barley, 1972.

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Item	Cost
Machine Operation	\$ 4.20
Fixed Machine	6,00
Seed	3.93
Fertilizer	2.30
Pesticide	2,25
Crop Insurance	2,20
Labor	6.00
TOTAL	\$26.88
Yield (bushels)	2,20

Appendix C, Table XII: Estimated Costs Per Acre for Soybeans, 1972. 1972.

Sources: <u>Selected U. S. Crop Budgets: Yields, Inputs, and</u> <u>Variable Costs</u>, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Tem Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Item			natadina - danih arabiyi cara		Cost
Machine O	peration				\$ 4.89
Fixed Mac	hine				4.00
Seed Cost	r .				1.19
Fertilize	r				0.83
Herbicide	de				0,25
Pescicide					0.20
Labor					8.00
TOTAL					\$19.36
Yield (to	ns)	and a state of the second s		n saman an an da mara da	2.2
Sourcest		S. Crop	Sudgets:	Yields,	Inputs, and

Appendix C, Table XIII: Estimated Costs Per Acre for Alfalfa Hay, 1972.

Sources: <u>Selected U. S. Crop Budgets: Yields, Inputs, and</u> <u>Variable Costs, Vol. III, Great Plains Region, ERS</u> 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Appendix	С,	Table	XIV:	Estimated	Costs	Per	Acre	for	Wild	
erbhainnar e	10.3	6. (CALE 442.928	WHE X &	Hay, 1972.	0528 . 73	cer .	ugre :	tor (Tople	13

Trem	
	Cost
Machine Operations	\$1.50
Fixed Machine	3.50
Fertilizer	0.00
Herbicide Anthan Parce Charge	9.90
Insecticide Charge	0.00
Labor	3.00
TOTAL	\$8.00
Yield (ton)	1.90

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Bakota State University); Wallace G. Aanderud, Farm Management Extension Recoomist, SDSU.

Item	Cost
Machine Operations	\$0.25
Fixed Machine	0.40
Annual Seed Charge	0.40
Annual Fence Charge	0.30
Annual Water Charge	0.10
Fertilizer	1.50
Herbicide	0.00
Insecticide	0.00
Labor	0.20
TOTAL	\$3.15
Yield (AUM)	3.75

Appendix C, Table XV: Estimated Costs Per Acre for Cropland Pasture, 1972.

Sources: <u>Selected U. S. Crop Budgets: Yields, Inputs, and</u> <u>Variable Costs</u>, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

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Item	Cost
Machine Operations	\$0.10
Fixed Machine	0.10
Annual Fence Charge	0.30
Annual Water Charge	0.05
Herbicide	0.00
Insecticide	0.00
Labor	0.20
TOTAL	\$0.75
Yield (AUM)	2.25

Appendix C, Table XVI: Estimated Costs Per Acre for Native Pasture, 1972.

Sources: Selected U. S. Crop Budgets: Yields, Inputs, and Variable Costs, Vol. III, Great Plains Region, ERS 459, United States Department of Agriculture; Wallace G. Aanderud, Merlyn M. Dahl and John N. Maher, "Ten Steps for Planning Your Farm or Ranch Business," Extension Circular 632 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University); Wallace G. Aanderud, Farm Management Extension Economist, SDSU.

light Geo Bait, 145 Realgamenters Rainbal, 922 Call Cop. Ferder Call Weld the Metabor, Re-I.: Receipts Reifer Calf (0.2) a A.1 cost a WWW. AND Cull Heifer (0.04 x 5.0 cut w 226.5%) TTACTA II. Pasture (5,554 APA + Sk. 201 Breeding Charge Building Repairs (). Transportation and con APPENDIX D IV. W. IV. Darwin K. Enternet Manzer p. 1971 Dald, Constant of the second builted the second of here shows a survey built be weath that we have to see the set of the

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Appendix D, Table I:	Beef Cow Unit, 16% Replacements Raised, 92%
and Manual and a second are	Calf Crop, Feeder Calf Sold in October, Re-
	placements First Calve at 2 Years, One Bull
	Per 25 Cows.

ı.	Receipts Steer Calf (0.46 x 4.5 cwt x \$34.44) Heifer Calf (0.26 x 4.1 cwt x \$30.44) Cull Cow (0.15 x 11.0 cwt x \$16.94) Cull Heifer (0.04 x 6.0 cwt x \$26.44)	\$ 71.29 32.45 27.95 <u>6.35</u> \$138.04
LLo	Operating Expenses	
II.	Operating Expenses Hay Equivalent (2,469 tons x \$18.83) Pasture (5.554 AUM x \$4.50) Supplement (0.01 cwt x \$4.60) Mineral and Salt (35 pounds x \$0.03) Breeding Charge Veterinary and Drugs Equipment Repairs (4% x \$5.60) Building Repairs (3.5% x \$9.20) Transportation and Cost of Marketing	\$46.50 24.99 0.05 1.05 5.00 3.00 0.22 0.32 2.75 \$83.88
TTT	The own Direct Costs (I minus II)	\$54.16
IV.	Depreciation Equipment (10% x \$11.20) Buildings (3% x \$18.40)	\$1.12 0.55
· V.	Return to Labor and Management (III minus IV)	\$1.67
v.,	Return to Labor and Management (III minus IV)	\$52.49
viv.	Labor Cost (7.5 hours x \$2.00) Ling Capital Costs	\$15.00
VII.	Return to Management disregarding Capital Costs and Taxes (V minus VI)	\$37.49
	and ranes (, manue -,	Loopens a

C	Dervin V Johnson, An Economic Analysis of Selected Beef
sources:	Enterprise Systems for Southeast South Dakota (unpublished
	Mactor's thesis, South Dakota State University, 1973),
	naster's theore, G. Aanderud, Myron T. Barber and Merlyn M.
	p. 107, Wallace for Planning a Farm or Ranch Business, Ex-
	tension Circular 633 (rev), Cooperative Extension Service,
	United States Department of Agriculture (bould builded beau
	University), pp. 10-19, 24-27.

Appendix D, Table II: Beef Cow Unit, 16% Replacements Purchased, 92% Calf Crop, Feeder Calf Sold in October, One Bull Per 25 Cows.

tersindada andar tersinda analysis tersinda analysis		
I. ^I	Receipts Steer Calf (0.46 x 4.5 cwt x \$34.44) Heifer Calf (0.46 x 4.1 cwt x \$30.44) Cull Cow (0.15 x 11.0 cwt x \$16.94)	\$ 71.29 57.41 27.95
ÍI.	Operating Expenses	\$156.65
II.	Operating Expenses Hay Equivalent (2.354 tons x \$18.83) Pasture (5.199 AUM x \$4.50) Replacement (0.16 x \$250.00) Mineral and Salt (25 pounds x \$0.03) Breeding Charge Veterinary and Drugs Equipment Repairs (4% x \$5.00) Building Repairs (3.5% x \$8.00) Transportation and Cost of Marketing	\$ 44.33 23.40 40.00 0.75 5.00 3.00 0.20 0.28 <u>3.00</u> \$119.96
III.	Income Over Direct Costs (I minus II)	\$36.69
IV.	Depreciation Equipment (10% x \$10.00) Buildings (3% x \$16.00)	\$1.00 0.48 \$1.48
V	Return to Labor and Management (III minus IV)	\$35.21
IV	Labor Cost (6.5 hours x \$2.00) ding Capital Costs	\$13.00 -84.62
VII.	Return to Management disregarding capital costs and Taxes (V minus VI)	\$22.21

Sources: Darwin K. Johnson, <u>An Economic Analysis of Selected Beef</u> <u>Enterprise Systems for Southeast South Dakota (unpublished</u> Master's thesis, South Dakota State University, 1973), p. 167; Wallace G. Aanderud, Myron T. Barber and Merlyn M. Dahl, <u>Guidebook for Planning a Farm or Ranch Business</u>, Extension Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 18-19, 24-27.

		i de au partira.
ī.	Receipts Yearling Steer Feeder (6.5 cwt x \$30.44) Minus Death Loss (1.5% x \$197.86)	\$197.86 -2.99 \$194.87
Π.	Operating Expenses Steer Calf (4.5 cwt x \$34.44) Corn Equivalent (8.435 bushels x \$1.08) Hay Equivalent (0.7812 tons x \$18.83) Pasture (1.2 AUM x \$4.50) Mineral and Salt (10 pounds x \$0.03) Veterinary and Drugs Equipment Repairs (4% x \$4.00) Building Repairs (3.5% x \$7.00) Transportation and Cost of Marketing	\$154.98 9.11 14.71 5.40 0.30 1.00 0.16 0.25 4.36 \$190.27
iii:	Income Over Direct Costs (I minus II)	\$4.60
IV.	Depreciation Equipment (10% x \$8.00) Buildings (3% x \$14.00)	\$0.80 0.42 \$1.22
v.	Return to Labor and Management (III minus IV)	\$3,38
IV.	Labor Cost (4 hours x \$2.00)	\$8.00
VII.	Return to Management disregarding Capital Costs and Taxes (V minus VI)	-\$4.62

Appendix D, Table III: Raise Yearling Steer Feeders, October to April, 200 Pound Weight Gain.

Source: Darwin K. Johnson, <u>An Economic Analysis of Selected Beef</u> Enterprise Systems for Southeast South Dakota (unpublished Master's thesis, South Dakota State University, 1973), p. 172.

I. Receipts	
Yearling Heifer Feeder (6.0 cwt x \$27.44) Minus Death Loss (1.5% x \$158.64)	\$164.64 -2.47 \$162.17
II. Operating Expenses Heifer Calf (4.1 cwt x \$30.44) Corn Equivalent (8.435 bushels x \$1.08) Hay Equivalent (0.7812 tons x \$18.83) Pasture (1.2 AUM x \$4.50) Mineral and Salt (10 pounds x \$0.03) Veterinary and Drugs Equipment Repairs (4% x \$4.00) Building Repairs (3.5% x \$7.00) Transportation and Cost of Marketing	\$124.80 9.11 14.71 5.40 0.30 1.00 0.16 0.25 <u>4.00</u> \$159.73
III. Income Over Direct Costs (I minus II)	\$2.44
IV. Depreciation Equipment (10% x \$8.00) Buildings (3% x \$14.00)	\$0.80 <u>0.42</u> \$1.12
V. Return to Labor and Management (III minus IV) V. Return to Labor and Management (III minus IV)	\$1.32
IV. Labor Cost (4 hours x \$2.00)	\$8.00
/II. Return to Management disregarding Capital Costs and Taxes (V minus VI)	-\$6.68
Source: Darwin K. Johnson, An Economic Analysis of S Derce: Enterprise Systems for Southeast South Dakot	elected Beef a (unpublished

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Appendix D, Table IV: Raise Yearling Heifer Feeders, October to April, 190 Pound Weight Gain.

T Dece		
I. Kecel	pts	\$307 34
Mir	$Depth Lose (27 \times $307.34)$	-6.15
THE THE	al Patfer (9 Start Start)	\$301,19
	Snus Death Loss (22 x 2266.43	100-110
II. Opera	ting Expenses	NOT THE
Ste	er Calf (4.5 cvt x \$34.44)	\$154.98
II. Con	m Equivalent (57.06 bushels x \$1.08)	61.62
Cor	n Silage (2,925 tons x \$8.00)	23,40
Hay	Equivalent (0.504 tons x \$18.83)	9.49
Sur	plement (0.3 cwt x \$4.60)	1.38
Mir	eral and Salt (30 pounds x \$0.03)	0.90
Vet	erinary and Drugs	2.00
Equ	upment Repairs (4% x \$20.00)	0.80
Bui	lding Repairs (3.5% x \$35.00)	1.23
Tra	insportation and Cost of Marketing	6.11
	uilding Repairs (3.5% x \$35,00)	\$261.91
	remaportation and Cost of Marheting	
III. Incom	ne Over Direct Costs (I minus II)	\$39.28
IV. Depre	ciation: Direct Costs (Indata II)	1134
Eau	ipment (10% x \$40.00)	\$4.00
IV. Bui	ldings (3% x \$70.00)	2.10
	dulprent (10% x \$40.00)	\$6.10
в	uildings (32 x \$70.00)	
V. Retur	m to Labor and Management (III minus IV)	\$33.18
VI. Labor	Cost (5 hours x \$2.00)	\$10.00
VII. Retur	n to Management disregarding Capital Costs	Bis.
and T	axes (V minus VI)	\$23.18
	urn to Management discogardice Casical Cast	

Appendix D, Table VII: Feed Yearling Stears, 5 M. Po und Meishe. Gain

in 7 Months.

Appendix D, Table VI: Feed Heifer Calves, 540 Pound Weight Gain in 10 Months.

Turn	and the second	
-	Fer Yearling Schern (12.00 CMC # 040.94)	942 Ja 249
I.	Receipts ach Loss (1,07 x 8323.36)	-3-23
	Fed Heifer (9.50 cwt x \$25.94)	\$246.43
	Minus Death Loss (2% x \$246.43	-4.93
III	Operation Expanses	\$241.50
	Yearling Steer (6.5 cm a \$30.44)	235.6.60
II.	Operating Expenses 21 bushels 1 81.089	And the second s
	Heifer Calf (4.1 cwt x \$30.44)	\$124.80
	Corn Equivalent (45.6 bushels x \$1.08)	49.25
	Corn Silage (2.925 tons x \$8.00)	23.40
	Hay Equivalent (0.504 tons x \$18.83)	9.49
	Supplement (0.30 cwt x \$4.60)	1.38
	Mineral and Salt (25 pounds x \$3.00)	0.75
	Veterinary and Drugs	2.00
	Equipment Repairs (\$% x \$20.00)	0.80
	Building Repairs (3.5% x \$35.00)	1.23
	Transportation and Cost of Marketing	5.36
II.	Income Over Direct Comes (L Winds Lis)	\$218.46
		400.04
III.	Income Over Direct Costs (I minus II)	\$23.04
	Equipment (5.6% x seen our	
IV.	Depreciation	èr 00
	Equipment (10% x \$40.00)	\$4.00
	Buildings (3% x \$70.00)	2.10
\mathbb{V}_{*}	Repurn to Labor and Managements (and sameses	\$0.10
VIV.	Return to Labor and Management (III minus IV)	\$16.94
	in the second ins Camital Costs	\$10.00
IIV.	Labor Cost (5 hours x \$2.00	410.00
	and Taxes IV minus av	
VII.	Return to Management disregarding capital costs	\$6.94
	and Taxes (V minus VI)	d Treat The local
Spurc	11 Barvin K. Abbury, the second state where the	C. C

Source: Darwin K. Johnson, <u>An Economic Analysis of Selected Beef</u> Enterprise Systems for Southeast South Dakota (unpublished Master's thesis, South Dakota State University, 1973), p. 173. Appendix D, Table VII: Feed Yearling Steers, 550 Pound Weight Gain in 7 Months.

I.	Receipts	
	Fed Yearling Steers (12.00 cwt x \$26.94)	\$323.28
	Alinus Death Loss (1.0% x \$323.28)	-3.23
		\$320.05
II.	Operating Expenses	
	Yearling Steer (6.5 cvt x \$30.44)	\$197.86
	Corn Equivalent (59,71 bushels x \$1.08)	64-49
	Corn Silage (1.2 tons x \$8.00)	9,60
	Hay Equivalent (0.2745 tons x \$18.83)	5.17
	Supplement (1.4 cwt x \$4.60)	6.44
	Mineral and Salt (22 pounds x \$0.03)	0.66
	Veterinary and Drugs	1.00
	Equipment Repairs (3.0% x \$20.00)	0.60
	Building Repairs (2.5% x \$35.00)	0.88
	Transportation and Cost of Marketing	7.35
		\$294.05
II.	Income Over Direct Costs (I minus II)	\$26.00
IV.	Depreciation	
	Equipment (5.6% x \$40.00)	\$2.24
	Buildings (1.7% x \$70.00)	1,19
		\$3.43
۷.	Return to Labor and Management (III minus IV)	\$22.57
I.	Labor Cost 4.5 hours x \$2.00)	\$9.00
Π.	Return to Management disregarding Capital Costs	
1.2	and Tayos (V minus VI)	\$12 57

Source: Darwin K. Johnson, An Economic Analysis of Selected Beef Enterprise Systems for Southeast South Dakota (unpublished Master's thesis, South Dakota State University, 1973), p. 178. Appendix D, Table VIII: Feed Yearling Heifers, 450 Pound Weight Gain in 7 Months.

I.	Receipts	
The second second	Fed Yearling Heifer (10.5 cwt x \$24,94)	\$261 97
	Minus Death Loss (1% x \$261.87)	-2 62
I.	Receipts	\$250 25
	Forder Pips (13.5 meas a Side of a first	9239.23
II.	Operating Expenses	
	Yearling Heifer (6.00 cwt x \$27.44)	\$164 64
	Corn Equivalent (47.53 bushels x \$1.08)	51 22
	Corn Silage (1.65 tons x \$8.00)	13 20
II.	Ope Hay Equivalent (0.305 tons x \$18.83)	5 74
	Supplement (0.5 cwt x \$4.60)	2 30
	Mineral and Salt (17 pounds x \$0.03)	0.51
	Veterinary and Drugs	1.00
	PEquipment Repairs (3% x \$20.00)	0.60
	Building Repairs (2.5% x \$35.00)	0.88
	Transportation and Cost of Marketing	6.56
	Treeding Charge	\$246.76
	Vecerinary and rank	126,000
III.	Income Over Direct Costs (I minus II)	\$12.49
IV.	Depreciation	a state
	Equipment (5.6% x \$40.00)	\$2 24
	Buildings (1.7% x \$70.00)	1 19
LI.	Income Over Direct Course of themat 633	\$3.43
IV.	Return to Labor and Management (III minus IV)	\$9.06
	Equipment (10% x 760,000	
VI.	Labor Cost (4.5 hours x \$2.00)	\$9.00
/II.	Return to Management disregarding Capital Costs	
V.	and Taxes (V minus VI)	\$0.06

Source: Darwin K. Johnson, <u>An Economic Analysis of Selected Beef</u> Enterprise Systems for Southeast South Dakota (unpublished Master's thesis, South Dakota State University, 1973), p. 177.

Source:

Hallace G. Augdarod, Trans T. Desper and Martyania Andr. Guidebook for Placebook & Star of Torac Parameter, Streetsion Circular 63' (new), Comparative Salastan Section. Buited States Department of Americalizate classic based a Porta Appendix D, Table IX: Sow Unit Producin Weaned Per Year,

Sow Unit Producing Feeder Pigs, 14.5 Pigs Weaned Per Year, March and September Farrowing, One Saved for Replacement from March Litter, Sell 40 Pound Feeder Pigs, One Boar Per 25 Sows.

Receipts I. Receipts Feeder Pigs (13.5 head x \$39.08 x 0.4 cwt) \$211.03 Sow (4.5 cwt x \$16.50) 74.25 Minus Sow Death Loss (2% x \$74.25) -1.49 \$283.79 II. Feeder Pigs (0.4 cot x 039.08) II. Operating Expenses \$75.60 Corn Equivalent (70 bushels x \$1.08) 17.00 Creep Ration (425 pounds x \$0.04) 6.33 Hay Equivalent (0.336 tons x \$18.83) Pasture (0.5 AUM x \$4.50) 2.25 19.00 Supplement (4.0 cwt x \$4.75) Mineral and Salt (50 pounds x \$0.03) 1.50 4.00 Breeding Charge 18.00 Veterinary and Drugs 1.28 Equipment Repairs (4% x \$32.00) 2.62 Building Repairs (3.5% x \$75.00) 4.00 Transportation and Cost of Marketing \$151.58 IV. Income Over Direct Costs (I minus II) \$132.21 III. IV. Depreciation \$ 6.40 Equipment (10% x \$64.00) 4.50 Buildings (3% x \$150.00) \$10.90 V. Return to Labor and Management (III minus IV) \$121.31 Return to Management disregarding Casteri des \$32.00 Labor Cost (16 hours x \$2.00) v. Return to Management disregarding Capital Costs VII. \$89.31 Sourcand Taxes (V minus VI) Source: Wallace G. Aanderud, Myron T. Barber and Merlyn M. Dahl, Guidebook for Planning a Farm or Ranch Business, Exten-

sion Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 94-95. Appendix D, Table X: Feeder Pigs, Half Finished for August-September Market, Half for February-March Market, Spring Pigs on Pasture, Fall in Drylot, 40 Pounds to 225 Pounds.

VI.	Labor Cost (0.4 hours x \$2.00)	\$0.80
v.	Return to Labor and Management (III minus IV)	\$7.86
IV.	Buildings (3% x \$12.00) Depreciation	\$0.96
IV.	Depreciation Equipment (10% x \$0.00)	\$0.60
III.	Income Over Direct Costs (I minus II)	\$8.82
	Transportation and Cost of Marketing	\$34.48
	Building Repairs (3.5% x \$6.00)	0.21
	Veterinary and Drugs	1.00
	Supplement (0.875 cwt x \$4.75) Mineral and Salt (7.5 pounds x \$0.03)	4.16 0.23
II.	Corn Equivalent (10.25 bushels x \$1.08) Pasture (0.1 AbM x \$4.50) Hay Equivalent (0.0112 tons x \$18.83)	11.07 0.45 0.21
II.	Operating Expenses Feeder Pigs (0.4 cwt x \$39.08)	\$15.63
	Minus Death Loss (1.5% x \$43.96) Cull Los (1.5 cut x 0.16 x \$43.96) Wool (11.8 pounds x 00.62)	-0.66 \$43.30
Ϊ.	Receipts Butcher Hogs (2,25 cut x \$19,54)	\$43.96

Source: Wallace G. Aanderud, Myron T. Barber and Merlyn M. Dahl, Guidebook for Planning a Farm or Ranch Business, Extension Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 96-99.
	Feeders, Half May-June Feeders, ment Ewes Raised, 2% Ewe Death L Per 35 Ewes.	20% Replace oss, One Ra
I	Receipts Feeder Lambs (0.7 cwt x 0.996 x \$23.36) Wool Incentive (0.7 cwt x 0.996 x \$0.50) Cull Fwe (1.3 cwt x 0.18 x \$5.86)	\$16.29 0.35
	Wool (11.8 pounds x \$0.62)	7.32 \$25.33
ц т.	Operating Expenses Corn Equivalent (1.08 bushels x \$1.08) Hay Equivalent (0.4414 tons x \$18.83) Pasture (1.24 AUM x \$4.50) Supplement (0.325 cwt x \$4.60) Mineral and Salt (16.2 pounds x \$0.03) Breeding Charge Veterinary and Drugs Shearing Equipment Repairs (4% x \$2.90) Building Repairs (3.5% x \$2.90) Transportation and Cost of Marketing	$ $ 1.17 8.31 5.58 1.50 0.49 0.60 0.68 0.60 0.12 0.10 0.85 $20.00 } $
III.	Income Over Direct Costs (I minus II)	\$5.33
IV.	Depreciation Equipment (10% x \$5.80) Buildings (3% x \$5.80)	\$0.58 0.17 \$0.75
V	Return to Labor and Management (III minus IV)	\$4.58
VI.	Labor Cost (2.9 hours x \$2.00)	\$5.80
VII.	Return to Management disregarding Capital Costs and Taxes (V minus VI)	-\$1.22

Guidebook for Planning a Farm of Ranch Business, Extension sion Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 78-79, 82-83, 86-87.

State University), pp. 78-79, 82-83.

Appendix D, Table XII: Ewe Unit, Sell 120% Lamb Crop, Half August Feeders, Half May-June Feeders, 20% Replac ment Ewes Purchased, 2% Ewe Death Loss, On Ram Per 35 Ewes.			
I.	Receipts		
т	Wool Incentive (.3 cut gain a 0.50)	0.13	
1.	Feeder Lambs (0.7 cwt x 1.w x $$23.36$) Heal Incentive (0.7 cwt x 1.2 x $$0.50$)	\$19.62	
	Cull Eve $(1.3 \text{ cwt x } 0.18 \text{ x } 55.86)$	1.37	
II.	Wool (10 pounds x $\$0.62$)	6.20	
	Purchase France (0170 x \$23,36)	\$27.61	
	War Namidariant (A 0722 tange w Sin 23)	1.44	
II.	Operating Expenses	6.15	
	Corn Equivalent (1 bushel x \$1.08)	\$ 1.08	
	Hay Equivalent (0.3624 x \$18.83)	6.82	
	Pasture (1.1 AUM x \$4.50)	4.95	
	Supplement (0.325 cwt x \$4.60)	1.50	
	Mineral and Salt (15 pounds x \$0.03)	0.45	
	Replacement Ewe Cost (0.2 x \$24.36)	4.87	
TTT.	Breeding Charge Costs (I sines II)	0.60	
an an air a	Veterinary and Drugs	0.60	
TU	Shearing	0.50	
4 7 y	Equipment Repairs (4% x \$2.50)	0.10	
	Building Repairs (3.5% x \$4.50)	0.09	
	Transportation and Cost of Marketing	0.85	
		\$22.41	
шĭ.	Income Over Direct Costs (I minus II)	\$5.20	
WI.	Labor (ege (0.2 hours z \$2,30)	学习, 这位	
TA.	$Fauirmont (10\% \times $5,00)$	\$0.50	
VII.	Evilding $(37 \times $5,00)$	0.15	
	Buildings (J. A 43.30)	\$0.65	
ni. i te di anastrona tina		- in the second production of the second	
Sol to	Return to Labor and Management (III minus IV)	\$4.55	
VI.	Labor Cost (2.4 hours x \$2.00)	\$4.80	
VTT	Return to Management disregarding Capital Costs		
	and Taxes (V minus VI)	-\$0.25	

Guidebook for Planning a Farm or Ranch Business, Extension Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 78-79, 82-83.

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I.	Receipts Fat Lamb (1 cvt x \$25.36)	\$25.36
	Minus Death Loss (2.0% x \$25.36)	-0.51 \$25.00
11.	Operating Expenses Purchase Feeder (0.70 x \$23.36) Corn Equivalent (2.4 bushels x \$1.08) Hay Equivalent (0.0722 tons x \$18.83) Mineral and Salt (5 pounds x \$0.03) Veterinary and Drugs Equipment Repairs (4% x \$2.00) Building Repairs (3.5% x \$4.00) Transportation and Costs of Marketing	\$16.35 2.59 1.36 0.15 0.30 0.08 0.14 0.94 \$21.91
III.	Income Over Direct Costs (I minus II)	\$3.09
IV.	Depreciation Equipment (10% x \$4.00) Buildings (3% x \$8.00)	\$0.40 0.24 \$0.64
v.	Return to Labor and Management (III minus IV)	\$2.45
VI.	Labor Cost (0.2 hours x \$2.00)	\$0.40
VII.	Return to Management disregarding Capital Costs and Taxes (V minus VI)	\$2.05

Source: Wallace G. Aanderud, Myron T. Barber and Merlyn M. Dahl, Guidebook for Planning a Farm or Ranch Business, Extension Circular 633 (rev), Cooperative Extension Service, United States Department of Agriculture (South Dakota State University), pp. 88-89.

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Appendix D, Table XIII: Feeder Lambs, Drylot, 2 Month Feeding Period, 30 Pound Weight Gain Per Lamb.