1974

A model for programming forage supplies

Craig L. Dobbins
Iowa State University

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A model for programming forage supplies

by

Craig Lee Dobbins

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
MASTER OF SCIENCE

Department: Economics
Major: Agricultural Economics

Signatures have been redacted for privacy

Iowa State University
Ames, Iowa
1974
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INTRODUCTION

The beef cow herd has been a part of Iowa's agriculture since its inception. However, in recent years Iowa's beef cow numbers have shown a dramatic increase. Dr. S. A. Ewing has estimated that 46 to 50 million beef cows will be needed by 1980 (39 million presently) to provide enough beef for 243 million people, thus Iowa's beef cow numbers could also be expected to increase. (1)

When one considers beef cows on Iowa farms he must also think about forage needs. Dr. W. F. Wedin, Iowa State University agronomist, has estimated that even in an unimproved state Iowa now produces enough hay and pasture to support 1½ million beef cows. If these acres were developed to their full potential it is estimated Iowa could support about seven million head. With sharper management and better use of the present mix of unimproved and improved grassland it is estimated that Iowa's beef cow numbers could be doubled. Thus Iowa has the physical potential to expand beef raising.

Since feed costs make up approximately two-thirds of the annual costs of keeping a beef cow, the economically efficient production and utilization of forage is a primary concern of the individual cow-calf producer. It is this problem that will be addressed in this study.
Background Information

Over a 20 year period from 1953 to 1972, beef cow numbers in the United States have increased from 23.29 million head on January 1, 1953, to 38.73 million head on January 1, 1972, a 65.87 percent increase. (26) (27)

As illustrated in Table 1 the primary increase in U.S. beef cow numbers has come about since 1962. Of the 65.87 percent increase in the U.S. beef cow numbers in this 20 year period, 44.66 percent of the increase has taken place since 1962. Although beef cow numbers in Iowa have followed the same general trends as for the U.S., the expansion in cow numbers since 1962 has been greater than the U.S. increase.

In comparing Iowa's increase in beef cow numbers from 1962 to 1972 with the other top ranking states in beef calf production for 1972; respectfully: Texas, Oklahoma, Missouri, Nebraska, Kansas, South Dakota, Iowa, Montana, Mississippi, Colorado, only the State of Missouri had a larger percentage increase.

The increased beef cow production in Iowa has caused a larger proportion of the U.S. beef calf production to be located in Iowa, thus indicating distributional changes in beef production. Although these geographical shifts have been slight in most cases, of the ten largest beef cow producing states in 1972 named previously, only Missouri, Kansas, Iowa and Mississippi have not seen a decrease in their proportion of the U.S. total. (26) (27)

Table 2 shows how the change in Iowa's beef cow numbers since 1962 compares with changes in other agricultural production in the state. With
the exception of soybeans the percentage increase in beef cow numbers since 1962 has been larger than the percentage increase in any other major agricultural production enterprises in the state.

Table 1. The changes in beef cow production for the United States and Iowa for the years of 1953 through 1972

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Beef Cows in USb</th>
<th>Percent of 1953 Total</th>
<th>Total Beef Cows in Iowa</th>
<th>Percent of 1953 Total</th>
<th>Iowa's Percentage of US Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>23.29</td>
<td>100.00</td>
<td>3.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1954</td>
<td>25.05</td>
<td>107.56</td>
<td>3.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td>25.66</td>
<td>110.18</td>
<td>3.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1956</td>
<td>25.76</td>
<td>110.61</td>
<td>3.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>24.94</td>
<td>107.08</td>
<td>3.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td>24.43</td>
<td>104.89</td>
<td>3.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>25.58</td>
<td>109.83</td>
<td>3.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>26.34</td>
<td>113.10</td>
<td>3.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>17.03</td>
<td>116.06</td>
<td>3.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td>28.23</td>
<td>121.21</td>
<td>3.65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td>29.89</td>
<td>128.34</td>
<td>3.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>31.73</td>
<td>136.24</td>
<td>3.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>32.70</td>
<td>140.40</td>
<td>3.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>34.34</td>
<td>147.45</td>
<td>3.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>34.60</td>
<td>148.56</td>
<td>3.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>35.31</td>
<td>151.61</td>
<td>3.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>36.13</td>
<td>155.13</td>
<td>3.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>37.33</td>
<td>160.28</td>
<td>3.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>37.44</td>
<td>160.76</td>
<td>4.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>38.63</td>
<td>165.87</td>
<td>4.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Livestock and Poultry, Inventory, January 1 (26). Cattle, Sheep, and Goat Inventory, January 1 (27).

The beef cow numbers for the years 1959 through 1972 represent only those beef cows in the 48 continent states.
Table 2. Total state production for selected agricultural enterprises in 1962 and 1972a

<table>
<thead>
<tr>
<th>Production Enterprise</th>
<th>Number in 1962</th>
<th>Number in 1972b</th>
<th>% of 1962 Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Cows (head)</td>
<td>929,377</td>
<td>1,439,104</td>
<td>154.85</td>
</tr>
<tr>
<td>Sows Farrowed (head)</td>
<td>2,564,831</td>
<td>2,375,561</td>
<td>92.62</td>
</tr>
<tr>
<td>Dairy Cows (head)</td>
<td>733,435</td>
<td>416,834</td>
<td>56.83</td>
</tr>
<tr>
<td>Grain Fed Cattle Marketed (head)</td>
<td>3,055,304</td>
<td>3,735,952</td>
<td>122.78</td>
</tr>
<tr>
<td>Corn for Grain (acres)</td>
<td>9,706,692</td>
<td>10,650,084</td>
<td>109.72</td>
</tr>
<tr>
<td>Soybeans (acres)</td>
<td>3,364,808</td>
<td>5,964,253</td>
<td>177.25</td>
</tr>
<tr>
<td>Oats (acres)</td>
<td>2,923,397</td>
<td>1,181,747</td>
<td>40.42</td>
</tr>
<tr>
<td>Hay (acres)</td>
<td>3,506,965</td>
<td>2,279,705</td>
<td>65.01</td>
</tr>
<tr>
<td>Pasture (acres)</td>
<td>8,143,313</td>
<td>6,735,239</td>
<td>82.72</td>
</tr>
</tbody>
</table>

aSources: Iowa Annual Farm Census 1962 (8) and Iowa Annual Farm Census 1972 (Preliminary) (9).

Preliminary Results.

Table 3 indicates that each crop reporting district in Iowa followed the same trends in beef raising, dairy production, cattle feeding, hay and pasture production as the state totals, i.e. dairy cattle, hay and pasture production decreased while beef cows and market cattle increased. However, even with reduced acreages in 1972, hay and pasture production still totaled 9.02 million acres. This is 26.76 percent of the 33.71 million acres in Iowa farms. Pasture alone constitutes 19.94 percent of Iowa farmland.

Distributional changes in beef calf production within the state are also shown in Table 3. In 1962 the five largest beef raising districts were respectively: South Central, East Central, Central, West Central and Southwest. These five districts accounted for 624 thousand head or 67.17 percent of the state total. In 1972 the five largest producing districts
were respectively: South Central, West Central, East Central, Southwest and Southeast. These top five districts are now producing 977 thousand head or 67.88 percent of the state total.

Table 3. Production levels in each of Iowa’s crop reporting districts for selected agricultural enterprises in 1962 and 1972 (numbers in thousands)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest</td>
<td>62</td>
<td>77</td>
<td>693</td>
<td>517</td>
<td>108</td>
<td>47</td>
<td>945</td>
<td>392</td>
</tr>
<tr>
<td>North Central</td>
<td>58</td>
<td>82</td>
<td>287</td>
<td>415</td>
<td>65</td>
<td>35</td>
<td>258</td>
<td>283</td>
</tr>
<tr>
<td>Northeast</td>
<td>80</td>
<td>244</td>
<td>140</td>
<td>1135</td>
<td>142</td>
<td>191</td>
<td>200</td>
<td>930</td>
</tr>
<tr>
<td>West Central</td>
<td>113</td>
<td>62</td>
<td>561</td>
<td>882</td>
<td>195</td>
<td>24</td>
<td>774</td>
<td>719</td>
</tr>
<tr>
<td>Central</td>
<td>117</td>
<td>60</td>
<td>394</td>
<td>763</td>
<td>147</td>
<td>22</td>
<td>446</td>
<td>603</td>
</tr>
<tr>
<td>East Central</td>
<td>122</td>
<td>92</td>
<td>421</td>
<td>1001</td>
<td>177</td>
<td>55</td>
<td>443</td>
<td>794</td>
</tr>
<tr>
<td>Southwest</td>
<td>111</td>
<td>32</td>
<td>354</td>
<td>828</td>
<td>172</td>
<td>11</td>
<td>414</td>
<td>697</td>
</tr>
<tr>
<td>South Central</td>
<td>161</td>
<td>43</td>
<td>69</td>
<td>1502</td>
<td>274</td>
<td>16</td>
<td>89</td>
<td>1406</td>
</tr>
<tr>
<td>Southeast</td>
<td>104</td>
<td>42</td>
<td>137</td>
<td>1101</td>
<td>159</td>
<td>16</td>
<td>166</td>
<td>912</td>
</tr>
<tr>
<td>State Total</td>
<td>929</td>
<td>733</td>
<td>3055</td>
<td>8143</td>
<td>1439</td>
<td>417</td>
<td>3736</td>
<td>6735</td>
</tr>
</tbody>
</table>

Sources: Iowa Annual Farm Census 1962 (8) and Iowa Annual Farm Census 1972 (Preliminary) (9).

Preliminary Results.

The ranking of the crop reporting districts shows that beef cow production has become concentrated in the border areas of Iowa. This is not a totally unexpected trend because it is this area of the state that contains an abundance of grazing land. The five leading beef raising districts account for 67.23 percent of the state's total pasture land and 58.25 percent of the state's hay production.
Statement of the Problem

Because beef cows are important utilizers of the hay and pasture produced on individual farms, the questions that follow are deserving of study. What is the best mix of grain and forage crops to raise? What forage variety should be grown and how should it be utilized? How many acres of each should be grown? What fertilizer level should be applied to cool season grasses? If pastured what type of grazing management is most efficient? How can crop residues best be used to supplement other forages? How many beef cows can be supported on an individual farm with given land and labor resources?

The problem of forage planning is indeed complex. Its complexity stems primarily from one source, the time dimension of forage production and utilization. Seasonal production patterns, as illustrated in Table 4, vary so much from one forage to another that total forage production is not a useful criterion to use in evaluating forages and in planning forage systems.

The problem of blending forages and management systems to provide an adequate forage supply has prompted a great deal of research in grassland production and utilization. Several guidelines for forage planning have emerged from this research:

1. Since the forage production pattern typically does not fit the animals' needs, planning should be based on a 12-month period. This method helps prevent the heavy stocking of pasture to utilize spring growth with resultant severe shortages during the summer and fall. When
planning a forage system the producer must consider harvested forage as well as grazed forage.

Table 4. Estimated availability of forage for grazing expressed as the percentage available per month

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky bluegrass - white clover, unimproved</td>
<td>25</td>
<td>30</td>
<td>10</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Kentucky bluegrass - white clover + nitrogen, phosphorus</td>
<td>35</td>
<td>35</td>
<td>8</td>
<td>5</td>
<td>10</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Renovated (continuous grazing) Birdsfoot trefoil - grass</td>
<td>10</td>
<td>25</td>
<td>25</td>
<td>20</td>
<td>10b</td>
<td>5b</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Birdsfoot trefoil - grass deferred for midsummer grazing</td>
<td>15</td>
<td>35</td>
<td>25</td>
<td>15b</td>
<td>5b</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tall - grasses + nitrogen(^c)</td>
<td>30</td>
<td>30</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tall - grasses + nitrogen, deferred for fall grazing(^c)</td>
<td>30</td>
<td>30</td>
<td>10</td>
<td>5</td>
<td>25</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplemental Sudangrass or sorghum - sudan hybrids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sudangrass or sorghum - sudan hybrids, deferred for fall and winter grazing</td>
<td>40</td>
<td>40</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)Source: Schaller (23).

\(^b\)Allowances have been made for winter huring of legume from September 15 to October 15.

\(^c\)Bromegrass, Orchardgrass, Tall Fescue, Reed Canarygrass or combinations.

2. Once the forage needs have been recognized the next step is to meet these needs. This involves the selection of forage species. In selecting a species it is necessary to take into account such factors as average rainfall, soil drainage, erosion hazard, soil pH level, nutrient supply, use of the stand and length of time it is to be in production.
3. If one species is exceptionally well adapted to a given location any mixture is likely to be lower yielding. While few mixtures will out-yield well-adapted grasses that are heavily fertilized with nitrogen, the quality of the forage can often be improved by including a legume. Thus the problem becomes one of the optimum degree of substitutions of quality for quantity. Simple mixtures are preferred to complex ones because the latter often reduce yields.

4. Some species perform better under one particular form of management. For example it has been found that grasses with jointed stems such as smooth bromegrass, produce more under a rotational grazing system than a continuous grazing system. (10) (14)

Moore (20) suggests that pastures in South Dakota be cross-fenced and planted to different grasses so that each is grazed at its optimum. He proposed that the pasture area be divided as follows: early spring 25 percent, late spring, early summer and some late summer grazing 38 percent, midsummer 12 percent, and late fall 25 percent. When this system has been employed production has increased from 1.5 acres of pasture per animal unit for four months to 1.5 acres of pasture per animal unit for seven months.

Results of an Ohio study (31) show that summer pasture slumps could be compensated for by using deferred grazing or combinations of round bales of early growth and accumulated regrowth. It was shown that forage can be stored in fields as standing material or round baled hay to supply livestock feed for all or part of the winter. In order to take advantage of these management methods a combination of tall fescue for winter
pasture, bluegrass and tall fescue for early spring and late fall pasture and orchardgrass for first crop hay and summer grazing was recommended.

While these and other studies have proposed general guidelines for technical efficiency in the utilization of forages, the individual beef cow producer is still faced with the vexing problem of selecting the combination of forage production that will provide the economic optimum. The factors that will influence this decision are many. They include such things as the quantity and quality of land available, amount of operator labor available, amount of hired labor available, and its prices. The response of legume and grass forages to fertilizer, prices of fertilizer, and lime, insecticides, herbicides and other inputs, expected yields and prices, and the distributional pattern of forages under different managements.

The task of accounting for all these things is nearly impossible using ordinary budgeting procedures. Linear programming, which provides a reasonably accurate basis for such decision making, has been available for several years. Because of the need to employ highly skilled individuals with specialized training in the construction and interpretation of linear programming models, linear programming has not been widely utilized on an individual farmer basis. This is primarily due to the lack of trained individuals and the prohibitive costs associated with such a program. In recent years an effort has been made to develop linear programming systems that substitute computer time for man time. Such systems have been developed and utilized at Purdue University, University of Illinois and Iowa State University.
The specific objective of this study is the development of a model and a systemized program that can be utilized in making an economic evaluation while simultaneous consideration is given to the quantity and quality of available land, the responses of perennial forage crops to fertilizer, costs of fertilizer, lime, insecticides and herbicides, the distributional patterns of forages placed under different managements, yield expectations, production prices, and technological requirements. Specifically the model will seek to facilitate the following decisions:

1. The optimal combination of grain and forage crops on a given land base with varying land qualities.

2. The optimal varieties and combinations of forages that should be selected for production and the type of management under which they should be produced.

3. The number of beef cows that are optimally suited to an individual farm.

4. The optimal use of crop refuse material.

5. The profitability of labor hiring.
BASIS FOR EVALUATION

In order to effectively evaluate, in an economic framework, the many alternative production possibilities that face the individual farmer it is necessary to specify a particular goal or objective. This objective will vary, depending upon how the economic unit being considered is defined. If the unit is a farm as a pure firm, the relevant objective would be the maximization of profit. If the economic unit includes the farm business and the family household in combination the relevant objective would be the maximization of the family’s welfare or utility. In both cases efficiency in production is attained when the resources are organized in such a manner that allow fulfillment of the particular objective.

For purposes of this study the economic unit is an individual farm, thus the appropriate objective for our analysis would be profit maximization. The conditions necessary for profit maximization under perfect competition can be illustrated by the objective function for constant returns to scale which follows.

\[
\text{Maximize } P = p_1 a_1 x_{11}^{b_{11}} x_{21}^{b_{21}} + p_2 a_2 x_{12}^{b_{12}} x_{22}^{b_{22}} - p_{x1} x_{11} - p_{x1} x_{12} - p_{x2} x_{21} - p_{x2} x_{22}
\]

This particular function embodies the production of two commodities from two resources. \( p_1 \) represents the price received for the \( i^{\text{th}} \) good produced, \( p_{x1} \) represents the price of the \( i^{\text{th}} \) input, and \( x_{ij} \) represents the amount of the \( i \) input used to produce the \( j^{\text{th}} \) commodity. Since the production function has constant returns to scale \( b_{11} \) plus \( b_{21} \) and \( b_{12} + b_{22} \) equal one.
Setting the partial derivatives of this objective function to zero we have:

$$\frac{\delta P}{\delta x_{11}} = b_{11} p_{i1} x_{11}^{b_{11}-1} x_{21}^{b_{21}-1} - p_{x1} = 0$$

$$\frac{\delta P}{\delta x_{21}} = b_{21} p_{i1} x_{11}^{b_{11}-1} x_{21}^{b_{21}-1} - p_{x2} = 0$$

$$\frac{\delta P}{\delta x_{12}} = b_{12} p_{i1} x_{12}^{b_{12}-1} x_{22}^{b_{22}-1} - p_{x1} = 0$$

$$\frac{\delta P}{\delta x_{22}} = b_{22} p_{i1} x_{12}^{b_{12}-1} x_{22}^{b_{22}-1} - p_{x2} = 0$$

Thus the input should be employed until the value of the marginal product received from a factor is equal to the price of the factor, i.e. \( MVP_{i1} = p_{x1} \).

By rewriting the above equations the following expressions can be derived.

$$P_{x1} = b_{11} p_{i1} x_{11}^{b_{11}-1} x_{21}^{b_{21}-1} = b_{12} p_{i2} x_{12}^{b_{12}-1} x_{22}^{b_{22}-1}$$

$$P_{x2} = b_{21} p_{i1} x_{12}^{b_{11}-1} x_{21}^{b_{21}-1} = b_{22} p_{i2} x_{12}^{b_{12}-1} x_{22}^{b_{22}-1}$$

or \( \frac{p_{1}}{p_{2}} = \frac{MPP_{12}}{MPP_{11}} = \frac{MPP_{22}}{MPP_{21}} \)

Where \( MPP_{ij} \) represents the marginal physical productivity of input \( i \) in the production of commodity \( j \). This condition states that the inputs should be employed in the production of all commodities until the ratios
of the marginal physical productivities equal the price ratio of the commodities. Because both marginal productivity ratios are equal to the same price ratio the following relationship can be derived from the expression above:

\[
\frac{MPP_{11}}{MPP_{21}} = \frac{MPP_{12}}{MPP_{22}}
\]

This states that the marginal rate of technical substitution of input 1 and 2 must be equal in the production of both commodities. Thus these three conditions should serve as criteria for the decision-making process.

In order to meaningfully apply these criteria it is necessary to have accurate prices, both for the inputs and the services committed to an enterprise and the products forthcoming from it. Markets generally supply accurate prices for most agricultural inputs and products. However, in the case of beef cow production which utilizes non-tillable land and crop aftermath there is no viable market to establish relevant prices. Neither does the market provide prices that can be depended upon to indicate differences in the value of output units among time period within the year.

Linear programming provides a method of evaluating alternative forage production by allowing the application of the economic efficiency criteria above without the specification of accurate prices for all inputs and outputs. The model used to make this evaluation is discussed in the next section.
STRUCTURE OF LINEAR PROGRAMMING MODEL

In developing a forage plan for the beef cow herd, there are two major nutritional requirements that must be met: energy and protein. Of these two, energy has received the greater amount of attention because of its limiting nature; i.e., when the energy requirement is met the protein level required is generally also satisfied. However, with the increased use of low protein roughages, such as corn stalks for wintering purposes, the level of protein in the ration could become critically low and thus merits consideration in developing a forage plan.

Nutritional needs of the cow-calf unit can be divided into two general categories, needs for maintenance and needs for production. While the maintenance requirements will remain constant throughout the year the requirements for production will vary. The size of the animal will be the primary determinant for maintenance needs, while needs for production will be governed by the calving season and lactation.

The monthly distribution of the 4100.97 pounds of total digestible nutrients (TDN) and 188.61 pounds of digestible protein required by a 1000 pound beef cow calving in April is given in Table 5. The average daily TDN requirement for this dry cow is 8.43 pounds of TDN. By the first of May the daily requirement for the cow and calf has increased 45 percent. The digestible protein change is even more dramatic, increasing from an average .68 pounds per day requirement for a dry cow to 1.25 pounds per day for a cow and calf in May, an 84 percent increase. By the time the calf has reached seven months of age the average daily TDN requirement for a cow and calf has reached 14.44 pounds per day, approximately 71 percent
Table 5. Daily total digestible nutrients and digestible protein required by cow calf unit on a monthly basis \(^a\)

<table>
<thead>
<tr>
<th>Month</th>
<th>Requirement For</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maintenance</td>
</tr>
<tr>
<td>Total Digestible Nutrients</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>7.87</td>
</tr>
<tr>
<td>February</td>
<td>7.87</td>
</tr>
<tr>
<td>March</td>
<td>7.87</td>
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<tr>
<td>April</td>
<td>7.87</td>
</tr>
<tr>
<td>May</td>
<td>7.87</td>
</tr>
<tr>
<td>June</td>
<td>7.87</td>
</tr>
<tr>
<td>July</td>
<td>7.87</td>
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<tr>
<td>August</td>
<td>7.87</td>
</tr>
<tr>
<td>September</td>
<td>7.87</td>
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<tr>
<td>December</td>
<td>7.87</td>
</tr>
<tr>
<td>Total</td>
<td></td>
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</table>

**Digestible Protein**

<table>
<thead>
<tr>
<th>Month</th>
<th>Requirement For</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>January</td>
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<td>November</td>
<td>.64</td>
</tr>
<tr>
<td>December</td>
<td>.64</td>
</tr>
</tbody>
</table>

\(^a\)Source: L. A. Maddox (19).

\(^b\)This table assumes that the cow is bred to calve in April and will wean a 400 pound calf in November.

\(^c\)The requirements for the calf are those above what is received in the milk from the cow.
<table>
<thead>
<tr>
<th>Calf( ^c )</th>
<th>Requirement For Total Daily Requirement</th>
<th>Total Monthly Requirement</th>
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<tbody>
<tr>
<td></td>
<td>8.27</td>
<td>256.37</td>
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<td></td>
<td>8.61</td>
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<td>1.16</td>
<td>34.80</td>
</tr>
<tr>
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<td>1.25</td>
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</tr>
<tr>
<td></td>
<td>.66</td>
<td>20.46</td>
</tr>
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</table>
more than a dry cow. At the same time the digestible protein requirement has increased to 1.41 pounds per day, an increase of more than 100 percent.

These wide variations in nutrient needs throughout the year make it necessary to use more accurate figures than average yearly TDN and digestible protein to insure proper nutritional levels. While separating the cow's requirements into those needed while dry and those needed while in production does provide for a great deal more accuracy, this breakdown is not of much help in specifying the supply of nutrients from forages. For this reason it was decided to use a monthly breakdown of nutrient needs and supplies.

In calculating the total amount of TDN and digestible protein required in any one month, it is important to include also the number of replacements and bulls that will be required for the herd. In any herd the number of replacements needed will depend on the number of cows culled from the herd each year. The model is structured so as to allow for two competitive sources of replacements, raising or purchase of bred heifers. It is assumed in the model that if replacement heifers are raised it is necessary to raise three percent more than the number of cows culled because of death losses and other mishaps that occur during the production of a replacement. Just as the number of replacements depends on the number of cows culled from the herd, the number of bulls required depends on the number of cows in the herd. For purposes of planning it is assumed that one bull can service 25 cows or replacements.
Because it is desired to find the optimal number of beef cows on an individual farm, the nutritional coefficients for the beef herd and the assumptions stated above were embodied in the internal part of the linear programming matrix rather than in the resource column. Table 6 illustrates the structure used. The equations formulated to express these nutritional requirements and assumptions are stated as maximum restraints; thus the positive coefficients in these equations represent demands that must be satisfied by other activities in the model. Using this type of structure allows the beef cow activity to seek its optimal level. As it does so, it automatically adjusts the total nutrient requirement for each month.

Once the nutritional requirements have been adequately defined, attention can be turned to an even more complexing problem, "What is the most economical way to supply the needed nutrients?"

In pursuit of the answer to this question one must be conscious of the resource restrictions within which the optimization must be made. The two resource restrictions recognized by the model are land and labor. Because of the great diversity of land types or qualities in the areas of large beef cow production the land resource is divided into three separate restraints: Class A land, Class B land, and Class C land. Class A land is defined as land that can be continuously row cropped. Class B land is land that will be placed in a rotation with a cover crop, while Class C land must be maintained in permanent pasture. This formulation of the land restriction is identical to forming three separate restrictions.

The labor resource is also divided into several restrictions. For this resource there are nineteen different restraints, each restraint
Table 6. Structure used in linear programming model to represent the nutritional demands and other assumptions made about the beef cow herd.

<table>
<thead>
<tr>
<th>Rows</th>
<th>Replacements</th>
<th>Bull</th>
<th>Cow-Calf</th>
<th>Cull Cow Selling</th>
<th>Replacement Buying</th>
<th>Heifer Selling</th>
<th>Steer Selling</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDN-JA</td>
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<td>486</td>
<td>256</td>
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<td>241</td>
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<td></td>
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<tr>
<td>DP-JA</td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DP-D</td>
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<tr>
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<tr>
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<td>.16</td>
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<td>-1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>STEER</td>
<td>- .45</td>
<td>.45</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heif</td>
<td>- .45</td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BULLR</td>
<td>- 25</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The rows identified with "TDN-" are the equations for TDN each month of the year; the rows identified with "DP-" are the equations for digestible protein; the row identified with "C-COW" is the equation for cull cows; the row identified with "REP" is the equation for replacements; the row identified with "STEER" is the equation for steer feeder calves; the row identified with "HEIF" is the equation for feeder heifers; the row identified with "BULLR" is the bull requirement equation. All equations represent maximum restrictions.
representing a specific time period of the year. During the periods of peak labor utilization, spring and fall, the time period was specified to be a length of fifteen or sixteen days. This formulation of the labor restrictions recognizes that labor cannot be freely substituted among seasons or even among periods, i.e. labor must be used when it is available, it cannot be saved and used at a later time.

Within the framework of these resource restrictions, several alternative methods of furnishing the TDN and digestible protein required by the cow herd were formulated. The types of forages selected as alternatives for consideration in the model are ones adapted to the southern Iowa area. They included the following:

1. Kentucky Bluegrass,
2. Birdsfoot Trefoil,
3. Tall growing cool season grasses - smooth brome, orchardgrass, tall fescue and reed canarygrass,
4. Alfalfa-grass,
5. Crown Vetch,
6. Switchgrass,
7. Supplemental - sorghum-sudangrass, forage sorghum,
8. Silage production - corn, forage sorghum, and oats,
9. Miscellaneous - meadow aftermath, meadow aftermath with round bales, new seedlings, cornstalks, and grain sorghum stover.

Because of the different growth habits of these forages it is assumed that they will be grown as pure stands, except in the case of alfalfa. This allows the individual producer to make more effective use of his
forages by capitalizing on their different growth patterns. The simple species or simple mixture is also easier to manage than the complex mixture.

The grass, grass-legume, and supplemental types of forage were then placed under different types of management. This was done in an effort to make the nutrient flow from these forages more uniform than can be obtained by continuously grazing all forages. The types of management considered in the model were as follows:

1. Rotational grazing involves comparatively short periods of grazing for each field and a recovery period to allow more effective consumption of forage with less waste from trampling, fouling and selective grazing. This system permits the farmer to match grazing more adequately to the growth habit of forage species, condition of pasture and animal needs than does continuous grazing. This type of grazing also favors legume persistence.

2. Stockpiling for fall involves holding animals off the pasture until September or October. Cattle are then allowed to graze this growth through the fall and winter months. This type of management serves as an alternative to feeding cattle harvested hay during these periods.

3. Three-season grazing system resembles the rotational grazing system but is used primarily for the tall growing cool season grasses. Applying this system to cool season grasses, grazing is begun in April and continued until June or July. The cattle are then removed during the summer months and replaced either in September or October for fall grazing. This
allows for the utilization of these forages when growth is rapid and quality is high.

4. Harvesting one to three crops and grazing the regrowth. This type of management allows for storing of high quality excess forage during peak production periods to be used during periods of low production. Depending on the number of crops harvested and the species of forage, the regrowth could be used for grazing during summer or fall.

5. Harvesting one or two crops for storage and harvesting second or third crop as small or large round bales to be grazed with aftermath. This type of management allows for storing the excess forage and also increases the amount of forage available for grazing during the fall through the use of round bales.

6. Continuous grazing was included because of its wide usage and applicability to the growth patterns of certain forages. This system of management involves placing cattle on pasture during spring and remaining there until fall.

7. Alternate grazing is very similar to the three-season type grazing except the grazing season does not span three seasons of the year. This type of management was used for annual supplemental pastures such as sorghum sudan. Using this grazing management, sorghum sudan is grazed during the summer months of July, August and September. The cow herd is then removed from the pasture until November when it is again allowed to graze the sorghum sudan.

While the management practices listed above deal with the distribution of the forage, the level of fertilizer will affect the quantity available
for distribution. This is particularly true for cool season grasses and levels of nitrogen application as evidenced by grazing studies in Southern Iowa. These studies have shown that beef output per acre can be doubled in bluegrass pasture by applying 60 pounds of nitrogen and 9 pounds of phosphorus (20 pounds of $P_2O_5$) per acre (1). Fertilizer application rates used for the linear programming model assume all renovated pastures will receive the fertilizer necessary for yield maintenance. For the widely utilized cool season grasses, orchardgrass, smooth brome, reed canarygrass, and Kentucky bluegrass, two fertilizer levels are considered because of their response to nitrogen fertilizer. The assumed fertilizer application rates are given in Table 7.

Combinations of these three factors were used to develop the alternative forage production activities in the model. For each alternative forage production activity there is an assumed monthly distribution of nutrients determined by the type of forage, type of management and fertilization level. The forage production alternatives and their distributions are presented in Appendix B.

The structure used to reflect the nutrient availability from the perennial forage production activities is illustrated in Table 8. Each perennial forage production activity has a unique nutrient distribution that is connected to the cow-calf production activities by means of the TDN and digestible protein equations. Since these equations have been formulated as maximum restrictions, the negative coefficients in these equations imply that these activities are nutrient sources. If the supply of nutrients should exceed the demand during the grazing season, it is
possible to store the excess in the form of baled hay. This hay is then fed as the need arises by a series of feeding activities. A similar structure is applied to the other types of perennial forages considered in the model to give the many alternative perennial forage production activities.

Table 7. Fertilizer rates in pounds per acre needed to maintain yields for perennial forages

<table>
<thead>
<tr>
<th>Forage Types</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa-grass</td>
<td>0</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Birdsfoot Trefoil</td>
<td>0</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Crown Vetch</td>
<td>0</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>Kentucky Bluegrass (low level)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kentucky Bluegrass (high level)</td>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Orchardgrass (low level)</td>
<td>120</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Orchardgrass (high level)</td>
<td>240</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Reed Canarygrass (low level)</td>
<td>120</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Reed Canarygrass (high level)</td>
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<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Smooth Brome (low level)</td>
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<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Smooth Brome (high level)</td>
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<td>40</td>
</tr>
<tr>
<td>Switchgrass</td>
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</tr>
<tr>
<td>Tall Fescue</td>
<td>240</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

It should be pointed out that perennial forage production was not considered an alternative on all classes of land. The alternative crop production activities on Class A land are restricted to row crops: corn, soybeans, grain sorghum, and high producing supplemental forages such as forage sorghum and sorghum sudan. Any forage produced on Class A land comes from the harvest or grazing of crop residues, supplemental pastures or corn silage. The major crop residue given consideration in the model
Table 8. Illustration of the structure used to reflect the monthly nutrient availability of perennial forages.

<table>
<thead>
<tr>
<th>Rows</th>
<th>OG1CG</th>
<th>OG13S</th>
<th>OGH21</th>
<th>ORBO1</th>
<th>ORBN1</th>
<th>ORBD1</th>
<th>OLBO1</th>
<th>OLBN1</th>
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<td>-95</td>
<td>-109</td>
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*Example uses orchardgrass as the type of forage, similar structure is used for all other perennial forages.*

*For meaning of activity and row names see Table 9.*
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<th>OG2H2</th>
<th>OG2H1</th>
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Table 9. Meaning of Table 8 abbreviated activity and row names

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<tr>
<th>Activity/Row Name</th>
<th>Description</th>
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<tr>
<td>OG1CG</td>
<td>continuous grazing of orchardgrass with 120 pounds of nitrogen applied per acre</td>
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<tr>
<td>OG13S</td>
<td>3-season grazing of orchardgrass with 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OGH21</td>
<td>harvesting two crops of orchardgrass hay for storage with 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>ORB01-ORB01</td>
<td>harvesting one crop of orchardgrass hay for storage and a second as small round bales to be grazed with the regrowth during the winter, 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OLB01-OLB01</td>
<td>harvesting one crop of orchardgrass hay for storage and a second as large round bales to be grazed with the regrowth during the winter, 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OG23S</td>
<td>3-season grazing of orchardgrass with 240 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OG2H2</td>
<td>harvesting two crops of orchardgrass hay for storage with 240 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OG1H1</td>
<td>harvesting one crop of orchardgrass hay for storage with 240 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OGRB2</td>
<td>harvesting one crop of orchardgrass hay for storage and a second as small round bales to be grazed with the regrowth during the winter, 240 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OGHJ-OGHD</td>
<td>feeding a ton of orchardgrass hay during each month of the year</td>
</tr>
<tr>
<td>Land B restraint</td>
<td>restraint on Class B land</td>
</tr>
<tr>
<td>TDN-JA-TDN-D</td>
<td>equations representing the TDN requirements and supplies</td>
</tr>
<tr>
<td>DP-JA-DP-D</td>
<td>equations representing the digestible protein requirements and supplies</td>
</tr>
<tr>
<td>OGH</td>
<td>equation expressing the availability of orchardgrass hay for feeding</td>
</tr>
</tbody>
</table>
is corn stock refuse. Activities were developed to allow for the grazing or harvest of cornstalks. If cornstalks are grazed, activities permit grazing the complete fall or only a portion of the fall. If grazed only a portion of the fall or harvested, the ground can be fall tilled for next year's crop. If grazed all fall, the tillage must take place in the spring.

Table 10 illustrates the structure used to represent the nutrients produced for corn silage and corn refuse. These forage production activities are another source of TDN and digestible protein for the cow herd; thus the negative coefficients in the TDN and digestible protein equations.

The other sources of forage production on Class A land include grain sorghum stubble grazing forage sorghum deferred fall grazing, sorghum sudan alternate grazing, and sorghum sudan deferred fall grazing. The structure used for grain sorghum stubble grazing and forage sorghum silage is similar to the structure of cornstalk grazing and silage harvesting. The structure of the forage sorghum and sorghum sudan grazing activities is similar to the structure used for the perennial forages.

Activities allowing for alternative timing of row cropping operations have been included in the model, activities such as CH01 and CH02 in Table 10. This allows some choice as to when an operation is undertaken and also some flexibility should labor become extremely restrictive in any time period. Alternative timeliness activities are allowed for plowing and planting as well as harvesting. It is assumed, however, that all operations will be completed in time to deter any yield reductions.
Table 10. Structure used to provide for nutrients supplied by corn

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<th>CSSH1</th>
<th>CSSH2</th>
<th>CSG1</th>
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*aFor meaning of activity and row names see Table 11.
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<th>CSSHFJ...CSSHD</th>
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Table 11. Meaning of Table 10 abbreviated activity and row names

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<td>Corn grain harvesting October 1-15</td>
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<tr>
<td>CH02</td>
<td>Corn grain harvesting October 16-30</td>
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<tr>
<td>CSH1</td>
<td>Cornstalk harvesting with flail chopper October 1-15</td>
</tr>
<tr>
<td>CSH2</td>
<td>Cornstalk harvesting with flail chopper October 16-30</td>
</tr>
<tr>
<td>CSSH1</td>
<td>Cornstalk harvesting with stakhand November 1-15</td>
</tr>
<tr>
<td>CSSH2</td>
<td>Cornstalk harvesting with stakhand November 16-30</td>
</tr>
<tr>
<td>CSG1-</td>
<td>Cornstalk grazing beginning October, November or December</td>
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<td>CSG3</td>
<td>Transfer for cornstalks directly to fall plowing</td>
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<td>CGO1</td>
<td>Cornstalk grazing during October 16-31 and then fall plowing</td>
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<tr>
<td>CSL1</td>
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<tr>
<td>CSL2</td>
<td>Corn silage harvest September 16-30</td>
</tr>
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<td>CSFD</td>
<td>Monthly activities for feeding cornstalks harvested with a flail chopper.</td>
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<tr>
<td>CSSHFD</td>
<td>Monthly activities for feeding cornstalk harvested with a stakhand.</td>
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<td>CSJ and CSD</td>
<td>Monthly activities for feeding corn silage</td>
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<td>Labor restraint for October 16-31</td>
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<td>L-N1</td>
<td>Labor restraint for November 1-15</td>
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<td>Labor restraint for November 16-31</td>
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<td>SCA</td>
<td>Equation representing the availability of mature unharvested corn</td>
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<td>Equation representing the availability and use of cornstalks during the</td>
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<td>Restraint on the dry matter capacity of the silo</td>
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Table 11 continued

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<th>HCSSH</th>
<th>equation representing the availability and use of cornstalks harvested with a stakhand</th>
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<tbody>
<tr>
<td>TDN-JA-</td>
<td>equations representing the TDN and digestible protein requirements and supplies</td>
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</tr>
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<td>equation representing the acres of cornstalks that could be fall plowed during the October 16-31 period</td>
</tr>
<tr>
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<td>equation representing the acres of cornstalks that could be fall plowed during the November 1-15 period</td>
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Table 12. Example of structure used in determining yearly renovation acres

<table>
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<th>OG13S</th>
<th>CGH21</th>
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<tr>
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</tr>
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</tr>
<tr>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. For meaning of activity and row names see Table 13.
<table>
<thead>
<tr>
<th>AGH2</th>
<th>AGH3</th>
<th>AGRP</th>
<th>OATP</th>
<th>OATGA</th>
<th>OATSA</th>
<th>OATHA</th>
<th>OATGO</th>
<th>OATSO</th>
<th>OATHO</th>
</tr>
</thead>
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<td></td>
<td></td>
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<td>-33</td>
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<td></td>
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<td>-0.7</td>
<td>-6.11</td>
<td>-1.03</td>
<td>-1.03</td>
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Table 13. Meaning of Table 12 abbreviated activity and row names

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OG10G</td>
<td>continuous grazing orchardgrass with 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OG13S</td>
<td>3-season grazing orchardgrass with 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OGH21</td>
<td>harvesting two crops of orchardgrass hay for storage and grazing the regrowth in fall; 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>CRBO1-CLBD1</td>
<td>harvesting one crop of orchardgrass hay for storage and the second as round bales to be grazed during the winter with the regrowth; 120 pounds of nitrogen applied per acre</td>
</tr>
<tr>
<td>OGRP</td>
<td>orchardgrass renovation</td>
</tr>
<tr>
<td>AGRG</td>
<td>rotational grazing alfalfa-grass</td>
</tr>
<tr>
<td>AGH1</td>
<td>harvesting one crop of alfalfa-grass hay for storage and grazing the regrowth</td>
</tr>
<tr>
<td>AGH2</td>
<td>harvesting two crops of alfalfa-grass hay for storage and grazing the regrowth</td>
</tr>
<tr>
<td>AGH3</td>
<td>harvesting three crops of alfalfa-grass hay for storage and grazing the regrowth</td>
</tr>
<tr>
<td>AGRP</td>
<td>alfalfa-grass renovation</td>
</tr>
<tr>
<td>OATGA</td>
<td>harvesting oats as grain on alfalfa-grass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>OATSA</td>
<td>harvesting oats as silage on alfalfa-grass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>OATHA</td>
<td>harvesting oats as hay on alfalfa-grass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>OATGC</td>
<td>harvesting oats as grain on orchardgrass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>OATSO</td>
<td>harvesting oats as silage on orchardgrass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>OATHO</td>
<td>harvesting oats as hay on orchardgrass renovated acres and grazing regrowth</td>
</tr>
<tr>
<td>Land B</td>
<td>Class B land restraint</td>
</tr>
<tr>
<td>TDN-JA-DP-D</td>
<td>equations representing the TDN and digestible protein requirements and supplies</td>
</tr>
</tbody>
</table>
Table 13 continued

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OGR</td>
<td>equation representing the amount of yearly orchardgrass renovation needed</td>
</tr>
<tr>
<td>NCR</td>
<td>equation representing nurse crop requirements</td>
</tr>
<tr>
<td>SOGR</td>
<td>equation expressing the alternative methods of utilizing oats produced on renovated orchardgrass acreage</td>
</tr>
<tr>
<td>AGR</td>
<td>equation representing the amount of yearly alfalfa-grass renovation needed</td>
</tr>
<tr>
<td>SAG</td>
<td>equation expressing the alternative methods of utilizing oats produced on renovated alfalfa-grass acreage</td>
</tr>
<tr>
<td>OG</td>
<td>equation representing oat grain production and utilization</td>
</tr>
<tr>
<td>STR</td>
<td>equation representing straw production and utilization</td>
</tr>
<tr>
<td>OS</td>
<td>equation representing oat silage production and utilization</td>
</tr>
<tr>
<td>OH</td>
<td>equation representing oat hay production and utilization</td>
</tr>
</tbody>
</table>
The cropping alternatives considered on Class B land includes all the row crop activities considered on Class A plus the perennial forage production activities. In order to more accurately reflect the type of cropping practices that can be undertaken on this land class, a maximum restraint has been placed on the quantity of row crops allowable. Since the plan derived is normative in nature, it is assumed to be repeated each year; thus the restriction on the row crops can be interpreted as being the maximum number of row crop acres in any one year.

The repetitive nature of the plan also makes it necessary to determine how many acres of perennial forages must be renovated each year. This determination is very important in making an economic decision about which forages will supply the needed nutrients at the lowest cost. Table 12 represents the structure used for determining the acres that must be renovated each year. All equations contained in Table 12 are formulated as maximum restrictions. With this type of restraint, the negative coefficients in the renovation equations, orchardgrass renovation (OCR) and alfalfa-grass renovation (AGR) represent the productive life of the forage. However, since the planning horizon is assumed to be one year in length, the productive life of the forage can be interpreted as the maximum number of acres of forage in production for each acre of renovation. It is this interpretation that was used in developing the renovation equations in the model. This formulation also allows for the simplification of the forage cost calculations. Because yearly expenses are always being deducted from yearly incomes it is not necessary to compound the costs in forage production.
Table 14. Structure used to represent the restraints on Class A and B land

<table>
<thead>
<tr>
<th>Rows $^b$</th>
<th>Activities $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Land 1</td>
<td>50</td>
</tr>
<tr>
<td>Land 2</td>
<td>150</td>
</tr>
<tr>
<td>Land A</td>
<td></td>
</tr>
<tr>
<td>Land B</td>
<td></td>
</tr>
<tr>
<td>BMAX</td>
<td></td>
</tr>
<tr>
<td>MAXRC</td>
<td></td>
</tr>
<tr>
<td>BMAXB</td>
<td></td>
</tr>
</tbody>
</table>

$^a$Meaning of abbreviated activity names:

- Land A activity that specifies the amount of Class A land available for crop production and the maximum restraint on soybean production.
- Land B activity that specifies the amount of Class B land available for crop production and the maximum restraints on row crops and soybeans.

$^b$Meaning of abbreviated row names:

- Land 1 equation representing the restriction on Class A land.
- Land 2 equation representing the restriction on Class B land.
- Land A equation representing the supply of Class A land that can be used for crop production.
- Land B equation representing the supply of Class B land that can be used for crop production.
- BMAX equation representing the maximum soybean production on Class A land.
- MAXRC equation representing the maximum row crop production on Class B land.
- BMAXB equation representing the maximum soybean production on Class B land.
The nurse crop equation assumes that oats will be used as a nurse crop whenever a perennial forage is renovated. The oats grown on the renovated acres can be harvested in any of three different ways, as grain and straw, silage or hay. The straw, silage and hay can be fed to the cow herd through a series of feeding activities. The model also provides the option for straw being sold along with the grain. After the oat crop has been harvested a low level of grazing is permitted.

In addition to the row crop restraint on Class B land there is also a cropping restraint placed on the number of soybeans produced on Class A and B land. Since the marginal value of land in each of these land classes is a function of these restrictions, two activities were used to represent these restrictions rather than placing them in the resource column. An example of the structure utilized for restraining the proportion of Class A land in soybeans and Class B land in row crops and soybeans is shown in Table 14. This example assumes that soybeans can be grown on only fifty percent of the row crop land, and row crop production on Class B land must be restricted to fifty acres per year. The activity unit for both the Land A and Land B activities is defined to be one acre; thus the restrictions on soybeans and row crops must also be expressed on a per acre basis. This can be done by dividing the maximum level of each restriction by the number of acres in each land class. An example of such a coefficient would be the one found in the BMAXB equation. This coefficient is calculated as follows:

\[
\frac{\text{Maximum soybean production Class B}}{\text{Total Class B land}} = \frac{25}{150} = .167
\]
Since all equations in this figure are maximum restrictions this coefficient will have a negative sign in the model representing the fact that for each acre of Class B land used in crop production we are permitted .167 acres of soybeans.

The long lived perennial forages Kentucky Bluegrass, Crown Vetch, and Birdsfoot Trefoil are the only production alternatives considered on Class C land. The structure utilized for these forages is the same as that discussed for the Class B perennial forage alternatives.
METHODOLOGY AND ASSUMPTIONS USED FOR INDIVIDUALIZATION OF THE MODEL

The computerized procedure used to derive individualized solutions is a three step program. The first step involves a FORTRAN source program that generates new resource and technical coefficients for each farm. The second step requires the use of these generated coefficients in the revision and reoptimization of the model by the MPSX routine. Step three consists of the use of another FORTRAN source program to report the results in a manner that can be easily understood by farmers.

The special input form designed to collect the information needed for individualization of the prestructured model is found in Appendix C. This information can be directly punched onto cards and utilized by the first FORTRAN program for generation of new resource and technical coefficients. These forms have been divided into fourteen different sections, each relating to a specific aspect of the farm business.

Section 1 specifies the land and facility resources available on each farm. The individual land restraints in the model are specified using the information contained in questions one, four and nine. The maximum acres of soybeans is used to restrict their production level. This restriction is placed in the model to allow for the disease preventative measure of growing soybeans in rotation with other annual crops.

This section also provides for restraints on size of the beef herd. The shelter capacity provides for an upper limit, while the size of the beef herd that must be maintained based on a subjective criterion constitutes the lower limit. If these two restraints are set at the same level,
the size of the beef herd can be specified exactly by the individual operator.

It is also possible to nullify either one or both of these restrictions by the response given to these two questions. The capacity restriction can be made nonrestrictive if answered with a large number while the minimum restriction can be abolished by specifying a zero for the size of beef herd that must be maintained.

The yields specified in Section 2 and 3, as stated, should represent the average yields expected from each crop. These yields should reflect the normal weather and cropping conditions that the individual farmer has experienced. In cases where farmers do not wish to consider a particular crop or type of forage among their alternatives, a yield of zero should be entered. The yields in Section 3 are used for calculating the distribution of the TDN and digestible protein for crop residues and supplemental forages. The potential yields given in this section are reduced to reflect losses during grazing or harvesting. The assumed grazing and harvest efficiencies are given in Table 15.

Table 15. Grazing and harvesting efficiencies assumed in calculating the nutrient availability of supplemental forages and crop refuse

<table>
<thead>
<tr>
<th>Crop</th>
<th>Percent Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornstalks grazed</td>
<td>15.0</td>
</tr>
<tr>
<td>Cornstalks harvested (flail)</td>
<td>45.0</td>
</tr>
<tr>
<td>Cornstalks harvested (stakhand)</td>
<td>55.0</td>
</tr>
<tr>
<td>Forage sorghum stockpiled for fall</td>
<td>40.0</td>
</tr>
<tr>
<td>Forage sorghum stubble</td>
<td>45.0</td>
</tr>
<tr>
<td>Grain sorghum stubble</td>
<td>35.0</td>
</tr>
<tr>
<td>Sorghum sudan alternate graze</td>
<td>55.0</td>
</tr>
<tr>
<td>Sorghum sudan stockpile fall</td>
<td>40.0</td>
</tr>
</tbody>
</table>
Table 16. Grazing and harvesting efficiencies assumed in calculating the nutrient availability of perennial forages

<table>
<thead>
<tr>
<th>Forage Description</th>
<th>Percent Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa-grass rotational graze</td>
<td>65.0</td>
</tr>
<tr>
<td>Alfalfa-grass grazing regrowth after harvest</td>
<td>60.0</td>
</tr>
<tr>
<td>Birdsfoot Trefoil grazing</td>
<td>65.0</td>
</tr>
<tr>
<td>Crown Vetch continuous grazing</td>
<td>60.0</td>
</tr>
<tr>
<td>Kentucky Bluegrass continuous grazing</td>
<td>60.0</td>
</tr>
<tr>
<td>Kentucky Bluegrass 3-season grazing</td>
<td>65.0</td>
</tr>
<tr>
<td>Orchardgrass continuous grazing and grazing of regrowth after harvest</td>
<td>60.0</td>
</tr>
<tr>
<td>Orchardgrass 3-season grazing</td>
<td>65.0</td>
</tr>
<tr>
<td>Reed Canarygrass continuous grazing and grazing of regrowth after harvest</td>
<td>55.0</td>
</tr>
<tr>
<td>Reed Canarygrass 3-season grazing</td>
<td>58.0</td>
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<tr>
<td>Smooth Brome continuous graze and grazing of regrowth after harvest</td>
<td>64.0</td>
</tr>
<tr>
<td>Smooth Brome 3-season graze</td>
<td>69.0</td>
</tr>
<tr>
<td>Tall Fescue grazing regrowth after harvest</td>
<td>52.0</td>
</tr>
<tr>
<td>Tall Fescue 3-season graze</td>
<td>57.0</td>
</tr>
<tr>
<td>Alfalfa-grass harvested for hay</td>
<td>75.0</td>
</tr>
<tr>
<td>Birdsfoot Trefoil harvested for hay</td>
<td>75.0</td>
</tr>
<tr>
<td>Orchardgrass harvested for hay</td>
<td>70.0</td>
</tr>
<tr>
<td>Reed Canarygrass harvested for hay</td>
<td>70.0</td>
</tr>
<tr>
<td>Smooth Brome harvested for hay</td>
<td>73.0</td>
</tr>
<tr>
<td>Tall Fescue harvested for hay</td>
<td>68.0</td>
</tr>
<tr>
<td>Alfalfa-grass&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>47.0</td>
</tr>
<tr>
<td>Alfalfa-grass&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>64.0</td>
</tr>
<tr>
<td>Birdsfoot Trefoil&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>47.0</td>
</tr>
<tr>
<td>Birdsfoot Trefoil&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>64.0</td>
</tr>
<tr>
<td>Orchardgrass&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>50.0</td>
</tr>
<tr>
<td>Orchardgrass&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>69.0</td>
</tr>
<tr>
<td>Reed Canarygrass&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>49.0</td>
</tr>
<tr>
<td>Reed Canarygrass&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>67.0</td>
</tr>
<tr>
<td>Smooth Brome&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>50.0</td>
</tr>
<tr>
<td>Smooth Brome&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>69.0</td>
</tr>
<tr>
<td>Tall Fescue&lt;sup&gt;b&lt;/sup&gt; small round bales</td>
<td>46.0</td>
</tr>
<tr>
<td>Tall Fescue&lt;sup&gt;b&lt;/sup&gt; large round bales</td>
<td>64.0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Source: Lechtenberg, Parsons, Petritz, Smith (18), Taylor (30).

<sup>b</sup>The efficiencies for large round bales assume that cows are restricted in their access to these bales. The efficiencies for the small round bales assume that the field will be fenced into strips but cows will be given unrestricted access to the bales in each of these strips.
Sections 4, 5, 6 and 7 of the input deals with the alternate types of perennial forages and the managements an operator may wish to consider. The yields given are in terms of total dry matter available and thus must be adjusted for utilization efficiency when calculating available quantities of TDN and digestible protein. The grazing efficiencies used for these perennial forages are given in Table 16.

Section 8 asks the farmer to supply the prices he expects to pay or receive for his products. These prices should reflect the average net prices the farmer expects during the planning period he is considering. This means that the price of products sold should have the cost of transporting, if incurred by the producer, deducted from the quoted market price; similarly the cost of purchased products should include the cost of transporting to the farm. If the producer does not ordinarily buy or sell some of the products listed, the market value of these products should still be estimated and included.

Production costs and time requirements for the annual crops are reported in Section 9. If an operation listed is performed more than once, the total cost and time required to complete the operation should be specified, i.e. our plan assumes corn will be cultivated one and one-half times; thus the cost and labor figures provided represent the total requirements of performing this operation one and one-half times per year. The labor requirements specified should include only labor demanded from the fixed labor supply. Operations performed by a custom operator should have a labor coefficient of zero and the costs should appear in the "Custom
Hire” section. It is assumed that preharvest production operations undertaken on both classes of land are identical. However, a land class distinction can be made with regard to harvesting and "Other Variable Costs".

Section 10 provides the information pertaining to perennial forage production. The major cost items of perennial forages involve renovation and annual maintenance. The annual maintenance costs of the forages considered are listed in Part D of this section. These costs plus annual fertilizer expenses are combined to give the total maintenance cost. Estimates of cost and time requirements should be made for each maintenance operation, particularly fencing, since the assumed efficiency for grazing of small round bales includes the use of strip grazing.

Total renovation costs of each type of pasture includes seed and drilling. For purposes of calculating per acre seed cost, the seeding rates in Table 17 were assumed.

Table 17. Seeding rates for perennial forages

<table>
<thead>
<tr>
<th>Alfalfa-Grass</th>
<th>Pound Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa and Orchardgrass or Smooth Brome</td>
<td>8.0</td>
</tr>
<tr>
<td>Birdsfoot Trefoil</td>
<td>6.5</td>
</tr>
<tr>
<td>Crown Vetch</td>
<td>6.0</td>
</tr>
<tr>
<td>Kentucky Bluegrass</td>
<td>10.0</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>20.0</td>
</tr>
<tr>
<td>Crown Vetch</td>
<td>9.0</td>
</tr>
<tr>
<td>Reed Canarygrass</td>
<td>11.0</td>
</tr>
<tr>
<td>Smooth Brome</td>
<td>17.5</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>6.5</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>13.5</td>
</tr>
</tbody>
</table>
The costs and time requirements associated with harvesting and utilization of the perennial and crop residue forages are specified in Section 11. These cost and time requirements should represent the cost of performing the specified operation once, even though the operation is performed several times per year. If an operation is performed by a custom operator, the labor requirement entered should be zero and the cost placed in the "Machine Hire" section. Part D of Section 11 is used to specify the costs and labor requirements of the different feeding activities contained in the model.

Beef cow costs and information used for calculation of nutrient coefficients are given in Section 12. With information contained in the source program (Appendix A) it is possible to calculate the nutrient requirements for cows ranging in weight from 700 to 1600 pounds and calves weighing 300 to 600 pounds at weaning.

The information in Section 13 is used to define the fixed labor supply and the availability of hired labor. The total hours column is used to define the maximum restraints on the fixed labor supply and the hourly hired labor is used to place a maximum restriction hourly labor hired. This labor hired on an hourly basis may supplement the fixed labor supply. The amount of hired labor needed because the job requires more than one man is not restricted by these restraints.

Section 14 collects the information on fixed costs. While this information is not used in determining the optimal solution it is used in the output program in calculating the returns to management.
Because of the number of iterations that must be carried out to reach the optimal solution, the model with an optimal basis is stored on tape. This information is contained in OLDPFILE of the MPSX routine and when used with the RESTORE REVISE, and SAVE routines the resource and technological coefficients can be changed and reoptimization begun several iterations closer to the optimal solution than the original starting point of zero production. The data needed for the revisions is generated by Step 1 and is stored temporarily on disk. The MPSX program then reads this information and uses it to modify the previously structured model to reflect the individual programming situation. The solutions obtained from the model are also temporarily stored on disk until they are read by the report writer program.
EXAMPLE OUTPUT FROM PRODUCER ORIENTATED MODEL

To illustrate the information obtainable from the program a hypothetical farm unit was constructed. This unit is assumed to be composed of 50 acres of Class A land, 375 acres of Class B land, and 75 acres of Class C land. Row crop production on Class B land is restricted to one-third of the available acreage, 125 acres. For both Class A and B land soybean production will be restricted to approximately one-half of the row crop acreage. The costs, labor requirements and available resources assumed for this unit are specified in the input forms under "Our Plan".

The optimal level of beef production derived for this unit includes 164.12 cows, 6.56 bulls and 21.15 head of replacements. To meet the nutritional demands of this herd the optimal levels of crop production shown in Table 18 were prescribed. Total hay production included 52.18 acres of alfalfa-grass harvested twice with the regrowth stockpiled for fall grazing, 19.53 acres of alfalfa-grass harvested three times and 24.06 acres of tall fescue harvested twice. Pasture production on Class B land was comprised of 22.91 acres of orchardgrass grazed under an early 3-season grazing management, 9.98 acres of birdsfoot trefoil continuously grazed, 74.97 acres of birdsfoot trefoil stockpiled for grazing during the summer and 3.02 acres of reed canarygrass grazed under a 3-season management. Continuously grazed birdsfoot trefoil composed the 68.18 acres of pasture that was produced on Class C land. It should be noted that all the cool season grasses included in this plan had nitrogen fertilizer applied at the 220 pound rate.
Table 18. Optimal crop acreages for each class of land contained in the solution using "Our Plan" data

<table>
<thead>
<tr>
<th>Class A land</th>
<th>Acres Produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>50.00</td>
</tr>
<tr>
<td>Class B Land</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>121.43</td>
</tr>
<tr>
<td>Soybeans</td>
<td>3.56</td>
</tr>
<tr>
<td>Oats and Straw</td>
<td>43.37</td>
</tr>
<tr>
<td>Hay</td>
<td>95.77</td>
</tr>
<tr>
<td>Pasture</td>
<td>110.88</td>
</tr>
<tr>
<td>Class C Land</td>
<td></td>
</tr>
<tr>
<td>Oats and Straw</td>
<td>6.82</td>
</tr>
<tr>
<td>Pasture</td>
<td>68.18</td>
</tr>
<tr>
<td>Total</td>
<td>500.00</td>
</tr>
</tbody>
</table>

In addition to the perennial forages produced for herd maintenance, the optimal program specified the utilization of cornstalks. Cornstalks produced on Class A land were utilized by grazing while those on Class B land were harvested prior to grazing. The fact that cornstalks were not fall plowed on Class A is one indication that labor availability is not a major problem during the spring field preparation periods. Thus more can be gained through grazing cornstalks than fall plowing.

Needless to say there were many forage production alternatives considered in the model that did not enter the optimal plan. For each of these alternatives there is associated a penalty. These penalties are reported on Page 5 of the output contained in Appendix E. They indicate the amount of income sacrificed by including an acre of the rejected alternative in the plan. In evaluating these penalties it is important to remember first, that these are the minimal reductions in returns that will
be incurred by the inclusion of a rejected alternative, i.e. reductions will be even higher if appropriate adjustments are not made in the activities initially in the plan. Since the adjustments leading to these minimal losses are very specific and have not been provided in the output report, inclusion of any rejected forage alternative by farmers will usually result in a larger reduction in income than reported by the penalty. Second, these figures do not say that inclusion of a rejected activity is unprofitable. Instead the penalties reflect the fact that the alternatives which have been selected provide an optimal forage plan and any deviation from this optimum will reduce the estimated income.

The returns generated in this plan include $32,992.65 from corn production, $621.98 from bean production, $2,977.11 from oat production, $1,163.57 from straw production, $5,128.61 from cull cows, $14,955.03 from the sale of steer calves, and $9,183.51 from the sale of heifer calves for a total of $67,022.47. The expenses incurred include $3,574.32 for fuel oil and repairs, $9,497.12 for fertilizer, $1,221.36 for herbicide, $514.29 for insecticides, $2,261.76 for seed, $363.98 for corn drying, $149.24 for machine hire, $4,589.68 in livestock expenses, $358.99 in feeding expenses, $1,112.20 for hired labor, $581.26 in other variable costs and $1,010.35 in interest on variable costs, a total of $25,232.53. The return over variable cost amounted to $41,789.94. A return to management of $6,004.43 was calculated by subtracting fixed crop and livestock expenses, fixed labor expense and land expenses.

As illustrated in Table 18 the total amount of land available in each class was used to the fullest extent possible. Because of this fact a
shadow price of greater than zero is reported for each of the three land resource restraints, $150.18, $78.15, $45.81 respectively for Class A, B, and C land. These shadow prices represent the marginal value product of the different land classes and provided insights into possible gains in income that can be made by acquiring larger quantities of the scarce resource. While it is not possible to know exactly over what range of acreages the marginal value products will remain at these levels, it is possible to make some estimate of the path they will follow by observing the levels of other resource utilizations. Table 19 reports utilization of the labor resource and illustrates that there is excess labor in many of the time periods. Thus it could be assumed that the marginal value product of land would remain fairly constant as the land acreage is increased.

The solution also determines when the stored forage should be fed and the return from the last pound of total digestible nutrients or digestible protein required by the feed herd. Table 20 represents how the stored feed was utilized. It can be seen that stored forage was resorted to during periods of year when it was not possible to graze enough forage to meet the herd's needs.

The quantity of TDN needed by the herd is given in Table 21. In all months but October the TDN requirements were just met, thus the shadow prices reported for these months are all greater than zero. These shadow prices report the marginal value product of TDN and provide insights into the profitability of acquiring TDN from purchased forages. To make such a comparison it is necessary to assume a dry matter and total digestible
nutrient percentage for the forage being considered. Using alfalfa-grass hay as an example these percentages would be 62.0 percent and 15.0 percent respectively. Thus in a ton of this hay there would provide 1,240.00 pounds of TDN. Using the return figure for April a ton of this hay would add approximately $47.12 to income.

Table 19. Labor utilization in the optimal program using "Our Plan"

<table>
<thead>
<tr>
<th>Period</th>
<th>Fixed Labor Utilized</th>
<th>Total Fixed Labor Supply</th>
<th>Hourly Hired Labor</th>
<th>Marginal Value Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>104.60</td>
<td>212.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>131.50</td>
<td>192.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March 1-15</td>
<td>86.61</td>
<td>115.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March 16-31</td>
<td>113.12</td>
<td>123.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April 1-15</td>
<td>128.57</td>
<td>128.57</td>
<td>128.57</td>
<td>2.50</td>
</tr>
<tr>
<td>April 16-30</td>
<td>128.57</td>
<td>128.57</td>
<td>15.98</td>
<td>2.50</td>
</tr>
<tr>
<td>May 1-15</td>
<td>106.12</td>
<td>154.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 16-31</td>
<td>40.56</td>
<td>164.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 1-15</td>
<td>154.29</td>
<td>154.29</td>
<td>28.73</td>
<td>2.50</td>
</tr>
<tr>
<td>June 16-30</td>
<td>96.40</td>
<td>154.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>149.79</td>
<td>318.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>62.17</td>
<td>239.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 1-15</td>
<td>23.45</td>
<td>128.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 16-30</td>
<td>26.31</td>
<td>128.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 1-15</td>
<td>26.14</td>
<td>128.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 16-31</td>
<td>137.14</td>
<td>137.14</td>
<td></td>
<td>2.38</td>
</tr>
<tr>
<td>November 1-15</td>
<td>128.57</td>
<td>128.57</td>
<td></td>
<td>1.82</td>
</tr>
<tr>
<td>November 16-30</td>
<td>20.45</td>
<td>128.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>168.07</td>
<td>257.14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 20. Tons of stored forage fed to beef herd

<table>
<thead>
<tr>
<th>Month</th>
<th>Type of Forage</th>
<th>Tall Fescue</th>
<th>Flailed Cornstalks</th>
<th>Stakhand Cornstalks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alfalfa-grass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>55.80</td>
<td>0.00</td>
<td>79.02</td>
<td>29.86</td>
</tr>
<tr>
<td>February</td>
<td>36.67</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>March</td>
<td>0.00</td>
<td>95.56</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>April</td>
<td>85.59</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>May</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>June</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>July</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>August</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>September</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>October</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>November</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>December</td>
<td>12.12</td>
<td>5.74</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Table 21. Monthly total digestible nutrients required by beef herd

<table>
<thead>
<tr>
<th>Month</th>
<th>TDN Required</th>
<th>Excess TDN</th>
<th>Marginal Value Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>59,801.57</td>
<td>0.00</td>
<td>.035</td>
</tr>
<tr>
<td>February</td>
<td>49,476.88</td>
<td>0.00</td>
<td>.035</td>
</tr>
<tr>
<td>March</td>
<td>73,138.54</td>
<td>0.00</td>
<td>.035</td>
</tr>
<tr>
<td>April</td>
<td>68,337.39</td>
<td>0.00</td>
<td>.038</td>
</tr>
<tr>
<td>May</td>
<td>84,762.52</td>
<td>0.00</td>
<td>.034</td>
</tr>
<tr>
<td>June</td>
<td>77,262.63</td>
<td>0.00</td>
<td>.029</td>
</tr>
<tr>
<td>July</td>
<td>84,735.00</td>
<td>0.00</td>
<td>.016</td>
</tr>
<tr>
<td>August</td>
<td>86,827.27</td>
<td>0.00</td>
<td>.028</td>
</tr>
<tr>
<td>September</td>
<td>86,111.99</td>
<td>0.00</td>
<td>.029</td>
</tr>
<tr>
<td>October</td>
<td>50,941.70</td>
<td>25,979.02</td>
<td>.000</td>
</tr>
<tr>
<td>November</td>
<td>52,265.58</td>
<td>0.00</td>
<td>.027</td>
</tr>
<tr>
<td>December</td>
<td>52,265.58</td>
<td>0.00</td>
<td>.035</td>
</tr>
</tbody>
</table>
Comparison of Optimal Solutions

In order to provide the producer information on how the plan would be altered with changes in the feeder calf price two additional solutions are included in the output. One reports on a solution with feeder calf price fifteen percent higher than in the original solution, the other with feeder calf prices fifteen percent lower. For purposes of the following discussion Solution 1 will refer to the solution with feeder calf prices at their original level, Solution 2 assumes feeder calves will be fifteen percent higher and Solution 3 assumes feeder calf prices fifteen percent lower than in Solution 1.

Table 22 illustrates the types of changes that will take place in crop acreages under these three plans.

Table 22. Optimal crop acreages in each solution using "Our Plan" data

<table>
<thead>
<tr>
<th>Class</th>
<th>Solution 1</th>
<th>Solution 2</th>
<th>Solution 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class A Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>50.00</td>
<td>40.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>0.00</td>
<td>9.92</td>
<td>0.00</td>
</tr>
<tr>
<td>Class B Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>121.43</td>
<td>124.99</td>
<td>124.99</td>
</tr>
<tr>
<td>Soybeans</td>
<td>3.56</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Oats and Straw</td>
<td>43.37</td>
<td>38.94</td>
<td>96.92</td>
</tr>
<tr>
<td>Hay</td>
<td>95.77</td>
<td>101.21</td>
<td>95.31</td>
</tr>
<tr>
<td>Pasture</td>
<td>110.88</td>
<td>109.86</td>
<td>57.78</td>
</tr>
<tr>
<td>Class C Land</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats and Straw</td>
<td>6.82</td>
<td>6.82</td>
<td>6.82</td>
</tr>
<tr>
<td>Pasture</td>
<td>68.18</td>
<td>68.18</td>
<td>68.18</td>
</tr>
<tr>
<td>Total</td>
<td>500.00</td>
<td>500.00</td>
<td>500.00</td>
</tr>
<tr>
<td>Marginal value product for each class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class A</td>
<td>150.18</td>
<td>154.51</td>
<td>150.51</td>
</tr>
<tr>
<td>Class B</td>
<td>78.15</td>
<td>89.24</td>
<td>70.68</td>
</tr>
<tr>
<td>Class C</td>
<td>45.81</td>
<td>59.66</td>
<td>34.78</td>
</tr>
</tbody>
</table>
As is shown in this table the price rise in Solution 2 caused a shift to a crop system that would support a larger beef cow herd. The optimal size of the beef herd in Solution 2 was comprised of 194.91 cows and 7.80 bulls, replacements were purchased rather than raised. The price decline that occurred in Solution 3 caused a shift to less forage intensive cropping practices and the beef herd was composed of 139.74 cows, 5.59 bulls and 18.01 replacements.

It should also be noted that changes took place with respect to the type of hay and pastures produced. These changes are indicated on Page 5 of each solution. In general as the price of feeder calves increases production is shifted to include more of the high yielding cool season grasses, as price declines production shifts to a large proportion of legume forages.

Changes in the return and expense picture are illustrated in Table 23. The return to management illustrates the fact that even though the price of feeder calves will vary fifteen percent the final return will have a much wider variation.

Comparison of labor utilization reflect the consequences of the different cropping systems in each of the plans. While the majority of the time periods have an excess quantity of labor it is necessary to hire extra hourly labor during spring planting in all three plans. Because of this there were very small changes in the marginal value product of labor for each of the periods. Such was not the case for the marginal value products of land. For the land classes with large acreages of perennial forages the marginal value products rose and fell with the value of feeder
cattle. This would be expected since a land producing these forages
derives its value from being utilized by the beef herd. This is in con-
trast with the value inputed to Class A land, which is derived primarily
from grain production.

Table 23. Comparison of the costs and returns for the solution contained
in the output report

<table>
<thead>
<tr>
<th>Returns</th>
<th>Solution 1</th>
<th>Solution 2</th>
<th>Solution 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>32,992.65</td>
<td>31,616.96</td>
<td>33,657.66</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>0.00</td>
<td>1,833.36</td>
<td>0.00</td>
</tr>
<tr>
<td>Soybeans</td>
<td>621.98</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Cattle</td>
<td>2,977.11</td>
<td>2,711.28</td>
<td>6,190.46</td>
</tr>
<tr>
<td>Straw</td>
<td>1,163.57</td>
<td>1,057.24</td>
<td>2,448.91</td>
</tr>
<tr>
<td>Cull Cows</td>
<td>5,128.61</td>
<td>6,091.08</td>
<td>4,366.79</td>
</tr>
<tr>
<td>Steer</td>
<td>14,955.03</td>
<td>20,425.81</td>
<td>10,823.53</td>
</tr>
<tr>
<td>Heifers</td>
<td>9,183.51</td>
<td>17,576.29</td>
<td>6,646.46</td>
</tr>
<tr>
<td>Total</td>
<td>67,022.47</td>
<td>81,312.02</td>
<td>64,133.81</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable Expenses</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel, Oil, Repairs</td>
<td>3,574.32</td>
<td>3,568.78</td>
<td>4,088.61</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>9,497.12</td>
<td>9,459.59</td>
<td>9,427.18</td>
</tr>
<tr>
<td>Herbicide</td>
<td>1,221.36</td>
<td>1,224.91</td>
<td>1,224.91</td>
</tr>
<tr>
<td>Insecticide</td>
<td>514.29</td>
<td>524.96</td>
<td>524.96</td>
</tr>
<tr>
<td>Seed</td>
<td>2,251.76</td>
<td>2,131.43</td>
<td>2,788.33</td>
</tr>
<tr>
<td>Drying Costs</td>
<td>363.98</td>
<td>364.62</td>
<td>372.00</td>
</tr>
<tr>
<td>Machine Hire</td>
<td>149.24</td>
<td>348.00</td>
<td>152.12</td>
</tr>
<tr>
<td>Livestock Expenses</td>
<td>4,587.68</td>
<td>4,927.44</td>
<td>3,906.21</td>
</tr>
<tr>
<td>Hired Labor</td>
<td>1,112.20</td>
<td>1,184.43</td>
<td>1,239.70</td>
</tr>
<tr>
<td>Replacements</td>
<td>0.00</td>
<td>9,136.61</td>
<td>0.00</td>
</tr>
<tr>
<td>Feeding Cost</td>
<td>358.99</td>
<td>381.12</td>
<td>325.09</td>
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<tr>
<td>Other Variable Cost</td>
<td>581.26</td>
<td>586.11</td>
<td>594.64</td>
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<tr>
<td>Interest</td>
<td>1,010.35</td>
<td>1,034.52</td>
<td>1,006.89</td>
</tr>
<tr>
<td>Total</td>
<td>25,232.53</td>
<td>34,872.55</td>
<td>25,650.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Return over variable cost</th>
<th></th>
<th></th>
<th>38,483.16</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Fixed Costs</th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>12,500.00</td>
<td>12,500.00</td>
<td>12,500.00</td>
</tr>
<tr>
<td>Labor</td>
<td>8,000.00</td>
<td>8,000.00</td>
<td>8,000.00</td>
</tr>
<tr>
<td>Crop</td>
<td>10,220.00</td>
<td>10,220.00</td>
<td>10,220.00</td>
</tr>
<tr>
<td>Livestock</td>
<td>5,065.51</td>
<td>5,347.66</td>
<td>4,450.76</td>
</tr>
</tbody>
</table>

| Return to management      | 6,004.43   | 10,371.81  | 3,312.40   |
OTHER APPLICATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

The preceding discussion illustrates how the model can be utilized to aid producers in planning forage systems that allows each individual to make efficient use of his land and labor resources. In addition to this use it is felt that the model may be useful in answering several other relevant questions concerning beef calf production.

One such application would involve the effects of various fertilizer prices upon the optimal mix of forages used for beef calf production. This price variation could be researched in a series of reoptimizations embodying different fertilizer prices. The model will allow for variations in price of single fertilizer nutrient or a combination of nutrients. Allocation of a restricted fertilizer supply among the alternative crop production activities can also be investigated with only minor modifications made in the model structure. Analysis of both points can be carried out on the basis of a fixed or an optimal herd size for each set of fertilizer prices.

The procedure of several reoptimizations can also be utilized for analyzing the effect of calving date on the optimal mix of forage production activities used to support the beef herd.

The effect of introducing cross-breeding can also be evaluated since this change is reflected in size of the mature cow, weaning weights of calves and the calving percentage. Thus a series of optimizations with these variables altered would provide information about changes that should be undertaken in forage programs to provide for the increased nutrient needs of a herd.
The model can also be used to compare the role of the beef herd under varying leasing systems assuming constant farm size and technologies. By entering the tenant's share of the crops and expenses for each leasing system the outcomes of the optimal plans can be compared for both cash rent and crop share leases.

Varying the quantity of land in each class allows exploration of the role a beef herd would play on a cash grain farm as well as the type of farms where beef herds have traditionally been found.

Although the model at its present stage of development is applicable in many planning situations there are additional extensions which will help to broaden its usefulness.

One such extension would be the inclusion of other livestock activities. On a great many Iowa farms alternative forms of livestock production compete with each other and crop production for labor. This competition greatly affects the optimal levels of the livestock and crop enterprises undertaken. In addition to the labor competition there are certain cattle production activities, such as backgrounding, that would compete directly with beef cows for nutrients from the forages produced. Because of these interactions inclusion of a broader spectrum of livestock production could have a major affect on the marginal value products of both the land and labor resources.

Another useful extension would be the inclusion of a creep feeding alternative for calves. Inclusion of this alternative would provide producers with information as to the profitability of this practice and also
would more accurately reflect the producer's situation where creep feeding is practiced.

As in any linear programming application, there is a constant need for continuing research with regard to production coefficients. This is especially true in a forage planning model, where not only refinement is sought for the costs and labor requirements, but also perennial forage productivities and their distribution throughout the year. Forage research would not only be helpful for improving the existing information on forage management, but also in developing new managements.
BIBLIOGRAPHY


18. Lechtenberg, Vic; Parsons, Sam; Petritz, Dave; and Smith, Bill. Storing and Feeding Big Hay Packages for Beef Cows. Departments of Animal Science, Agronomy, Agricultural Engineering, and Agricultural Economics. Purdue University, 1973.


ACKNOWLEDGMENTS

The author wishes to acknowledge the many helpful comments and suggestions made by Dr. Raymond Beneke during the preparation of this thesis.

A big thanks is also extended to my wife, Nancellla, for her large contribution in terms of encouragement and understanding so essential for the completion of this thesis.
APPENDIX A: TOTAL DIGESTIBLE NUTRIENTS AND DIGESTIBLE PROTEIN REQUIREMENTS OF COW AND CALF
Table 24. Total digestible nutrients and digestible protein required per day by cows of varying weights for maintenance

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*aSource: Maddox (19).*
Table 25. Daily total digestible nutrients and digestible protein required from pasture by calves of varying weaning weightsa

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Source: Maddox (19).
APPENDIX B: FORAGE PRODUCTION DATA USED

TO DEVELOP BASIC PLAN
Table 26. Abbreviations used in following tables

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<td>H1G</td>
<td>Harvest one crop of hay for storage and graze regrowth</td>
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Sources: Adopted from Kuhlmann (17) and Schaller (23).
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Table 28. Annual potential yields of perennial and supplemental forages under different forms of management

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<th>Hay Equivalent Yield</th>
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\(^a\)Source: Adopted from Kuhlmann (17).

\(^b\)The first row of each forage is given in pounds, the second is given in tons.
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<th>Type of Forage and Management</th>
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Table 29. Total digestible nutrient and digestible protein percentages on a dry matter basis assumed for feeds

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Source: National Academy of Sciences (28).
Table 30. Monthly distribution of total digestible nutrients and digestible protein for grazed forages used in our plan

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APPENDIX C: SUGGESTED COSTS AND TIME REQUIREMENTS

FOR OPERATION OF MACHINERY
### Table 31. Field time requirements and suggested fuel, oil, repair and miscellaneous variable costs

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\(^a\)Sources: Background information for use with Crop-Cpt System (34) and Bowers (6).

\(^b\)Includes costs of repairs, fuel, lubrication, and oil for tractors and self propelled items; and repairs and lubrication for other items.

\(^c\)Does not allow for travel time to the field and initial mounting or set-up time of equipment.
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<td><strong>Pre-emergence Operations</strong></td>
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<td>Drill (with fertilizer)</td>
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<td>20'</td>
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<td>Suggested Fuel Oil, Repair &amp; Misc. Variable Cost/Acre</td>
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<td>3-30&quot; header</td>
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<td>Small Grain and Soybeans</td>
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<tr>
<td>12' platform</td>
<td>1.63</td>
<td>.47</td>
<td>2.1</td>
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<td>16' platform</td>
<td>1.57</td>
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<td>2.5</td>
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<tr>
<td>18' platform</td>
<td>1.55</td>
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<td>2.7</td>
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<tr>
<td>24' platform</td>
<td>1.48</td>
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<tr>
<td>Operation</td>
<td>Equipment Size</td>
<td>Suggested Fuel Oil, Repair &amp; Misc. Variable Cost/Acre</td>
<td>Field Time Requirements</td>
</tr>
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<td>-----------------------------------</td>
<td>----------------</td>
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<tr>
<td><strong>Grain Harvesting (Con't.)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying Corn and Sorghum</td>
<td></td>
<td>.006 per 1% moisture per bu.</td>
<td></td>
</tr>
<tr>
<td>Hauling Grain (to farm storage)</td>
<td></td>
<td>.010/bu.</td>
<td>Use combine time as guide</td>
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<tr>
<td><strong>Forage Harvesting</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mow</td>
<td>7' bar</td>
<td>.55</td>
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<tr>
<td>Condition</td>
<td>--</td>
<td>.51</td>
<td>.30</td>
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<tr>
<td>Mow-condition</td>
<td>7' bar</td>
<td>.83</td>
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<td>Rake</td>
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<td>.29</td>
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<tr>
<td><strong>Windrow (self-propelled)</strong></td>
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<td>Small Grains</td>
<td>12'</td>
<td>.60</td>
<td>.21</td>
</tr>
<tr>
<td></td>
<td>14'</td>
<td>.60</td>
<td>.18</td>
</tr>
<tr>
<td>Hay</td>
<td>12'</td>
<td>.71</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>14'</td>
<td>.71</td>
<td>.19</td>
</tr>
<tr>
<td>Baling Hay (145 bales or 4 ton)</td>
<td>PTO Baler</td>
<td>8.00 or 5.5¢/bale</td>
<td>.20 hr/T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.0 ton or 1.3 A.</td>
</tr>
<tr>
<td>Baling Straw (40 bales or 3/4 ton)</td>
<td>PTO Baler</td>
<td>2.20 or 5.5¢/bale</td>
<td>.36 hr/T</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.78 ton or 3.7 A.</td>
</tr>
<tr>
<td>Hauling Bales (to farm storage)</td>
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<td>0.01/bale</td>
<td>Use baling time as guide</td>
</tr>
<tr>
<td>Operation</td>
<td>Equipment Size</td>
<td>Suggested Fuel Oil, Repair &amp; Misc.</td>
<td>Variable Cost/Acre</td>
</tr>
<tr>
<td>-----------------------------------</td>
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<td>-----------------------------------</td>
<td>--------------------</td>
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<tr>
<td>Chopping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn and Sorghum</td>
<td>PTO Chopper 1-row</td>
<td>.31/T</td>
<td>.09 hr/T</td>
</tr>
<tr>
<td></td>
<td>PTO Chopper 2-row</td>
<td>.21/T</td>
<td>.06 hr/T</td>
</tr>
<tr>
<td></td>
<td>Self-propelled 2-row</td>
<td>.23/T</td>
<td>.05 hr/T</td>
</tr>
<tr>
<td></td>
<td>Self-propelled 3-row</td>
<td>.17/T</td>
<td>.04 hr/T</td>
</tr>
<tr>
<td>Hay and Oats</td>
<td>PTO Chopper 1-row unit</td>
<td>.52/T</td>
<td>.12 hr/T</td>
</tr>
<tr>
<td></td>
<td>PTO Chopper 2-row unit</td>
<td>.31/T</td>
<td>.09 hr/T</td>
</tr>
<tr>
<td></td>
<td>Self-propelled 2-row unit</td>
<td>.37/T</td>
<td>.06 hr/T</td>
</tr>
<tr>
<td></td>
<td>Self-propelled 3-row unit</td>
<td>.26/T</td>
<td>.04 hr/T</td>
</tr>
<tr>
<td>Fail Chopper</td>
<td></td>
<td>2.40</td>
<td>.75</td>
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<tr>
<td>Blower (without recutter)</td>
<td>Hopper</td>
<td>.08/T</td>
<td>.04 hr/T</td>
</tr>
<tr>
<td></td>
<td>Conveyor</td>
<td>.10/T</td>
<td>.04 hr/T</td>
</tr>
<tr>
<td>Silage Hauling</td>
<td></td>
<td>.16/T</td>
<td>Use chopping time as guide</td>
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</table>
APPENDIX D: INPUT FORMS FOR INDIVIDUAL PRODUCER

UTILIZATION OF MODEL
Crop and Beef Production Worksheets

for

Name ____________________________
Address ___________________________
Date ______________________________
## Section 1. General Information

### A. Land Base of the farm. Includes both owned and rented land.

1. Acres that can be continuously row cropped (Class A)  
   - **Current Plan**: 50/A.  
   - **Your Plan**: _/A.

2. Maximum Class A acres that can be placed in soybeans each year  
   - **Current Plan**: 25/A.  
   - **Your Plan**: _/A.

3. Estimated cash rent for Class A  
   - **Current Plan**: 40/A.  
   - **Your Plan**: _/A.

4. Acres that must be placed in a rotation (Class B)  
   - **Current Plan**: 375/A.  
   - **Your Plan**: _/A.

5. Maximum acres of Class B that can be placed in row crops  
   - **Current Plan**: 125/A.  
   - **Your Plan**: _/A.

6. Maximum acres of Class B that can be placed in soybeans each year  
   - **Current Plan**: 65/A.  
   - **Your Plan**: _/A.

7. Estimated cash rent for Class B  
   - **Current Plan**: 25/A.  
   - **Your Plan**: _/A.

8. Acres that must be kept in improved permanent pasture (Class C)  
   - **Current Plan**: 75/A.  
   - **Your Plan**: _/A.

9. Estimated cash rent for Class C  
   - **Current Plan**: 15/A.  
   - **Your Plan**: _/A.

### B. Fixed Facilities

1. Silo capacity (in terms of corn silage)  
   - **Current Plan**: 150/T.  
   - **Your Plan**: _/T.

2. Shelter for beef cows  
   - **Current Plan**: 1000/Head  
   - **Your Plan**: _/Head

### C. Size of beef herd that must be maintained  

- **Current Plan**: 50/Head  
- **Your Plan**: _/Head
Section 2. Annual Crop Yield Expectations -- Expected yields should consider normal weather conditions.

The yields should represent the average of owned and rented land for each land class. It is assumed that yields of oat grain, oat hay, oat silage and straw will be the same on Class A and Class B land.

Our Plan

<table>
<thead>
<tr>
<th></th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Grain</td>
<td>110 Bu/A</td>
<td>100 Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>17 Ton/A</td>
<td>15.3 Ton/A</td>
<td>-- Ton/A</td>
</tr>
<tr>
<td>Soybeans</td>
<td>35 Bu/A</td>
<td>33 Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>110 Bu/A</td>
<td>100 Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Oats</td>
<td>-- Bu/A</td>
<td>60 Bu/A</td>
<td>55 Bu/A</td>
</tr>
<tr>
<td>Oat Silage</td>
<td>-- Ton/A</td>
<td>6.11 Ton/A</td>
<td>5.6 Ton/A</td>
</tr>
<tr>
<td>Oat Hay</td>
<td>-- Ton/A</td>
<td>1.03 Ton/A</td>
<td>0.3 Ton/A</td>
</tr>
<tr>
<td>Straw</td>
<td>-- Ton/A</td>
<td>0.8 Ton/A</td>
<td>0.6 Ton/A</td>
</tr>
<tr>
<td>Forage Sorghum Silage</td>
<td>15.00 Ton/A</td>
<td>13.5 Ton/A</td>
<td>-- Ton/A</td>
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</table>

Your Plan

<table>
<thead>
<tr>
<th></th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Grain</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
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<tr>
<td>Corn Silage</td>
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<tr>
<td>Soybeans</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Oats</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
<td>-- Bu/A</td>
</tr>
<tr>
<td>Oat Silage</td>
<td>-- Ton/A</td>
<td>-- Ton/A</td>
<td>-- Ton/A</td>
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<tr>
<td>Oat Hay</td>
<td>-- Ton/A</td>
<td>-- Ton/A</td>
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<tr>
<td>Straw</td>
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</tr>
<tr>
<td>Forage Sorghum Silage</td>
<td>-- Ton/A</td>
<td>-- Ton/A</td>
<td>-- Ton/A</td>
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</table>

Section 3. Crop Residues and Supplemental Pasture Yields

The crop residues and supplemental pastures in our model are listed below.

The yields given are in terms of total available dry matter. Those yields enclosed in parentheses, ( ), approximate field moisture yields. Place the yield you wish to have considered in your model in the column headed "Your Plan Total Dry Matter Available". If you do not wish to consider an alternative in our plan, enter a yield of zero.
<table>
<thead>
<tr>
<th>Crop and Management</th>
<th>Class</th>
<th>Our Plan Total Dry Matter Available Ton/Acre</th>
<th>Your Plan Total Dry Matter Available Ton/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cornstalks Continuous Graze</td>
<td>A</td>
<td>2.60 (4.00)</td>
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<tr>
<td>2. Cornstalks Flail Chop-Ensile</td>
<td>A</td>
<td>2.60 (4.33)</td>
<td></td>
</tr>
<tr>
<td>3. Cornstalks StalkHand Harvest</td>
<td>A</td>
<td>2.60 (3.96)</td>
<td></td>
</tr>
<tr>
<td>4. Cornstalks Continuous Graze</td>
<td>B</td>
<td>2.40 (3.69)</td>
<td></td>
</tr>
<tr>
<td>5. Cornstalks Flail Chop-Ensile</td>
<td>B</td>
<td>2.40 (4.00)</td>
<td></td>
</tr>
<tr>
<td>6. Cornstalks StalkHand Harvest</td>
<td>B</td>
<td>2.40 (3.65)</td>
<td></td>
</tr>
<tr>
<td>7. Forage Sorghum Stockpile Fall</td>
<td>A</td>
<td>6.75 (17.22)</td>
<td></td>
</tr>
<tr>
<td>8. Forage Sorghum Stockpile Fall</td>
<td>B</td>
<td>6.07 (15.04)</td>
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</tr>
<tr>
<td>9. Forage Sorghum Silage-Graze</td>
<td>A</td>
<td>.83 (2.81)</td>
<td></td>
</tr>
<tr>
<td>10. Forage Sorghum Silage-Graze</td>
<td>D</td>
<td>.75 (2.56)</td>
<td></td>
</tr>
<tr>
<td>11. Grain Sorghum Stubble Continuous Graze</td>
<td>A</td>
<td>2.16 (2.70)</td>
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</tr>
<tr>
<td>12. Grain Sorghum Stubble Continuous Graze</td>
<td>D</td>
<td>1.95 (2.70)</td>
<td></td>
</tr>
<tr>
<td>13. Sorghum Sudan Alternate Graze</td>
<td>A</td>
<td>4.08 (13.60)</td>
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</tr>
<tr>
<td>14. Sorghum Sudan Alternate Graze</td>
<td>B</td>
<td>3.72 (14.88)</td>
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</table>
### Section 4. Perennial Forage Yields

The perennial forages and their managements considered in our plan and the total dry matter available, are listed below. Place the number of those alternatives that you do not wish to consider in the column headed, "Delete From Our Plan". To adjust the yields respond with the appropriate answer to the two questions at the end of the list in Section 7.

<table>
<thead>
<tr>
<th>Crop and Management</th>
<th>Class</th>
<th>Our Plan</th>
<th>Your Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dry Matter Available</td>
<td>Ton/Acre</td>
<td>Total Dry Matter Available</td>
<td>Ton/Acre</td>
</tr>
<tr>
<td>15. Sorghum Sudan Stockpile Fall</td>
<td>A</td>
<td>4.01 (13.37)</td>
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<tr>
<td>16. Sorghum Sudan Stockpile Fall</td>
<td>B</td>
<td>3.61 (14.40)</td>
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</table>

### Crop and Management

A. Varieties and managements available on Class B Land

<table>
<thead>
<tr>
<th>Crop and Management</th>
<th>Yield</th>
<th>Delete From Our Plan</th>
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</thead>
<tbody>
<tr>
<td>Total D.M./Acre Hay Equivalent</td>
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</tr>
<tr>
<td>1. Alfalfa-Grass Rotational Graze</td>
<td>3.06</td>
<td>3.50</td>
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<tr>
<td>2. Alfalfa-Grass Harvest 1, Graze</td>
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<td>4.06</td>
</tr>
<tr>
<td>3. Alfalfa-Grass Harvest 2, Graze</td>
<td>3.57</td>
<td>4.06</td>
</tr>
<tr>
<td>4. Alfalfa-Grass Harvest 2, Stockpile for fall grazing</td>
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<td>4.06</td>
</tr>
<tr>
<td>5. Alfalfa-Grass Harvest 3, Graze</td>
<td>3.35</td>
<td>3.81</td>
</tr>
<tr>
<td>6. Birdsfoot Trefoil Continuous Graze</td>
<td>2.41</td>
<td>2.65</td>
</tr>
<tr>
<td>7. Birdsfoot Trefoil Stockpile Early Summer</td>
<td>2.30</td>
<td>2.53</td>
</tr>
<tr>
<td>Crop and Management</td>
<td>Our Plan Yield</td>
<td>Hay Equivalent</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>8. Birdsfoot Trefoil Stockpile Late Summer</td>
<td>2.23</td>
<td>2.45</td>
</tr>
<tr>
<td>9. Birdsfoot Trefoil Harvest 1, Stockpile Late Summer</td>
<td>2.39</td>
<td>2.63</td>
</tr>
<tr>
<td>10. Orchardgrass Continuous Graze, 120 lbs. N/A</td>
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<td>3.14</td>
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<tr>
<td>11. Orchardgrass 3-Season Graze, 120 lbs. N/A</td>
<td>2.39</td>
<td>2.71</td>
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<tr>
<td>12. Orchardgrass 3-Season Graze Early, 120 lbs. N/A</td>
<td>2.19</td>
<td>2.48</td>
</tr>
<tr>
<td>13. Orchardgrass Harvest 2, 120 lbs. N/A</td>
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<td>3.00</td>
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<tr>
<td>14. Orchardgrass 3-Season Graze, 240 lbs. N/A</td>
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</tr>
<tr>
<td>15. Orchardgrass Harvest 2, Graze 240 lbs. N/A</td>
<td>4.67</td>
<td>5.29</td>
</tr>
<tr>
<td>16. Orchardgrass Harvest 1, Graze Early 240 lbs. N/A</td>
<td>4.63</td>
<td>5.24</td>
</tr>
<tr>
<td>17. Reed Canarygrass Continuous Graze, 120 lbs. N/A</td>
<td>3.38</td>
<td>3.70</td>
</tr>
<tr>
<td>18. Reed Canarygrass Harvest 2, Graze 120 lbs. N/A</td>
<td>3.49</td>
<td>3.82</td>
</tr>
<tr>
<td>19. Reed Canarygrass Harvest 1, Round Bale 2 120 lbs. N/A</td>
<td>3.49</td>
<td>3.82</td>
</tr>
<tr>
<td>20. Reed Canarygrass 3-Season Graze Early 240 lbs. N/A</td>
<td>4.70</td>
<td>5.15</td>
</tr>
<tr>
<td>21. Reed Canarygrass 3-Season Graze, 240 lbs. N/A</td>
<td>4.94</td>
<td>4.97</td>
</tr>
<tr>
<td>Crop and Management</td>
<td>Our Plan</td>
<td>Yield</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td>Yield</td>
<td>Hay</td>
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<tr>
<td>22. Reed Canarygrass Harvest 2, Graze 240 lbs.</td>
<td>4.94</td>
<td>5.44</td>
</tr>
<tr>
<td>23. Reed Canarygrass Harvest 1, Graze 240 lbs.</td>
<td>5.11</td>
<td>5.60</td>
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<tr>
<td>24. Smooth Brome Continuous Graze, 120 lbs.</td>
<td>2.73</td>
<td>3.04</td>
</tr>
<tr>
<td>25. Smooth Brome 3-Season Graze, 120 lbs.</td>
<td>2.34</td>
<td>2.62</td>
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<td>26. Smooth Brome 3-Season Graze Early 120 lbs.</td>
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<td>2.40</td>
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<td>27. Smooth Brome Harvest 2, Graze 120 lbs.</td>
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<td>2.91</td>
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<tr>
<td>28. Smooth Brome 3-Season Graze, 240 lbs.</td>
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<td>4.26</td>
</tr>
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<td>29. Smooth Brome Harvest 2, Graze 240 lbs.</td>
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<td>4.59</td>
</tr>
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<td>30. Smooth Brome Harvest 1, Graze 240 lbs.</td>
<td>4.13</td>
<td>4.60</td>
</tr>
<tr>
<td>31. Switchgrass Continuous Graze, 60 lbs.</td>
<td>3.40</td>
<td>3.86</td>
</tr>
<tr>
<td>32. Tall Fescue 3-Season Graze, 240 lbs.</td>
<td>4.95</td>
<td>5.59</td>
</tr>
<tr>
<td>33. Tall Fescue Harvest 2, Graze 240 lbs.</td>
<td>5.70</td>
<td>6.44</td>
</tr>
<tr>
<td>34. Tall Fescue Harvest 1, Graze 240 lbs.</td>
<td>5.73</td>
<td>6.47</td>
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D. Varieties and Managements Available on Class C Land

35. Birdsfoot Trefoil Continuous Graze

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<th>Yield</th>
<th>Hay</th>
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<tr>
<td></td>
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<td>Crop and Management</td>
<td>Our Plan Yield</td>
<td>Hay Equivalent</td>
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<tr>
<td>---------------------</td>
<td>----------------</td>
<td>----------------</td>
<td>---------------------</td>
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<tr>
<td>36. Birdsfoot Trefoil Stockpile Early Summer</td>
<td>2.30</td>
<td>2.53</td>
<td></td>
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<tr>
<td>37. Birdsfoot Trefoil Stockpile Late Summer</td>
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<tr>
<td>38. Birdsfoot Trefoil Harvest 1, Stockpile Late Summer</td>
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<td>2.63</td>
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<tr>
<td>40. Kentucky Bluegrass Continuous Graze</td>
<td>1.42</td>
<td>1.60</td>
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<tr>
<td>41. Kentucky Bluegrass Continuous Graze, 60 lbs. N/A</td>
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<tr>
<td>42. Kentucky Bluegrass 3-Season Graze, 60 lbs. N/A</td>
<td>2.72</td>
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Section 5. Grazing During Renovation Year

A. Class B Land: Oats harvested as grain

<p>| | | |</p>
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<tbody>
<tr>
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<td>.83</td>
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<tr>
<td>2. Birdsfoot Trefoil</td>
<td>.55</td>
<td>.60</td>
</tr>
<tr>
<td>3. Orchardgrass</td>
<td>.69</td>
<td>.78</td>
</tr>
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<td>4. Reed Canarygrass</td>
<td>.74</td>
<td>.81</td>
</tr>
<tr>
<td>5. Smooth Brome</td>
<td>.68</td>
<td>.76</td>
</tr>
<tr>
<td>6. Switch Grass</td>
<td>.48</td>
<td>.55</td>
</tr>
<tr>
<td>7. Tall Fescue</td>
<td>.87</td>
<td>.98</td>
</tr>
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</table>

B. Class B Land: Oats harvested as silage

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
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<td>.83</td>
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<tr>
<td>9. Birdsfoot Trefoil</td>
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<td>.60</td>
</tr>
<tr>
<td>Crop and Management</td>
<td>Our Plan Yield</td>
<td>Hay Equivalent</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>10. Orchardgrass</td>
<td>.63</td>
<td>.79</td>
</tr>
<tr>
<td>11. Reed Canarygrass</td>
<td>.78</td>
<td>.91</td>
</tr>
<tr>
<td>12. Smooth Bromegrass</td>
<td>.60</td>
<td>.77</td>
</tr>
<tr>
<td>13. Switch Grass</td>
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<td>.55</td>
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<tr>
<td>14. Tall Fescue</td>
<td>.87</td>
<td>.90</td>
</tr>
<tr>
<td>15. Class 3 Land: Cattle harvested as hay</td>
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<td></td>
</tr>
<tr>
<td>16. Alfalfa Grass</td>
<td>.78</td>
<td>1.11</td>
</tr>
<tr>
<td>17. Birdsfoot Trefoil</td>
<td>.25</td>
<td>.32</td>
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<td>18. Orchardgrass</td>
<td>.22</td>
<td>1.05</td>
</tr>
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<td>19. Reed Canarygrass</td>
<td>1.01</td>
<td>1.11</td>
</tr>
<tr>
<td>20. Smooth Bromegrass</td>
<td>.91</td>
<td>1.08</td>
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<tr>
<td>21. Switch Grass</td>
<td>.86</td>
<td>.90</td>
</tr>
<tr>
<td>22. Tall Fescue</td>
<td>1.17</td>
<td>1.32</td>
</tr>
<tr>
<td>23. Class 3 Land: Cattle harvested as grain</td>
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<td></td>
</tr>
<tr>
<td>24. Birdsfoot Trefoil</td>
<td>.55</td>
<td>.60</td>
</tr>
<tr>
<td>25. Crown Vetch</td>
<td>.75</td>
<td>.95</td>
</tr>
<tr>
<td>26. Kentucky Bluegrass</td>
<td>.92</td>
<td>.81</td>
</tr>
<tr>
<td>27. Class 3 Land: Cattle harvested as silage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28. Birdsfoot Trefoil</td>
<td>.55</td>
<td>.82</td>
</tr>
<tr>
<td>29. Crown Vetch</td>
<td>.75</td>
<td>.95</td>
</tr>
<tr>
<td>30. Kentucky Bluegrass</td>
<td>.72</td>
<td>.81</td>
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<tr>
<td>Crop and Management</td>
<td>Yield</td>
<td>Tea D.R./Acre</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td>---------------</td>
</tr>
<tr>
<td>F. Class C. Land: Cattle harvested as hay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. Redfoot Trefell</td>
<td>.75</td>
<td>.02</td>
</tr>
<tr>
<td>30. Crown Vetch</td>
<td>1.01</td>
<td>1.12</td>
</tr>
<tr>
<td>31. Kentucky Bluegrass</td>
<td>.99</td>
<td>1.10</td>
</tr>
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</table>

Section 6. Harvesting Last Cutting as Small Round Bales and Cramming in Fall

<table>
<thead>
<tr>
<th>Crop and Management</th>
<th>Yield</th>
<th>Tea D.R./Acre</th>
<th>Hay Equivalent</th>
<th>Delete From Our Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alfalfa-Grass Harvest 1, Round Bale 2</td>
<td>3.11</td>
<td>3.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Orchardgrass Harvest 1, Round Bale 2</td>
<td>2.65</td>
<td>2.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Orchardgrass Harvest 1, Round Bale 2</td>
<td>4.67</td>
<td>5.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Red Canarygrass Harvest 1, Round Bale 2</td>
<td>3.49</td>
<td>3.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Red Canarygrass Harvest 1, Round Bale 2</td>
<td>4.91</td>
<td>5.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Smooth Brome Harvest 1, Round Bale 2</td>
<td>2.61</td>
<td>2.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Smooth Brome Harvest 1, Round Bale 2</td>
<td>4.20</td>
<td>4.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Tall Fescue Harvest 1, Round Bale 2</td>
<td>5.70</td>
<td>6.40</td>
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</table>
### Our Plan

<table>
<thead>
<tr>
<th>Crop and Management</th>
<th>Yield</th>
<th>Hay Equivalent</th>
<th>Delete From Our Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest 1, Round Bale 2</td>
<td>2.14</td>
<td>2.35</td>
<td>——</td>
</tr>
</tbody>
</table>

**Section 7. Harvesting Last Cutting as Large Round Bales and Grazing in Fall**

| 1. Alfalfa-Grass | 3.11 | 3.52 | —— |
| Harvest 2, Round Bale 3 |  |  | |
| 2. Orchardgrass | 2.45 | 2.99 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 120 lbs. N/A |  |  | |
| 3. Orchardgrass | 4.67 | 5.22 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 240 lbs. N/A |  |  | |
| 4. Reed Canarygrass | 3.49 | 3.82 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 120 lbs. N/A |  |  | |
| 5. Reed Canarygrass | 4.94 | 5.41 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 240 lbs. N/A |  |  | |
| 6. Smooth Brome | 2.51 | 2.91 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 120 lbs. N/A |  |  | |
| 7. Smooth Brome | 4.28 | 4.77 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 240 lbs. N/A |  |  | |
| 8. Tall Fescue | 5.70 | 6.14 | —— |
| Harvest 1, Round Bale 2 |  |  | |
| 240 lbs. N/A |  |  | |
| 9. Birdfoot Trefol# | 2.14 | 2.35 | —— |
| Harvest 2, Round Bale 2 |  |  | |

In order to accurately reflect the yields on my farm, the total dry matter yields of all the perennial forages should be ______.

1 = Decreased; 2 = Left the Same; 3 = Increased

By what percent do you wish to alter these yields? ______.

*Birdfoot Trefol is harvested as round bales on both Class D & C land.*
### Section 8. Price Expectation (Net at the Farm)

<table>
<thead>
<tr>
<th>Item</th>
<th>Our Plan</th>
<th>Your Plan</th>
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<tbody>
<tr>
<td>Corn</td>
<td>$1.87/bu.</td>
<td></td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>1.68/bu.</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>5.20/bu.</td>
<td></td>
</tr>
<tr>
<td>Cots</td>
<td>1.00/bu.</td>
<td></td>
</tr>
<tr>
<td>Straw</td>
<td>20.00/ton.</td>
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</tr>
<tr>
<td>Feeder Steers</td>
<td>45.00/cwt.</td>
<td></td>
</tr>
<tr>
<td>Feeder Heifers</td>
<td>41.00/cwt.</td>
<td></td>
</tr>
<tr>
<td>Cull Cows</td>
<td>250.00/heifer</td>
<td></td>
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<tr>
<td>Purchased Replacement Heifers</td>
<td>275.00/heifer</td>
<td></td>
</tr>
<tr>
<td>Rate of return on investment desired</td>
<td>7%/Year</td>
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### Section 9. Variable Costs and Field Time Requirements for Annual Crops.

#### A. Corn - Variable Cost and Field Time Requirements: Class A Land

<table>
<thead>
<tr>
<th>Cost Per Acre</th>
<th>Our Plan</th>
<th>Your Plan</th>
<th>Yours For Acre</th>
<th>Your Plan</th>
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<tr>
<td><strong>Field Preparation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Fall or Spring)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Chop Stalks</td>
<td>$.57</td>
<td></td>
<td>.17 hrs.</td>
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<tr>
<td>Spread P and K</td>
<td>.28</td>
<td></td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Flow</td>
<td>1.57</td>
<td></td>
<td>.56</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$2.42</td>
<td>(1)$</td>
<td>.78 hrs.</td>
<td>(5)</td>
</tr>
<tr>
<td><strong>Field Preparation</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Spring Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td>$.50</td>
<td></td>
<td>.12 hrs.</td>
<td></td>
</tr>
<tr>
<td>Apply N</td>
<td>.50</td>
<td></td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.00</td>
<td>(2)$</td>
<td>.32 hrs.</td>
<td>(6)</td>
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<tr>
<td><strong>Planting Operations</strong></td>
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<tr>
<td>Disk</td>
<td>$.50</td>
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<td>.12 hrs.</td>
<td></td>
</tr>
<tr>
<td>Plant 2</td>
<td>.61</td>
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<td>.21</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$1.11</td>
<td>(3)$</td>
<td>.33 hrs.</td>
<td>(8)</td>
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<tr>
<td><strong>Weed Control</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Harrow</td>
<td>$.26</td>
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<td>.09 hrs.</td>
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<tr>
<td>Rotary Hoe</td>
<td>(1)x</td>
<td>.60</td>
<td>.15</td>
<td>(10)</td>
</tr>
<tr>
<td>Cultivate</td>
<td>(1/2)x</td>
<td>.72</td>
<td>.20</td>
<td>(11)</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$1.51</td>
<td>(4)$</td>
<td>.52 hrs.</td>
<td></td>
</tr>
</tbody>
</table>

*Notes:
1. These should include only the labor required from the fixed labor supply.
2. Do not include the labor required of a custom operator or hired because the job required more than one man.
3. Herbicide and insecticide applied with planter attachment in our plan.*
### Section 9 Corn (continued)

<table>
<thead>
<tr>
<th></th>
<th>Your Plan</th>
<th>Your Plan</th>
<th>Your Plan</th>
<th>Your Plan</th>
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</thead>
<tbody>
<tr>
<td><strong>Harvest-Grain, Class 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combine</td>
<td>$2.00</td>
<td></td>
<td>.56 hrs.</td>
<td>(16)</td>
</tr>
<tr>
<td>Haul</td>
<td>1.10</td>
<td></td>
<td>.21 hrs.</td>
<td>(17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>$3.10</td>
<td>(12) hrs.</td>
<td>1.07 hrs.</td>
<td>(18) hrs.</td>
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</tbody>
</table>

**Harvest-Grain, Class 2**

Will these costs and field time requirements be the same as those used on Class A land? (Yes - 1, No - 2)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Combine</td>
<td>$2.00</td>
<td></td>
<td>.52 hrs.</td>
<td>(20)</td>
</tr>
<tr>
<td>Haul</td>
<td>1.00</td>
<td></td>
<td>.73 hrs.</td>
<td>(21)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>$3.00</td>
<td>(13) hrs.</td>
<td>1.25 hrs.</td>
<td>(22) hrs.</td>
</tr>
</tbody>
</table>

Drying cost per 10 points moisture removed: $0.06/bu. (19) hrs./bu.

**Harvest-Silage, Class A**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chop</td>
<td>$2.22</td>
<td></td>
<td>.25 hrs.</td>
<td>(23)</td>
</tr>
<tr>
<td>Mail and store</td>
<td>1.05</td>
<td></td>
<td>.75 hrs.</td>
<td>(24)</td>
</tr>
<tr>
<td>Hired labor for harvesting silage</td>
<td></td>
<td></td>
<td>2.02 hrs.</td>
<td>(25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>$5.30</td>
<td>(15) hrs.</td>
<td>3.00 hrs.</td>
<td>(26) hrs.</td>
</tr>
</tbody>
</table>

*Plan should include only the labor required from the fixed labor supply. Do not include the labor required of a custom operator or hired labor because job required more than one man. Hours of labor needed other than custom operator and/or fixed labor supply because silage harvesting is considered to be at least a two-man job.*
**Section 3 Corn (continued)**

<table>
<thead>
<tr>
<th>Harvest-Silage, Class A</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>** Chop**</td>
<td>$3.21</td>
<td>$</td>
</tr>
<tr>
<td>** Field preparation**</td>
<td>$0.00</td>
<td>(33)_</td>
</tr>
<tr>
<td>** Harvest grain**</td>
<td>$0.00</td>
<td>(35)_</td>
</tr>
<tr>
<td>** Harvest silage**</td>
<td>$0.00</td>
<td>(36)_</td>
</tr>
<tr>
<td>** Total**</td>
<td>$6.00</td>
<td>(27)_</td>
</tr>
</tbody>
</table>

**Custom Hire, Class A and B**

| Field preparation | $0.00 | (33)\_ |
| Planting and weed control | $0.00 | (34)\_ |
| Harvest grain | $0.00 | (35)\_ |
| Harvest silage | $0.00 | (36)\_ |

**Other Variable Costs, Class A**

| Seed | $9.00 | (37)\_ |
| Fertilizer and lime | $20.00 | (38)\_ |
| Herbicide | $7.00 | (39)\_ |
| Insecticide | $3.00 | (40)\_ |
| Crop Insurance | $2.00 | (41)\_ |
| Miscellaneous | $0.25 | (42)\_ |

**Other Variable Costs, Class B**

| Seed | $9.00 | (44)\_ |
| Fertilizer and lime | $25.00 | (45)\_ |
| Herbicide | $7.00 | (46)\_ |
| Insecticide | $3.00 | (47)\_ |
| Crop Insurance | $3.00 | (48)\_ |
| Miscellaneous | $0.25 | (49)\_ |

*Item should include only the labor required from the fixed labor supply.
Do not include the labor required of a custom operator or hired labor because job required more than one man.

*Hours of labor needed other than custom operator and/or fixed labor supply because silage harvesting is considered to be at least a two-man job.
B. Soybeans - Variable Cost and Field Time Requirements

<table>
<thead>
<tr>
<th>Field Preparation (Fall or Spring)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>chop stalks</td>
<td>$0.27</td>
<td>___ hrs.</td>
</tr>
<tr>
<td>spread P and K</td>
<td>$0.28</td>
<td>___ hrs.</td>
</tr>
<tr>
<td>plow</td>
<td>$1.52</td>
<td>___ hrs.</td>
</tr>
<tr>
<td>subtotal</td>
<td>$2.42</td>
<td>___ hrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field Preparation (Spring Only)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$0.0</td>
<td>(1)$0.0 hrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Planting Operations</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>disk</td>
<td>(2x)$1.00</td>
<td>2 1/2 hrs.</td>
</tr>
<tr>
<td>plant1</td>
<td>$0.61</td>
<td>20 hrs. (6)</td>
</tr>
<tr>
<td>subtotal</td>
<td>$1.61</td>
<td>(2)$0.5 hrs. (7)hrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weeds Control</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>narrow</td>
<td>$0.23</td>
<td>0.20 hrs. (8)</td>
</tr>
<tr>
<td>rotary hoe</td>
<td>(2x)$0.23</td>
<td>0.20 hrs. (9)</td>
</tr>
<tr>
<td>cultivation</td>
<td>(2x)$1.14</td>
<td>0.10 hrs. (10)</td>
</tr>
<tr>
<td>subtotal</td>
<td>$2.07</td>
<td>(3)$0.6 hrs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>harvest, class A</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>combine</td>
<td>$1.57</td>
<td>0.40 hrs. (11)</td>
</tr>
<tr>
<td>haul</td>
<td>$0.35</td>
<td>0.35 hrs. (12)</td>
</tr>
<tr>
<td>subtotal</td>
<td>$1.92</td>
<td>(4)$0.75 hrs.</td>
</tr>
</tbody>
</table>

1Herbicide applied with planter attachment in our plan
2Item should include only the labor required from the fixed labor supply.
Do not include the labor required of the custom operator or hired because job required more than one man.
<table>
<thead>
<tr>
<th>Soybeans (continued)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvest, Class B</td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Will these costs and field time requirements be the same as those used for Class A land? (Yes - 1.0; No - 2.0)</td>
<td>(31)____</td>
<td></td>
</tr>
<tr>
<td>Combine</td>
<td>$1.57</td>
<td>$____</td>
</tr>
<tr>
<td>Haul</td>
<td>.23</td>
<td>____</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$1.90</td>
<td>(14)$____</td>
</tr>
<tr>
<td>Custom Hire Costs, Class A and B</td>
<td>(15)$____</td>
<td></td>
</tr>
<tr>
<td>Field preparation</td>
<td>$0.00</td>
<td>____</td>
</tr>
<tr>
<td>Planting and weed control</td>
<td>0.00</td>
<td>(16)____</td>
</tr>
<tr>
<td>Harvest</td>
<td>0.00</td>
<td>(17)____</td>
</tr>
<tr>
<td>Other Variable Costs, Class A</td>
<td>(18)$____</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$8.00</td>
<td>____</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>10.00</td>
<td>(19)____</td>
</tr>
<tr>
<td>Herbicide</td>
<td>7.00</td>
<td>(20)____</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
<td>(21)____</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>4.00</td>
<td>(22)____</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(23)____</td>
</tr>
<tr>
<td>Other Variable Costs, Class B</td>
<td>(25)$____</td>
<td></td>
</tr>
<tr>
<td>Will these costs be the same as on Class A land? (Yes - 1.0; No - 2.0)</td>
<td>(24)____</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$8.00</td>
<td>(25)$____</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>2.00</td>
<td>(26)____</td>
</tr>
<tr>
<td>Herbicide</td>
<td>7.00</td>
<td>(27)____</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
<td>(28)____</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>4.00</td>
<td>(29)____</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(30)____</td>
</tr>
</tbody>
</table>

---

1 Item should include only the labor required from the fixed labor supply. Do not include the labor required of the custom operator or hired because job required more than one man.
### C. Grain Sorghum Variable Cost and Field Time Requirements, Class A Land

<table>
<thead>
<tr>
<th>Field Preparation</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Fall or Spring)</strong></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Chop Stalks</td>
<td>$.57</td>
<td></td>
</tr>
<tr>
<td>Spread P and K</td>
<td>.28</td>
<td></td>
</tr>
<tr>
<td>Plow</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$2.42</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field Preparation</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Spring only)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td>.50</td>
<td></td>
</tr>
<tr>
<td>Apply N</td>
<td>.58</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.08</td>
<td>(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Planting Operations</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk</td>
<td>.50</td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td>.61</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.11</td>
<td>(2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weed Control</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrow</td>
<td>.26</td>
<td></td>
</tr>
<tr>
<td>Rotor, Hoe</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td>Cultivation</td>
<td>.80</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.51</td>
<td>(2)</td>
</tr>
</tbody>
</table>

*Herbicide and insecticide applied with planter attachment in our plan.*
<table>
<thead>
<tr>
<th>Grain Sorghum (continued)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cur Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Harvest, Class A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combine</td>
<td>$2.32</td>
<td>$2.32</td>
</tr>
<tr>
<td>(0.000/bu.)</td>
<td>1.10</td>
<td>1.10</td>
</tr>
<tr>
<td>Haul</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.000/bu.)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Combing and hauling</td>
<td>$3.42</td>
<td>$3.42</td>
</tr>
<tr>
<td>(10)</td>
<td></td>
<td>(24)</td>
</tr>
<tr>
<td>Harvest-Grain, Class B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will these costs and field time requirements be the same as those used for Class A land? (Yes = 1.0; No = 2.0)</td>
<td>(25)</td>
<td></td>
</tr>
<tr>
<td>Combine</td>
<td>$2.32</td>
<td>$2.32</td>
</tr>
<tr>
<td>(0.000/bu.)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Haul</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.000/bu.)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Combing and hauling</td>
<td>$3.32</td>
<td>$3.32</td>
</tr>
<tr>
<td>(11)</td>
<td></td>
<td>(28)</td>
</tr>
<tr>
<td>Drying cost per 10 points moisture removed</td>
<td>$.06/bu.</td>
<td>(12) $0.60/bu.</td>
</tr>
<tr>
<td>Custom Hire, Class A and B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field preparation</td>
<td>$0.00</td>
<td>(13) $0.00</td>
</tr>
<tr>
<td>Planting and weed control</td>
<td>0.00</td>
<td>(14) $0.00</td>
</tr>
<tr>
<td>Harvest</td>
<td>0.00</td>
<td>(15) $0.00</td>
</tr>
<tr>
<td>Other Variable Costs, Class A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$5.00</td>
<td>(16) $5.00</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>20.00</td>
<td>(17) $20.00</td>
</tr>
<tr>
<td>Inhibitor</td>
<td>7.00</td>
<td>(18) $7.00</td>
</tr>
<tr>
<td>Insecticide</td>
<td>3.00</td>
<td>(19) $3.00</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>2.00</td>
<td>(20) $2.00</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(21) $0.25</td>
</tr>
</tbody>
</table>

*These should include only the labor required from the fixed labor supply. Do not include the labor required of the custom operator or hired because job required more than one man.*
Grain Sorghum (continued)

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Other Variable Costs, Class B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Will these costs be the same as those on Class A land?
(Yes - 1.0; No - 2.0)

<table>
<thead>
<tr>
<th>Item</th>
<th>Our Plan</th>
<th>Your Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>$5.00</td>
<td>(30) $5.00</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>25.00</td>
<td>(31)</td>
</tr>
<tr>
<td>Herbicide</td>
<td>7.00</td>
<td>(32)</td>
</tr>
<tr>
<td>Insecticide</td>
<td>3.00</td>
<td>(33)</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>3.00</td>
<td>(34)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>25.00</td>
<td>(35)</td>
</tr>
</tbody>
</table>
### D. Forage Sorghum - Variable Cost and Field Time Requirements

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th></th>
<th>Hours Per Acre</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Field Preparation</strong> (Spring only)**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chop stalks</td>
<td>$0.50</td>
<td>$0.42</td>
<td>0.17 hrs.</td>
<td>0.78 hrs.</td>
</tr>
<tr>
<td>Spread P and K</td>
<td>$1.57</td>
<td>$1.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$2.47</td>
<td>$2.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Planting Operations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td>(2x)$1.00</td>
<td>$1.00</td>
<td>0.24 hrs.</td>
<td>0.4 hrs.</td>
</tr>
<tr>
<td>Plant</td>
<td>$0.61</td>
<td>$0.60</td>
<td>0.20 hrs.</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.61</td>
<td>(1)$1.60</td>
<td>0.54 hrs.</td>
<td>(5)</td>
</tr>
<tr>
<td><strong>Weed Control</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harrow</td>
<td>$0.23</td>
<td>$0.22</td>
<td>0.09 hrs.</td>
<td>(6)</td>
</tr>
<tr>
<td>Rotary Hoe</td>
<td>(1)x $0.32</td>
<td>$0.32</td>
<td>0.13 hrs.</td>
<td>(7)</td>
</tr>
<tr>
<td>Cultivation</td>
<td>(1.2)x $0.35</td>
<td>$0.35</td>
<td>0.60 hrs.</td>
<td>(8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$1.60</td>
<td>(2)$1.60</td>
<td>0.53 hrs.</td>
<td></td>
</tr>
<tr>
<td><strong>Harvest-Silage, Class A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chopping</td>
<td>$2.15</td>
<td>$2.15</td>
<td>0.64 hrs.</td>
<td>(9)</td>
</tr>
<tr>
<td>Haul and store</td>
<td>$2.60</td>
<td>$2.60</td>
<td>0.0 hrs.</td>
<td>(10)</td>
</tr>
<tr>
<td>Hired labor for harvesting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>forage sorghum silage2</td>
<td>$1.29</td>
<td>$1.29</td>
<td></td>
<td>(11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$6.75</td>
<td>(3)$6.75</td>
<td>0.64 hrs.</td>
<td>(12)</td>
</tr>
</tbody>
</table>

1 Herbicide applied with planter attachment in our plan.
2 Hours of labor needed other than custom operator and/or fixed labor supply because silage harvesting is considered to be at least a two-man job.
3 Item should include only the labor required from the fixed labor supply.
4 Do not include the labor required of a custom operator or hired labor because job required more than one man.
Forage Sorghum (continued)  | Cost Per Acre | Hours Per Acre |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
</tbody>
</table>

**Harvest-Silage, Class B**

Will these costs and field time requirements be the same as those used on Class A land? (Yes - 1.0; No - 2.0) (28)_____

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Per Acre</th>
<th>Field Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopping</td>
<td>$2.00</td>
<td>$____</td>
</tr>
<tr>
<td>Haul and store</td>
<td>$3.24</td>
<td>____</td>
</tr>
<tr>
<td>Hired labor for harvesting forage sorghum silage</td>
<td>____</td>
<td>____</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$6.07</td>
<td>(13)$</td>
</tr>
</tbody>
</table>

**Custom Hire Costs, Class A and B**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Per Acre</th>
<th>Field Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Preparation</td>
<td>$0.00</td>
<td>(14)$</td>
</tr>
<tr>
<td>Planting and weed control</td>
<td>0.00</td>
<td>(15)</td>
</tr>
<tr>
<td>Harvesting Silage</td>
<td>0.00</td>
<td>(16)</td>
</tr>
</tbody>
</table>

**Other Variable Costs, Class A**

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Per Acre</th>
<th>Field Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>$3.50</td>
<td>(17)$</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>$5.00</td>
<td>(18)</td>
</tr>
<tr>
<td>Herbicide</td>
<td>$0.00</td>
<td>(19)</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
<td>(20)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(21)</td>
</tr>
</tbody>
</table>

**Other Variable Costs, Class B**

Will these costs be the same as those used on Class A land? (Yes - 1.0; No - 2.0) (22)_____

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Per Acre</th>
<th>Field Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>$2.50</td>
<td>(23)$</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>$5.00</td>
<td>(24)</td>
</tr>
<tr>
<td>Herbicide</td>
<td>$0.00</td>
<td>(25)</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
<td>(26)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(27)</td>
</tr>
</tbody>
</table>

Notes:
- Hours of labor needed other than custom operator and/or fixed labor supply because silage harvesting is considered to be at least a two-man job.
- Items should include only the labor required from the fixed labor supply.
- Do not include the labor required of a custom operator or hired labor because job required more than one man.


### E. Sorghum Sudan - Variable Cost and Field Time Requirements

<table>
<thead>
<tr>
<th>Field Preparation, Class A and Class B (Spring only)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Chop stalks</td>
<td>$0.57</td>
<td>$___</td>
</tr>
<tr>
<td>Spread P and K</td>
<td>$0.25</td>
<td>$___</td>
</tr>
<tr>
<td>Plow</td>
<td>$1.52</td>
<td>$___</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$2.42</td>
<td>$___</td>
</tr>
</tbody>
</table>

**Planting Operations, Class A and B**

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk</td>
<td>$1.00</td>
<td>$___</td>
</tr>
<tr>
<td>Planting</td>
<td>$0.61</td>
<td>$___</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$1.61</td>
<td>$___</td>
</tr>
</tbody>
</table>

**Weed Control, Class A and B**

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrow</td>
<td>$0.23</td>
<td>$___</td>
</tr>
<tr>
<td>Rotary Hoe</td>
<td>$0.32</td>
<td>$___</td>
</tr>
<tr>
<td>Cultivation</td>
<td>$0.22</td>
<td>$___</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$1.60</td>
<td>$___</td>
</tr>
</tbody>
</table>

**Custom Wire Costs, Class A and B**

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field preparation</td>
<td>$0.00</td>
<td>$___</td>
</tr>
<tr>
<td>Planting and weed control</td>
<td>$0.00</td>
<td>$___</td>
</tr>
</tbody>
</table>

**Other Variable Costs, Class A**

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>$5.20</td>
<td>$___</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>$3.00</td>
<td>$___</td>
</tr>
<tr>
<td>Herbicide</td>
<td>$4.00</td>
<td>$___</td>
</tr>
<tr>
<td>Insecticide</td>
<td>$0.00</td>
<td>$___</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$0.25</td>
<td>$___</td>
</tr>
</tbody>
</table>

*Herbicide applied with planter attachment in our plan.*
<table>
<thead>
<tr>
<th>Other Variable Costs, Class B</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cur Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Will these costs be the same as those used on Class A land? (Yes - 1.0; No - 2.0)</td>
<td>(15)</td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$5.50</td>
<td>(16)$</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>3.00</td>
<td>(17)</td>
</tr>
<tr>
<td>Herbicide</td>
<td>4.00</td>
<td>(18)</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
<td>(19)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>.25</td>
<td>(20)</td>
</tr>
</tbody>
</table>
### F. Costs - Variable Costs and Field Time Requirements, Class B Land

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cur Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td><strong>Growing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chop stalks</td>
<td>$ .57</td>
<td>(1)</td>
</tr>
<tr>
<td>Spread fertilizer</td>
<td>$.28</td>
<td></td>
</tr>
<tr>
<td>Disk</td>
<td>$.26</td>
<td></td>
</tr>
<tr>
<td>Seeding</td>
<td>$.55</td>
<td></td>
</tr>
<tr>
<td>Harrow</td>
<td>$.23</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$2.45</td>
<td>(2)</td>
</tr>
</tbody>
</table>

| **Harvesting Grain and Straw** | | |
| Windrow            | $0.00         |               | .00 hrs.      | (9)           |
| Combine            | $1.57         |               | .40           | (10)          |
| Haul and store     | $.60          |               | .30           | (11)          |
| Rake straw         | $.31          |               | .29           | (12)          |
| Bale straw         | $.50          |               | .26           | (13)          |
| Haul and store straw | $.42       |               | .00           | (14)          |
| Hired labor for straw baling | 0.00 | 1.16 | (15) | |
| **Subtotal**       | $0.60         | (3)           | 1.20 hrs.     | (16)          |

| **Harvesting-Cut Silage** | | |
| Windrowing          | $custom       |               | .00 hrs.      | (17)          |
| Chopping           | $1.39         |               | .55           | (18)          |
| Haul and store     | $.46          |               | .00           | (19)          |
| Hired labor for silage harvest | 0.00 | 1.65 | (20) | |
| **Subtotal**       | $3.35         | (4)           | .55 hrs.      | (21)          |

*1 Hours of labor needed other than custom operator and/or fixed labor supply because operation is considered to be at least a two-man job.

*2 Item should include only the labor required from the fixed labor supply. Do not include labor required of a custom operator or hired because job required more than one man.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cur Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Custom Hire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing</td>
<td>$0.00</td>
<td>(22)†</td>
</tr>
<tr>
<td>Combining</td>
<td>0.00</td>
<td>(23)</td>
</tr>
<tr>
<td>Baling straw</td>
<td>0.00</td>
<td>(24)</td>
</tr>
<tr>
<td>Harvesting-Cat Silage</td>
<td>3.00</td>
<td>(25)</td>
</tr>
<tr>
<td>Other Variable Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$3.50</td>
<td>(26)†</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>20.00</td>
<td>(27)†</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>0.00</td>
<td>(28)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0.25</td>
<td>(29)</td>
</tr>
</tbody>
</table>
### G. Cattle - Variable Costs and Field Time Requirements, Class C Land

<table>
<thead>
<tr>
<th></th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td><strong>Growing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spread fertilizer</td>
<td>$0.26</td>
<td>$</td>
</tr>
<tr>
<td>Flow</td>
<td>4.86</td>
<td>(1)</td>
</tr>
<tr>
<td>Disk</td>
<td>1.00</td>
<td>(2x)</td>
</tr>
<tr>
<td>Seeding</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>Harrow</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$3.37</strong></td>
<td>(2)</td>
</tr>
<tr>
<td><strong>Harvesting</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windrowing</td>
<td>$custom</td>
<td>$</td>
</tr>
<tr>
<td>Combine</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>Haul and Store</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Bake straw</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Bale straw</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>Haul and store straw</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td><strong>Hired labor for straw baling</strong></td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$8.31</strong></td>
<td>(3)</td>
</tr>
<tr>
<td><strong>Harvesting-Cat Silage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windrowing</td>
<td>$custom</td>
<td>$</td>
</tr>
<tr>
<td>Chopping</td>
<td>1.73</td>
<td></td>
</tr>
<tr>
<td>Haul and store</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td><strong>Hired labor for silage harvest</strong></td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$3.07</strong></td>
<td>(4)</td>
</tr>
</tbody>
</table>

1Hours of labor needed other than custom operator and/or fixed labor supply because operation is considered to be at least a two-man job.

2Then should include only the labor required from the fixed labor supply. Do not include labor required of a custom operator or hired because job required more than one man.
<table>
<thead>
<tr>
<th>Oats (continued)</th>
<th>Cost Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>Custom Hire</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growing</td>
<td>$0.00</td>
<td>(02)</td>
</tr>
<tr>
<td>Combining</td>
<td>$0.00</td>
<td>(02)</td>
</tr>
<tr>
<td>Baling straw</td>
<td>$0.00</td>
<td>(34)</td>
</tr>
<tr>
<td>Harvesting-oat Stlage</td>
<td>$2.00</td>
<td>(35)</td>
</tr>
<tr>
<td>Other Variable Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>$2.50</td>
<td>(06)</td>
</tr>
<tr>
<td>Fertilizer and lime</td>
<td>$2.00</td>
<td>(07)</td>
</tr>
<tr>
<td>Crop Insurance</td>
<td>$0.00</td>
<td>(08)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$0.25</td>
<td>(39)</td>
</tr>
</tbody>
</table>
Section 10. Forage Production

A. What is the productive life of the following grass and legume pastures?

<table>
<thead>
<tr>
<th>Forage Type</th>
<th>Our Plan</th>
<th>Your Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa-grass</td>
<td>2</td>
<td>(1)</td>
</tr>
<tr>
<td>Dicedfoot Trefall on Class B</td>
<td>10</td>
<td>(2)</td>
</tr>
<tr>
<td>Crown Wichita</td>
<td>10</td>
<td>(3)</td>
</tr>
<tr>
<td>Kentucky Bluegrass</td>
<td>20</td>
<td>(4)</td>
</tr>
<tr>
<td>Orchardgrass with 120 lbs. of N applied each year</td>
<td>6</td>
<td>(5)</td>
</tr>
<tr>
<td>Orchardgrass with 240 lbs. of N applied each year</td>
<td>4</td>
<td>(6)</td>
</tr>
<tr>
<td>Reed Canarygrass with 120 lbs. of N applied each year</td>
<td>8</td>
<td>(7)</td>
</tr>
<tr>
<td>Reed Canarygrass with 240 lbs. of N applied each year</td>
<td>7</td>
<td>(8)</td>
</tr>
<tr>
<td>Smooth Trifoal</td>
<td>6</td>
<td>(9)</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>20</td>
<td>(10)</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>5</td>
<td>(11)</td>
</tr>
<tr>
<td>Birdsfoot Trefall on Class C</td>
<td>10</td>
<td>(12)</td>
</tr>
</tbody>
</table>

B. Fertilizer Costs Per Pound

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Cost Per Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>$0.14</td>
</tr>
<tr>
<td>P</td>
<td>$0.14</td>
</tr>
<tr>
<td>K</td>
<td>$0.06</td>
</tr>
</tbody>
</table>

The productive life of a forage is defined as being the number of years the forage will be available for use after the seeding year.
Forage Production (continued)

3. Seed Costs Per Pound

<table>
<thead>
<tr>
<th></th>
<th>Cur Plan</th>
<th>Your Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>$1.50</td>
<td>(1)</td>
</tr>
<tr>
<td>Birdsfoot Trefoil</td>
<td>1.90</td>
<td>(2)</td>
</tr>
<tr>
<td>Crown Vetch</td>
<td>3.00</td>
<td>(3)</td>
</tr>
<tr>
<td>Kentucky Bluegrass</td>
<td>1.20</td>
<td>(4)</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>.68</td>
<td>(5)</td>
</tr>
<tr>
<td>Reed Canarygrass</td>
<td>.70</td>
<td>(6)</td>
</tr>
<tr>
<td>Smooth Berm</td>
<td>.75</td>
<td>(7)</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>.66</td>
<td>(8)</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>.39</td>
<td>(9)</td>
</tr>
</tbody>
</table>

D. Variable Costs and Field Time Requirements of Production

<table>
<thead>
<tr>
<th>Costs Per Acre</th>
<th>Hours Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cur Plan</td>
<td>Your Plan</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Planting</strong></td>
<td></td>
</tr>
<tr>
<td>Drill</td>
<td>$0.51</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$0.51</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td></td>
</tr>
<tr>
<td>Clipping</td>
<td>$0.55</td>
</tr>
<tr>
<td>Fencing</td>
<td>$0.58</td>
</tr>
<tr>
<td>Fertilizer application</td>
<td>$2.28</td>
</tr>
</tbody>
</table>

This fencing cost is for the additional fencing required when rotational or alternate grazing is used.
Section 11. Harvest and utilization of hay, crop residues, and other forages. These costs should reflect the expense incurred to perform these operations once per year.

<table>
<thead>
<tr>
<th>Variable Costs</th>
<th>Hours of Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Our Plan</td>
</tr>
<tr>
<td><strong>A. Harvesting Hay</strong></td>
<td></td>
</tr>
<tr>
<td>Now</td>
<td>$0.50/ton</td>
</tr>
<tr>
<td>Condition</td>
<td></td>
</tr>
<tr>
<td>Rake</td>
<td>$0.20/ton</td>
</tr>
<tr>
<td>Bale</td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>$2.00/ton</td>
</tr>
<tr>
<td>Small Round Bales</td>
<td>custom/ton</td>
</tr>
<tr>
<td>Large Round Bales</td>
<td>custom/ton</td>
</tr>
<tr>
<td>Nail and Store</td>
<td>$0.50/ton</td>
</tr>
<tr>
<td><strong>Custom Hire for Hay Harvesting</strong></td>
<td></td>
</tr>
<tr>
<td>Baling</td>
<td></td>
</tr>
<tr>
<td>Rectangular</td>
<td>$0.00/ton</td>
</tr>
<tr>
<td>Small Round Bales</td>
<td>$15.00/ton</td>
</tr>
<tr>
<td>Large Round Bales</td>
<td>$15.00/ton</td>
</tr>
<tr>
<td><strong>B. Harvesting Corn Stalks</strong></td>
<td></td>
</tr>
<tr>
<td>Flail Chopping</td>
<td>$0.00/ton</td>
</tr>
<tr>
<td>Hauling and Storage</td>
<td>$0.50/ton</td>
</tr>
<tr>
<td>Stalkhand Harvest</td>
<td>custom/ton</td>
</tr>
<tr>
<td>Nail and Storage</td>
<td>$0.00/ton</td>
</tr>
<tr>
<td><strong>Custom Hire for Harvesting Corn Stalks</strong></td>
<td></td>
</tr>
<tr>
<td>Flail Chopping</td>
<td>$0.00/ton</td>
</tr>
<tr>
<td>Stalkhand</td>
<td>$5.00/ton</td>
</tr>
<tr>
<td><strong>C. Hired Labor</strong></td>
<td></td>
</tr>
<tr>
<td>Hay Baling - Rectangular</td>
<td>$0.00/ton</td>
</tr>
<tr>
<td>Cornstalk Harvest - Flail Chopper</td>
<td>$0.25/ton</td>
</tr>
</tbody>
</table>

* Hours of labor needed other than custom operator and/or fixed labor supply because hay baling and harvesting cornstalk for ensiling is considered to be at least a two-man job.
Section 11 (continued)

D. Utilization of Harvested Forage

Feeding Hay $1.02/T. (1)$ _____/T.  1.1/T.  (5)_____/T.

Feeding Corn and Sorghum Silage .66/T. (2) _____/T.  .38/T.  (6)_____/T.

Feeding Oat Silage .74/T. (3) _____/T.  .18/T.  (7)_____/T.

Cornstalks in Stakhland .10/T. (4) _____/T.  .05/T.  (8)_____/T.
Section 12. Beef Cow Herd

A. General Information

1. What is the average weight of your mature beef cows? 1000 lbs. (1) ___ lbs.

2. What is the average value of your cows? $300.00 /cow (2) ___ /cow

3. Your calving season will begin? month 3 (3) month

4. What percent of cows giving birth to a calf will wean a calf? 90.0 % (4) ___ %

5. Average weaning weight of steer calves? 450.0 lbs. (5) ___ lbs.

6. Average weaning weight of heifer calves? 425.0 lbs. (6) ___ lbs.

7. What percent of the cows will be culled each year? 12.5 % (7) ___ %

B. Variable Cost and labor requirements for a cow and calf

Salt and Mineral $8.00 /head (8) ___ /head
Vet and Medical 7.00 (9) ___
Supplies 3.00 (10) ___
Power and Fuel 5.00 (11) ___
Insurance 1.00 (12) ___
Miscellaneous .50 (13) ___

Subtotal $24.50 /head (14) ___ /head

Total yearly non-feed labor for a cow and calf 2.73 hrs. (15) ___ hrs.
Section 12 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Our Plan</th>
<th>Your Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. Variable Cost and labor requirements for herd bulls</strong></td>
<td></td>
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<tr>
<td>Salt and Mineral</td>
<td>$8.00 /head</td>
<td>(16) $</td>
</tr>
<tr>
<td>Vet and Medical</td>
<td>3.00</td>
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</tr>
<tr>
<td>Supplies</td>
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<td></td>
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<tr>
<td>Power and Fuel</td>
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</tr>
<tr>
<td>Insurance</td>
<td>2.00</td>
<td></td>
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<tr>
<td>Miscellaneous</td>
<td>.50</td>
<td></td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$19.50 /head</td>
<td>(22) $</td>
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<tr>
<td><strong>Total yearly non-feed labor per bull</strong></td>
<td>3.00 hrs.</td>
<td>(23) hrs.</td>
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<td><strong>D. Variable Cost and labor requirements for replacement stock</strong></td>
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<tr>
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<td>$8.00 /head</td>
<td>(24) $</td>
</tr>
<tr>
<td>Vet and Medical</td>
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<tr>
<td>Supplies</td>
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<tr>
<td>Power and Fuel</td>
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</tr>
<tr>
<td>Insurance</td>
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<tr>
<td>Miscellaneous</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td>$20.75 /head</td>
<td>(30)</td>
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<tr>
<td><strong>Total yearly non-feed labor per replacement</strong></td>
<td>4.00 hrs.</td>
<td>(31) hrs.</td>
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### Your Plan

**Hours Available For Day For Crop**

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<th>Family Hired Labor Hours</th>
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<td><strong>February</strong></td>
<td>28</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>March 1 - 15</strong></td>
<td>15</td>
<td>9</td>
<td>3</td>
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<tr>
<td><strong>March 16 - 30</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
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<tr>
<td><strong>April 1 - 15</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>April 16 - 30</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>May 1 - 15</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>May 16 - 30</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>June 1 - 15</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>June 16 - 30</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>July 1 - 15</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>July 16 - 30</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>August 1 - 15</strong></td>
<td>15</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td><strong>August 16 - 30</strong></td>
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<td>4</td>
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<td><strong>Sept. 1 - 15</strong></td>
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<td><strong>Sept. 16 - 30</strong></td>
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<td>4</td>
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<td><strong>Nov. 16 - 30</strong></td>
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<td>10</td>
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<td><strong>December</strong></td>
<td>31</td>
<td>3</td>
<td>1</td>
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</tbody>
</table>

**Note:** Please check your plan to ensure all hours are accurately recorded. If you have hourly labor, please mark accordingly.
Section 19. Fixed Costs

1. Total annual fixed machinery and building costs chargeable to crop production.
   
   **Our Plan** | **Your Plan**
   --- | ---
   $10,220.00 |   

2. Fixed labor costs (average annual cost charge to crop and beef production).
   
   Operator and family labor: $8,000.00  
   Permanent hired labor: $0  
   
   **Total**: $8,000.00

3. Total annual fixed building and equipment costs chargeable to beef production.
   
   **Our Plan**: $227.00  
   **Your Plan**:   


APPENDIX E: SAMPLE OUTPUT OF OPTIMAL SOLUTIONS WITH VARYING FEEDER CALF PRICES
FORAGE PLAN FOR OUR PLAN DATA

LAND USE SUMMARY

<table>
<thead>
<tr>
<th>ACRES PLANTED</th>
<th>AVERAGE YIELD</th>
<th>TOTAL HARVESTED</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
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</tbody>
</table>

CLASS A LAND

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acres Planted</th>
<th>Yield</th>
<th>Total Harvested</th>
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</thead>
<tbody>
<tr>
<td>Corn</td>
<td>50.00</td>
<td>110.00</td>
<td>5500.00</td>
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<tr>
<td>Corn Silage</td>
<td>0.00</td>
<td>17.00</td>
<td>0.00</td>
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<tr>
<td>Soybeans</td>
<td>0.00</td>
<td>33.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Grain Sorghum</td>
<td>0.00</td>
<td>110.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Forage Sorghum Silage</td>
<td>0.00</td>
<td>15.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Forage Sorghum Grazing</td>
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<tr>
<td>Sorghum Sudan</td>
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<tr>
<td>TOTAL CLASS A</td>
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CLASS B LAND

<table>
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<tr>
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<td>0.00</td>
<td>100.00</td>
<td>0.00</td>
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<tr>
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<td>0.00</td>
</tr>
<tr>
<td>Forage Sorghum Grazing</td>
<td>0.00</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sorghum Sudan</td>
<td>0.00</td>
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<td>---</td>
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<tr>
<td>Oat Grain</td>
<td>43.37</td>
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<td>2602.11</td>
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<tr>
<td>Straw</td>
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</tr>
<tr>
<td>Oat Silage</td>
<td>0.00</td>
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<td>0.00</td>
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<td>Hay</td>
<td>95.77</td>
<td>3.04</td>
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<td>Pasture</td>
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CLASS C LAND

<table>
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<tr>
<td>Pasture</td>
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COMPARISON OF LAND UTILIZATION BY CLASS

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<th>Class</th>
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<th>Total Available</th>
<th>Return</th>
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<td>A</td>
<td>50.00</td>
<td>50.00</td>
<td>150.18</td>
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<tr>
<td>B</td>
<td>375.00</td>
<td>375.00</td>
<td>78.15</td>
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<tr>
<td>C</td>
<td>75.00</td>
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<td>TOTAL</td>
<td>550.00</td>
<td>500.00</td>
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1/ TOTAL YIELD FOR GRAIN IS MEASURED IN BUSHELs, TOTAL YIELD FOR HAY AND SILAGE IS MEASURED IN TON.
2/ THE RETURN FIGURE REPRESENTS THE NUMBER OF DOLLARS THE LAST ACRE CONTRIBUTED TO NET INCOME.
# Crop Expenses

## Forage Crops

### Forage Sorghum

<table>
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<tr>
<th>Item</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Fuel, Oil, Repairs</td>
<td>0.00</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>0.00</td>
</tr>
<tr>
<td>Herbicide</td>
<td>0.00</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
</tr>
<tr>
<td>Seed</td>
<td>0.00</td>
</tr>
<tr>
<td>Machine Hire</td>
<td>0.00</td>
</tr>
<tr>
<td>Other Variable Costs</td>
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</tr>
<tr>
<td>Interest</td>
<td>0.00</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td><strong>0.00</strong></td>
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### Sorgum Sudan

<table>
<thead>
<tr>
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<tbody>
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<tr>
<td>Fertilizer</td>
<td>0.00</td>
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<td>Herbicide</td>
<td>0.00</td>
</tr>
<tr>
<td>Insecticide</td>
<td>0.00</td>
</tr>
<tr>
<td>Seed</td>
<td>0.00</td>
</tr>
<tr>
<td>Machine Hire</td>
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<td>Other Variable Costs</td>
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### Hay

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### Silage

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## Grain Crops

### Grain Sorghum

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### Soybeans

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### Oats

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### CROP EXPENSES CONTINUED

#### CORNSTALKS HARVESTED

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#### LIVESTOCK EXPENSES

##### COW-CALF 164.12 HEAD

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<td>Salt and Mineral</td>
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##### BULLS 6.56 HEAD

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<td>Interest</td>
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##### REPLACEMENTS 21.15 HEAD

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**INCOME STATEMENT**

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**RETURN OVER VARIABLE COST**

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**LABOR SUMMARY**

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<th>RETURN</th>
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**EXPENSES**

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1/ HOURLY HIRED LABOR DOES NOT INCLUDE HOURLY LABOR HIRED BECAUSE A JOB REQUIRES MORE THAN ONE MAN
2/ THE RETURN FIGURE REPRESENTS THE NUMBER OF DOLLARS THE LAST HOUR CONTRIBUTED TO NET INCOME
### Forages in the Plan

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<tr>
<th>Forage Type</th>
<th>Acres</th>
<th>Penalty</th>
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<tbody>
<tr>
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<td>14.98</td>
</tr>
<tr>
<td>3-Season</td>
<td>0.00</td>
<td>20.29</td>
</tr>
<tr>
<td>3-Season Early</td>
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<td>20.77</td>
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<tr>
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<td>3-Season Early</td>
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</tr>
<tr>
<td>Harvest 1 Crop</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Harvest 2 Crops</td>
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<td>0.00</td>
</tr>
<tr>
<td>Alfalfa Grass</td>
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<td>Rotational Graze</td>
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<tr>
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<td>0.00</td>
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<tr>
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<td>Smooth Brome 120N</td>
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1/ The penalty refers to how much net income would be reduced if one acre of this forage was included in the plan.
### Supplemental Pastures Class A

<table>
<thead>
<tr>
<th>Forage</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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<tbody>
<tr>
<td>Sorghum Sudan Alt. Gr.</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
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### Supplemental Pastures Class B

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<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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### Cornstalks Grazed

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<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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</thead>
<tbody>
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### Grain Sorghum Stubble Grazed

<table>
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<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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### Total Digestible Nutrients

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<th>Excess</th>
<th>Return</th>
</tr>
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### Digestible Protein

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1/ The return figure represents how much the last pound of ton or digestible protein contributed to net income.
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<th>FEBRUARY</th>
<th>MARCH</th>
<th>APRIL</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUGUST</th>
<th>SEPTEMBER</th>
<th>OCTOBER</th>
<th>NOVEMBER</th>
<th>DECEMBER</th>
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<tbody>
<tr>
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<td>0.00</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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This section reports the optimal solution with price of feeder calves 15% higher than plan 1.

### Land Use Summary

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### Comparison of Land Utilization by Class

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1. Total yield for grain is measured in bushels, total yield for hay and silage is measured in ton.
2. The return figure represents the number of dollars the last acre contributed to net income.
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| SORGHUM SUCAN          |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 0.00     |          |          |          |          |          |          |          |          |
| FERTILIZER             | 0.00     |          |          |          |          |          |          |          |          |
| HERBICIDE              | 0.00     |          |          |          |          |          |          |          |          |
| INSECTICIDE            | 0.00     |          |          |          |          |          |          |          |          |
| SEED                   | 0.00     |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 0.00     |          |          |          |          |          |          |          |          |
| INTEREST               | 0.00     |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 0.00     |          |          |          |          |          |          |          |          |

| HAY                    |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 1080.38  |          |          |          |          |          |          |          |          |
| FERTILIZER             | 2680.51  |          |          |          |          |          |          |          |          |
| SEED                   | 358.33   |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 154.26   |          |          |          |          |          |          |          |          |
| INTEREST               | 162.61   |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 4436.08  |          |          |          |          |          |          |          |          |

| PASTURE                |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 156.98   |          |          |          |          |          |          |          |          |
| FERTILIZER             | 1298.09  |          |          |          |          |          |          |          |          |
| SEED                   | 202.74   |          |          |          |          |          |          |          |          |
| FENSING                | 5.96     |          |          |          |          |          |          |          |          |
| INTEREST               | 70.82    |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 1734.60  |          |          |          |          |          |          |          |          |

| SILAGE                 |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 0.00     |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| INTEREST               | 0.00     |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 0.00     |          |          |          |          |          |          |          |          |

| GRAIN CROPS            |          |          |          |          |          |          |          |          |          |
| FORAGE SORGHUM         |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 0.00     |          |          |          |          |          |          |          |          |
| FERTILIZER             | 0.00     |          |          |          |          |          |          |          |          |
| HERBICIDE              | 0.00     |          |          |          |          |          |          |          |          |
| INSECTICIDE            | 0.00     |          |          |          |          |          |          |          |          |
| SEED                   | 0.00     |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 0.00     |          |          |          |          |          |          |          |          |
| INTEREST               | 0.00     |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 0.00     |          |          |          |          |          |          |          |          |

| GRAIN CORN             |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 1646.28  |          |          |          |          |          |          |          |          |
| FERTILIZER             | 4246.91  |          |          |          |          |          |          |          |          |
| HERBICIDE              | 1155.47  |          |          |          |          |          |          |          |          |
| INSECTICIDE            | 495.20   |          |          |          |          |          |          |          |          |
| SEED                   | 1360.61  |          |          |          |          |          |          |          |          |
| DRYING COSTS           | 344.98   |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 536.47   |          |          |          |          |          |          |          |          |
| INTEREST               | 342.51   |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 10128.42 |          |          |          |          |          |          |          |          |

| GRAIN SORGHUM          |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 94.64    |          |          |          |          |          |          |          |          |
| FERTILIZER             | 277.78   |          |          |          |          |          |          |          |          |
| HERBICIDE              | 69.45    |          |          |          |          |          |          |          |          |
| INSECTICIDE            | 29.76    |          |          |          |          |          |          |          |          |
| SEED                   | 49.60    |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 32.24    |          |          |          |          |          |          |          |          |
| INTEREST               | 20.06    |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 593.18   |          |          |          |          |          |          |          |          |

| SOYBEANS               |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 0.00     |          |          |          |          |          |          |          |          |
| FERTILIZER             | 0.00     |          |          |          |          |          |          |          |          |
| HERBICIDE              | 0.00     |          |          |          |          |          |          |          |          |
| INSECTICIDE            | 0.00     |          |          |          |          |          |          |          |          |
| SEED                   | 0.00     |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 0.00     |          |          |          |          |          |          |          |          |
| INTEREST               | 0.00     |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 0.00     |          |          |          |          |          |          |          |          |

| OATS                   |          |          |          |          |          |          |          |          |          |
| FUEL, OIL, REPAIRS     | 509.90   |          |          |          |          |          |          |          |          |
| FERTILIZER             | 956.31   |          |          |          |          |          |          |          |          |
| SEED                   | 160.15   |          |          |          |          |          |          |          |          |
| MACHINE HIRE           | 0.00     |          |          |          |          |          |          |          |          |
| OTHER VARIABLE COSTS   | 11.44    |          |          |          |          |          |          |          |          |
| INTEREST               | 57.32    |          |          |          |          |          |          |          |          |
| SUBTOTAL               | 1695.12  |          |          |          |          |          |          |          |          |
## CROP EXPENSES CONTINUED

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### LIVESTOCK EXPENSES

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#### REPLACEMENTS (0.00 HEAD)

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# RETURN OVER VARIABLE COST

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# LABOR SUMMARY

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1/ Hourly hired labor does not include hourly labor hired because job requires more than one man.
2/ The return figure represents the number of dollars the last hour contributed to net income.
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1/ THE PENALTY REFERS TO HOW MUCH NET INCOME WOULD BE REDUCED IF ONE ACRE OF THIS FORAGE WAS INCLUDED IN THE PLAN.
### Forages in the Plan Continued

#### Supplemental Pastures Class A

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<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
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#### Cornstalks Grazed

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<th>Dec</th>
<th>Jan</th>
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#### Grain Sorghum Stubble Grazed

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### Nutrient Requirements

#### Total Digestible Nutrients

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#### Digestible Protein

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1/ The return figure represents how much the last pound of TDN or digestible protein contributed to net income.
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<th>April</th>
<th>May</th>
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<th>July</th>
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This section reports the optimal solution with price of feeder calves 15% lower than in Plan 1.

### Land Use Summary

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### Comparison of Land Utilization by Class

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1/ Total yield for grain is measured in bushels, total yield for hay and silage is measured in ton.

2/ The return figure represents the number of dollars the last acre contributed to net income.
<table>
<thead>
<tr>
<th>CROP EXPENSES</th>
<th>GRAIN CROPS</th>
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<td><strong>GRAIN CROPS</strong></td>
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<td><strong>SORGHUM SUCAN</strong></td>
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<td>FUEL, OIL, REPAIRS</td>
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<td>FERTILIZER</td>
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<tr>
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<td>HERBICIDE</td>
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<td>INSECTICIDE</td>
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<td><strong>SUBTOTAL</strong></td>
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<td><strong>SOYBEANS</strong></td>
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<td>FERTILIZER</td>
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<tr>
<td>SEED</td>
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**TOTAL:**

- Forage Crops: 10776.47
- Grain Crops: 3837.68
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<th>Cost (000's)</th>
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### INCOME STATEMENT

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**RETURN OVER VARIABLE COST**

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**RETURN TO MANAGEMENT**

|                      | 3312.40    |

### EXPENSES

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### LABOR SUMMARY

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1/ Hourly Hired Labor does not include hourly labor hired because job requires more than one man.
2/ The return figure represents the number of dollars the last hour contributed to net income.
# Forages in the Plan

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## Solution 3 Page 5

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1/ The penalty refers to how much net income would be reduced if one acre of this forage was included in the plan.
### Forages in the Plan Continued

#### Supplemental Pastures Class A

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#### Cornstalks Grazed

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### Nutrient Requirements

#### Total Digestible Nutrients

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#### Digestible Protein

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1/ The return figure represents how much the last pound of ton or digestible protein contributed to net income.
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