

THE DEVELOPMENT OF FORAGE NUTRIENT  
VALUE COEFFICIENTS FOR USE IN  
CARD'S 1985 RCA MODEL

by

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## INTRODUCTION

After preliminary work on the livestock sector for the 1985 CARD/RCA model was completed in the summer of 1983, it was felt that one of the weaker areas in the sector was the linkage between the livestock sector and the range sector. At that time it was decided that the best way to approach this problem would be through the development of feed transfer activities.

The purpose of this paper is to present a brief overview of the development of the nutrient value coefficients for net energy, protein, calcium, and phosphorus supplied by grazed forages in the 31 market regions. The data developed in this paper serves as coefficients for feed transfer activities in the livestock sector of the CARD/RCA model. This overview will include:

- I. A discussion of how the nutrient supplies of grazed forages were originally calculated and the methods used for converting to pasture transfer coefficients, and some of the problems with that method;
- II. A discussion of how the new method evolved to eliminate some of the weaknesses in the original linkage; and finally,
- III. A brief look at weaknesses that still exist and new weaknesses that were discovered with these new coefficients.

Originally, the net energy, protein, calcium, and phosphorus values for grazed forages utilized by the beef and dairy activities were calculated as aggregate values for all 28 market regions. Thus, there were only eight different coefficients used in the feed transfer activities. As shown in Appendix C, Table C.1, the original coefficients for beef were calculated as an average of the National Research Council's (NRC)<sup>1</sup> nutrient values for Kentucky Blue Grass, Brome Grass, Timothy, and Reed Canary Grass. The four coefficients for dairy were originally calculated as an average of only the first three of the above.

After these eight values had been developed, they were converted to the coefficients used in the feed transfer activities. Separate conversions were needed for protein and net energy values and calcium and phosphorus values.

#### Protein, Calcium, and Phosphorus Conversion

In the NRC tables, protein, calcium, and phosphorus had been given as a straight percentage of the dry matter for each of the grazed forages. From Table C.1 a dry matter content of 36.4 percent for beef and 40 percent for dairy was assumed for all market regions. Since the feed transfer activities for forages come into the livestock model in tons, the first step is to determine the dry matter value of a ton and then multiply that times the nutrient value percentages for protein,

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<sup>1</sup>As provided by the National Academy of Sciences publications on nutrient requirements for beef and dairy cattle.

calcium, and phosphorus. This procedure determined the pounds of a given nutrient supplied in a ton of pasture. The final step in the conversion converted the pounds per ton units to kilograms per ton. Therefore, in the original conversion, the following formula provided the nutrient value coefficients:

$$(2000 \times \text{DM}\%) \times (\text{NV}) \times (.4536) = \text{Coefficient value for protein}$$

where:

NV and DM% are the appropriate constant values from Table C.1.

The coefficients for calcium and phosphorus were too small for proper representation in the matrix. To get more usable values, the formula was modified grams per ton was calculated rather than the kilogram. Thus, the formula for calculating calcium and phosphorus values was:

$$(2000 \times \text{DM}\%) \times (\text{NV}) \times (.4536) \times (1000) = \text{Coefficient values for calcium and phosphorus}$$

#### Net Energy Conversion

The net energy coefficients were developed according to the following formula based on information found in the NRC guides to nutrient requirements of beef and dairy cattle:

$$NE = [(NE_M + NE_G)/2] + NE_L / 2(\text{Mkal/kg})$$

where: NE = net energy value used  
 NE<sub>M</sub> = net energy required for maintenance  
 NE<sub>G</sub> = net energy required for gains  
 NE<sub>L</sub> = net energy required for lactation

For the beef coefficients only the first part of the formula was used since NE<sub>L</sub> values are not applicable for beef.

Because the net energy values from the NRC data are in units of milocalories per kilogram, they also had to be converted to units appropriate for the feed transfer activities (milicalories per ton).

Thus, the formula for net energy became:

$$(2000 \times \text{DM}\%) \times (\text{NE}) \times (.4536) = \text{Coefficient value for net energy}$$

#### Weaknesses in This Approach

It is obvious that this is not an accurate representation of the nutrient levels supplied by grazed forages in different parts of the country. In fact, not only are different forages used in varying amounts in different areas, but the nutrient values of the approximately 85 statistical species<sup>1</sup> used as grazed forages varied widely in nutritive content and dry matter percentage (upon which the nutrient values are based). Therefore, a better representation of the forages grown in different areas of the country and, specifically, different market regions is required.

<sup>1</sup>As determined by our state extension survey discussed in Part II of this report.

The best way to determine the nutrient values provided by the different combinations of forages utilized in grazing in the different market regions across the country is to determine precisely which forages were being used and in what proportion. Then weights for determining grazed forage nutrient values are developed. These are based on the NRC data on nutrient content of the various species.

#### Information on State Proportions

An exhaustive list of possible forages utilized in each state was developed. Surveys similar to Table 1 were then sent to state extension forage specialists. In those surveys the extension specialist had an opportunity to divide his state into three separate areas. He was requested to give his "best estimations" as to how these forages would break-down proportionally on a wet-matter basis in the grazed diets of beef and dairy cattle. Positive responses were received from 39 of the 48 states.<sup>1</sup> Thirty-seven of those state specialists responded according to the format of the survey and those responses are documented in Appendix A, Tables A.1 through A.37. Two states, California and Arizona, provided information that was used to calculate the nutrient value coefficients in those states. This information is documented in Appendix B, Tables B.1 and B.2.

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<sup>1</sup>See Appendix C, Table C.2 to identify those forage specialists that participated in the survey.

Table 1. Example of survey sent to state forage extension specialists

Kentucky	Beef			Dairy		
Big Bluestem	---	---	---	---	---	---
Little Bluestem	---	---	---	---	---	---
Sideoats Grama	---	---	---	---	---	---
Switch Grass	---	---	---	---	---	---
Kentucky Bluegrass	---	---	---	---	---	---
Redtop	---	---	---	---	---	---
Smooth Bromegrass	---	---	---	---	---	---
Reed Canarygrass	---	---	---	---	---	---
Timothy	---	---	---	---	---	---
Orchard Grass	---	---	---	---	---	---
Tall Fescue	---	---	---	---	---	---
Ryegrasses	---	---	---	---	---	---
Bermuda Grass	---	---	---	---	---	---
Johnsongrass	---	---	---	---	---	---
Dallisgrass	---	---	---	---	---	---
Forage Sorghums	---	---	---	---	---	---
Forage Small Grains	---	---	---	---	---	---
Red Clover	---	---	---	---	---	---
White Clover	---	---	---	---	---	---
Crimson Clover	---	---	---	---	---	---
Birdsfoot Trefoil	---	---	---	---	---	---
Lespedezas	---	---	---	---	---	---
Crownvetch	---	---	---	---	---	---
Hairy Vetch	---	---	---	---	---	---
Kudzu	---	---	---	---	---	---
Alfalfa	---	---	---	---	---	---
Other (Specify)	---	---	---	---	---	---
Other (Specify)	---	---	---	---	---	---
Other (Specify)	---	---	---	---	---	---
	100	100	100	100	100	100

### The Nutrient Value Information

Once the information from the state forage extension people was analyzed, approximately 85 species (out of the original 200 included in the survey) of forages were identified as being grazed in substantial amounts. However, nutrient values for approximately 40 of the species were documented in the NRC Guides. The other 35 sets of values are derived from a variety of different sources. These sources are documented in Appendix C, Table C.3. The actual calculations of these values are available but not included in this report.

While this methodology determined values for the majority of values, there are between 5 and 10 species for which no nutrient values are available. Fortunately, these species represent a very small proportion of the total grazed forage in any one area of any state. It was assumed that the missing values could be approximated by values of other species for which data was available.

### Aggregating the Values

After the nutrient value information on protein percent, calcium percent, phosphorus percent, and net energy is compiled, this information for each area that the state forage specialists has designated within a particular state is aggregated.

Aggregate values for dry matter percent, protein percent, calcium percent, phosphorus percent, and the respective net energies are developed based on the proportional breakdown that the state extension spe-



cialists made. When this process of aggregation is completed, 39 (multiplied by the number of beef regions in each state) sets of nutrient value provided by grazed forages to beef and 39 (multiplied by the number of dairy regions in each state) sets provided by grazed forages to dairy provide information for the development of feed transfer activities.

#### A comparison of this methodology

The coefficients developed in this paper vary greatly from the original coefficients used. These differences are clearly represented by looking at the "old" and "new" values for Kentucky, southern Florida, and Iowa in Table 2. (Because of lack of space, the values for all states and areas within those states are not included in this summary, but are available.)

From Table 2 a couple of trends are obvious. First, it is obvious that the constant dry matter percentage that was originally used tended to make the calculations misleading, even if the nutrient values for the various forages had been similar. Secondly, the specific forages that were used in the original average to get the "old values" were all high in net energy. This leads to higher net energy values than from any of the combinations of forages than provided by the extension forage specialists.

Table 2. Comparisons of "old" and "new" nutrient values for Kentucky, southern Florida, and Iowa

	NE (mcal/ton)	Protein (kg/ton)	Calcium (g/ton)	Phosphorus (g/ton)
<b>Beef</b>				
Old values (All states)	599.351	36.324	1,222.910	961.597
New values for Kentucky	275.123	43.198	1,702.536	910.606
New values for southern Florida	209.701	28.169	1,288.160	533.502
New values for Iowa	293.639	48.961	2,477.268	1,033.340

#### The Feed Transfer Activities

Once the conversions are completed, the areas within each state have to be assigned to one of the 31 market regions and then those values weighted within each market region. This process is still being completed at the present time.

## WEAKNESSES

The linkage between forages and livestock use has been improved. However, through the work with the respective state forage specialists on the new coefficients, a couple of new problems are acknowledged.

The first problem with this new linkage is that information on proportions of grazed forages was not received for the following states:

Colorado	Minnesota	Oklahoma
Delaware	North Dakota	Utah
Georgia	South Dakota	Wyoming

However, it is felt that the nutrient values of grazed forages in these states can be fairly represented by combinations of results from neighboring states and that these values will be much more representative of these areas than the original values used.

The second problem is the one that is widely known to anyone dealing with forages in the western part of the United States . . . the uncertainty of what is really being consumed by beef cattle and to a lesser extent dairy cattle in these areas. Along the same reasoning is the problem of fluctuations of the nutrient values and dry matter percentages (as well as palatability), especially in the western part of the country. Through the greatly appreciated cooperation of the forage extension people in these areas, these values are the best available at this time. With certainty, however, it can be said that these new coefficients are more representative than those that were previously developed.

Future work can certainly be done to improve upon the coefficients that will be used in the pasture feed transfer activities for the 1985 CARD/RCA model. As more knowledge becomes available on the proportions of grazed forages and on the nutrient values of those forages. The pasture transfer activities will become more precise.

#### Conclusion

Since the preliminary work on the livestock sector was completed in the summer of 1983, the pasture transfer activity coefficients for the grazed beef and dairy activities have been disaggregated from a national set of values for beef and a national set of values for dairy to a set of weighted-value coefficients that are based on a particular group of areas within each state as determined by the respective extension forage specialist in each state. These values are more representative of the varying combinations of forages that are utilized in different market regions and the different aggregate dry matter percentages in different areas of the country.

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APPENDIX A

RELATIVE IMPORTANCE OF VARIOUS FORAGES IN THE  
RESPECTIVE STATES AS ESTIMATED BY THE  
STATE EXTENSION FORAGE SPECIALISTS

TABLE A. 1

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN ALABAMA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	NORTH	BLBLT	SOUTH	NORTH	BLBLT	SOUTH
ORCHARD GRASS	1.000			3.000		
TALL FESCUE	42.000	17.500	3.000	19.000	10.500	
RYEGRASSES	9.000	10.000	12.000	17.000	14.500	19.000
BAHIAGRASS	5.000	10.000	43.000	1.000	4.000	21.500
CARPET GRASS	0.500	2.000	2.000			
BERMUDA GRASS	12.000	10.000	16.500	6.000	4.000	11.000
JOHNSONGRASS	0.500	4.000		0.500	5.000	
DALLISGRASS	2.000	24.000	2.000	4.000	28.500	2.000
FORAGE SORGHUMS	3.000	4.000	2.000	8.000	8.000	6.000
FORAGE SMALL GRAINS	5.000	5.000	7.000	12.500	9.000	15.500
RED CLOVER	2.000	1.500	0.500	5.000	2.000	1.000
WHITE CLOVER	6.000	3.500	1.000	8.000	6.000	3.000
CRIMSON CLOVER	1.000	0.500	1.500	3.000	1.500	2.000
ARROWLEAF CLOVER	2.000	2.000	3.000	5.000	2.000	7.000
LESPEDEZAS	6.000	2.000	1.000			
HAIKY VETCH	1.000	0.500	0.500	2.000	1.000	1.000
COMMON VETCH			0.500			1.000
BALL CLOVER		0.500	1.000		0.500	1.000
PERSIAN CLOVER		0.500			0.500	
KUDZU	0.500	0.500	0.500	0.500	0.500	0.500
ALFALFA				2.000	0.500	0.500
MILLET	1.500	2.000	3.000	3.500	2.000	8.000
	100%	100%	100%	100%	100%	100%

BLBLT REFERS TO THE BLACK BELT REGION OF ALABAMA

TABLE A. 2

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN ARKANSAS

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	N 1/3	C 1/3	S 1/3	N 1/3	C 1/3	S 1/3
LITTLE BLUESTEM	2.000	2.000	2.000	2.000	2.000	2.000
ORCHARD GRASS	1.000	1.000		1.000	1.000	
TALL FESCUE	68.000	44.000	18.000	68.000	44.000	18.000
RYEGRASSES	3.000	4.000	7.000	3.000	4.000	7.000
BAHIA GRASS		5.000	15.000		5.000	15.000
BERMUDA GRASS	18.000	35.000	49.000	18.000	35.000	49.000
FORAGE SORGHUMS	2.000	2.000	2.000	2.000	2.000	2.000
FORAGE SMALL GRAINS	3.000	4.000	5.000	3.000	4.000	5.000
ALFALFA	3.000	3.000	2.000	3.000	3.000	2.000
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

N REFERS TO NORTH, C REFERS TO CENTRAL, AND S TO SOUTH





TABLE A.4

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN FLORIDA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	NORTH	CNTRA	SOUTH	NORTH	CNTRA	SOUTH
TALL FESCUE	0.500					
RYEGRASSES	4.000	4.000	2.000	1.000	1.000	1.000
BAHIA GRASS	40.000	42.000	40.000	40.000	56.000	40.000
CARPET GRASS	26.000	29.000	36.000			
BERMUDA GRASS	22.000	17.000	8.000	41.000	30.000	2.000
DIGIT GRASS		1.000	10.000			50.000
SAINT AUGUSTINE GRASS			3.000			
FORAGE SORGHUMS	1.000	1.000		6.000	5.000	2.000
FORAGE SMALL GRAINS	2.000	1.000		7.000	4.000	1.000
RED CLOVER	0.500	0.500		1.000	1.000	
SWEET CLOVER		0.500				
WHITE CLOVER	4.000	4.000	1.000	3.000	3.000	4.000
CRIMSON CLOVER				1.000		
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

CNTRA REFERS TO THE CENTRAL PART OF THE STATE  
VERY LITTLE DAIRY CATTLE FORAGING IN FLORIDA



TABLE A.6

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN ILLINOIS

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS	
	N 1/4	C 1/2	S 1/4	N 1/2	S 1/2
KENTUCKY BLUEGRASS	35.000	35.000	20.000	25.000	30.000
REDTOP			2.000		1.000
SMOOTH BROMEGRASS	25.000	10.000	3.000	30.000	10.000
REED CANARYGRASS		1.000	2.000		
TIMOTHY	2.000	5.000	5.000	5.000	10.000
ORCHARD GRASS		10.000	20.000	5.000	10.000
TALL FESCUE		5.000	12.000		5.000
RYEGRASSES					1.000
FORAGE SMALL GRAINS		1.000	2.000		1.000
RED CLOVER	10.000	10.000	10.000	10.000	10.000
ALSIKE CLOVER		1.000	1.000		
WHITE CLOVER	1.000	2.000	3.000		1.000
BIRDSFOOT TREFOIL	2.000				
LESPEDEZAS			5.000		1.000
ALFALFA	25.000	20.000	15.000	25.000	20.000
	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%

N REFERS TO NORTH, C REFERS TO CENTRAL, AND S TO SOUTH





TABLE A.9

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN KANSAS

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	NE/SE	C 1/3	W 1/3	ENTIRE STATE		
WESTERN WHEAT GRASS		5.000	5.000			
BIG BLUESTEM	4.000	15.000	5.000			
LITTLE BLUESTEM	4.000	20.000	10.000			
SAND BLUESTEM		5.000	10.000			
SIDEOATS GRAMA		15.000	10.000			
BLUE GRAMA		10.000	50.000			
SWITCH GRASS		5.000				
KENTUCKY BLUEGRASS	2.500	5.000				
SMOOTH BROMEGRASS	38.000				5.000	
ORCHARD GRASS	1.500					
TALL FESCUE	37.500				5.000	
FORAGE SORGHUMS	5.000	5.000	5.000		40.000	
FORAGE SMALL GRAINS	5.000	5.000	5.000		5.000	
LESPEDEZAS	2.500					
ALFALFA					40.000	
MILLET					5.000	
INDIAN RICEGRASS		10.000				
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

NE/SE REFERS TO THE NORTHEASTERN AND SOUTHEASTERN  
PORTIONS OF THE STATE, C REFERS TO THE CENTRAL PART OF  
THE STATE, AND W REFERS TO THE WESTERN PART OF THE STATE









TABLE A.13

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN MARYLAND

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	WEST	CTRAL	SHORE	ENTIRE STATE		
KENTUCKY BLUEGRASS	16.000	30.000	10.000	16.000		
SMOOTH BROMEGRASS	0.500	1.000		1.500		
REED CANARYGRASS	0.500	0.500	0.500			
TIMOTHY	5.000	5.000	1.000	2.000		
ORCHARD GRASS	15.000	10.000	10.000	26.000		
TALL FESCUE	24.000	22.500	25.000			
BERMUDA GRASS			4.500			
FORAGE SORGHUMS	1.000	1.000	5.000	2.000		
FORAGE SMALL GRAINS	1.000	1.000	10.000	2.000		
RED CLOVER	15.000	24.000	18.000	26.000		
WHITE CLOVER	10.000	2.000	5.000	20.000		
BIRDSFOOT TREFOIL	5.000			1.000		
LESPEDEZAS	0.500	1.000	10.000	2.000		
CROWN VETCH	4.000			1.000		
HAIKY VETCH	0.500	0.500	0.500	0.500		
ALFALFA	2.000	1.500	0.500			
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

CNTRAL REFERS TO THE CENTRAL PART OF THE STATE AND SHORE  
REFERS TO THE SOUTHERN AND EASTERN SHORES.



TABLE A. 15

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN MICHIGAN

FORAGES INCLUDE	BEEF REGIONS		DAIRY REGIONS		
	L PEN	U PEN	L PEN	U PEN	
KENTUCKY BLUEGRASS	27,300	23,000	20,000	20,000	
SMOOTH BROMEGRASS	15,000	10,000	19,000	14,000	
REED CANARYGRASS	1,000	2,000	1,000	1,000	
TIMOTHY	10,000	10,000	10,000	10,000	
ORCHARD GRASS	5,000	6,000	5,000	5,000	
RED CLOVER	10,000		5,000	10,000	
ALSIKE CLOVER	1,000	10,000	1,000	1,000	
SWEET CLOVER	0,200				
WHITE CLOVER	5,000	7,000	3,000	7,000	
BIRDSFOOT TREFOIL	0,500	12,000	1,000	15,000	
ALFALFA	15,000	10,000	25,000	5,000	
SUDANGRASS	3,000		5,000	2,000	
QUACKGRASS	7,000	10,000	5,000	10,000	
	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%

L PEN AND U PEN REFER TO LOWER AND UPPER PENINSULAS OF  
MICHIGAN









TABLE A.19

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN NEBRASKA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	E 1/3	PHAND	S-WC	SE	NE	
WESTERN WHEAT GRASS		20.000	5.000			
INTERMEDIATE & PUBESCENT WHEAT GRASS	2.000				5.000	
BIG BLUESTEM	10.000		5.000			
LITTLE BLUESTEM	1.000	1.000	15.000			
SIDEOATS GRAMA	1.000	1.000				
BLUE GRAMA		25.000	25.000			
BUFFALO GRASS		5.000	10.000			
SWITCH GRASS	5.000		7.000			
KENTUCKY BLUEGRASS	20.000			20.000	25.000	
SMOOTH BROMEGRASS	50.000		5.000	70.000	50.000	
REED CANARYGRASS	1.000					
ORCHARD GRASS					5.000	
TALL FESCUE	1.000					
FORAGE SORGHUMS	1.000	2.000	3.000	1.000	1.000	
RED CLOVER				1.000	2.000	
WHITE CLOVER					2.000	
ALFALFA	2.000			8.000	10.000	
SALTGRASS		2.000				
INDIAN RICEGRASS	1.000					
NEEDLE GRASS		20.000	15.000			
SAND DROPSEED		5.000				
PRAIRIE SANDREED		15.000				
FORBS	5.000	4.000	10.000			
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

PHAND REFERS TO THE PANHANDLE OF NEBRASKA

S-WC REFERS TO THE SOUTHWEST AND SOUTHCENTRAL REGIONS



TABLE A.21

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN NEW HAMPSHIRE.

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	NORTH	C&S		NORTH	C&S	
KENTUCKY BLUEGRASS	39.000	25.000		37.500	21.000	
REDTOP	6.000	5.000		6.000	3.000	
SMOOTH BROMEGRASS	1.000	4.000		1.000	5.000	
REED CANARYGRASS	1.000	2.000		1.000	4.000	
TIMOTHY	35.000	22.000		33.500	18.000	
ORCHARD GRASS	2.000	10.000		2.000	11.000	
TALL FESCUE	2.000	3.000		2.000	3.000	
FORAGE SMALL GRAINS		4.000			5.000	
RED CLOVER	5.000	7.000		5.000	8.000	
ALSIKE CLOVER	3.000	4.000		3.000	4.000	
WHITE CLOVER	6.000	9.000		6.000	10.000	
ALFALFA		5.000		3.000	8.000	
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

C&S REFERS TO THE CENTRAL AND SOUTHERN PARTS OF NH  
THE NORTHERN COUNTIES OF GRAFTON AND CARROL ARE  
SIGNIFIED BY THE NORTH AREA



TABLE A.23

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN NEW MEXICO

FORAGES INCLUDE	BEEF REGIONS		DAIRY REGIONS		
	E 1/2	W 1/2	(NO DAIRY GRAZING)		
WESTERN WHEAT GRASS	1.000	3.000			
CRESTED WHEAT GRASS		1.000			
TALL WHEAT GRASS	2.000	2.000			
SIDEOATS GRAMA	1.000	2.000			
BLUE GRAMA	40.000	40.000			
BUFFALO GRASS	10.000	5.000			
SAND LOVE GRASS	4.000	4.000			
TALL FESCUE	5.000	8.000			
FORAGE SMALL GRAINS	10.000	8.000			
ALFALFA	2.000	2.000			
GALLETA GRASS	10.000	10.000			
SAND DROPSEED	15.000	15.000			
	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%

IN NEW MEXICO ALMOST ALL OF THE FORAGES UTILIZED BY  
DAIRY CATTLE ARE AS HAYS(ALFALFA)



TABLE A. 25

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN NORTH CAROLINA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	CSTPL	PIEDM	MOUNT	CSTPL	PIEDM	MOUNT
KENTUCKY BLUEGRASS	16.000	32.000	48.000	21.000	28.000	56.000
TIMOTHY			1.000			
ORCHARD GRASS		10.000	18.000		25.000	20.000
TALL FESCUE	11.000	30.000	20.000	5.000	15.000	10.000
RYEGRASSES	8.000	5.000		15.000	5.000	
BAHIA GRASS	1.000			1.000		
CARPET GRASS	2.000			1.000		
BERMUDA GRASS	24.000	3.000		20.000		
DALLISGRASS	2.000			1.000		
VASEYGRASS	1.000			1.000		
FORAGE SORGHUMS	10.000	3.000		13.000	10.000	
FORAGE SMALL GRAINS	10.000	5.000		15.000	10.000	
RED CLOVER		2.000	2.000		2.000	3.000
WHITE CLOVER	4.000	6.000	10.000	5.000	5.000	11.000
CRIMSON CLOVER	2.000			2.000		
LESPEDEZAS	3.000	2.000				
HAIRY VETCH	1.000	1.000				
FORAGE SOYBEAN	5.000					
ALFALFA		1.000	1.000			
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

CSTPL REFERS TO THE COASTAL PLAINS OF NORTH CAROLINA  
 PIEDM REFERS TO THE PIEDMONT REGION OF N.C.  
 MOUNT REFERS TO THE MOUNTAIN REGIONS OF N.C.







TABLE A.28

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN PENNSYLVANIA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	SE1/3	REST		SE1/3	REST	
SWITCH GRASS	2.000	2.000				
KENTUCKY BLUEGRASS	20.000	25.000		21.000	30.000	
REDTOP	2.000			2.000		
SMOOTH BROMEGRASS	5.000	5.000		12.000	15.000	
REED CANARYGRASS	5.000	10.000		5.000	10.000	
TIMOTHY	15.000	17.000		21.000	20.000	
ORCHARD GRASS	15.000	10.000		18.000	15.000	
JOHNSONGRASS	10.000	10.000		2.000		
FORAGE SMALL GRAINS	3.000			2.000		
RED CLOVER	10.000	10.000		7.000		
ALSIKE CLOVER					2.000	
WHITE CLOVER	10.000	5.000		5.000	3.000	
BIRDSFOOT TREFOIL		3.000			5.000	
CROWN VETCH		1.000				
BOTTLEBRUSH SQUIRRELTAIL	3.000	2.000		5.000		
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

HERE THE SOUTHEASTERN 1/3 OF PENNSYLVANIA IS SEPARATED  
FROM THE REST OF THE STATE



TABLE A.30

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN SOUTH CAROLINA

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	PIEDM	CSTPL		PIEDM	CSTPL	
ORCHARD GRASS	2.000					
TALL FESCUE	62.000	3.000		26.000		
RYEGRASSES	1.000	2.000		1.000	1.000	
BAHIA GRASS	1.000	8.000			2.000	
CARPET GRASS		1.000				
BERMUDA GRASS	8.000	50.000		15.000	36.000	
DALLISGRASS	7.000	15.000		5.000	10.000	
FORAGE SORGHUMS	2.000			5.000	3.000	
FORAGE SMALL GRAINS	10.000	15.000		25.000	25.000	
RED CLOVER	0.500					
WHITE CLOVER	1.500			0.500		
CRIMSON CLOVER	0.500	1.000		1.000	1.000	
ARROWLEAF CLOVER	1.000	1.000		1.000	1.000	
LESPEDEZAS	1.500	1.000		1.000	1.000	
ALFALFA				0.500		
SUDANGRASS	1.000	1.000		10.000	5.000	
MILLET	1.000	2.000		9.000	15.000	
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

PIEDM REFERS TO THE PIEDMONT REGION OF SOUTH CAROLINA  
CSTPL REFERS TO THE COASTAL PLAINS REGION OF S.C.



TABLE A.32

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN TEXAS

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	W 1/2	E 1/2	S .10	E 1/2		
BIG BLUESTEM		5.000	3.000			
LITTLE BLUESTEM		8.000	20.000	2.000		
SIDEOATS GRAMA	14.000	10.000	5.000			
BLUE GRAMA	39.000		2.000			
BUFFALO GRASS			40.000			
SAND LOVE GRASS	3.000					
WEEPING LOVE GRASS	3.000					
TEXAS BLUEGRASS		2.000				
RYEGRASSES		4.000		10.000		
BAHIA GRASS		10.000		3.000		
BERMUDA GRASS	3.000	20.000	5.000	50.000		
JOHNSONGRASS	3.000	2.000	2.000	1.000		
DALLISGRASS		4.000				
FORAGE SORGHUMS	4.000	3.000	6.000	5.000		
FORAGE SMALL GRAINS	7.000	8.000	3.000	22.000		
SPOTTED BURCLOVER.	1.000	3.000	2.000			
SWEET CLOVER	2.000		2.000			
WHITE CLOVER		4.000				
CRIMSON CLOVER		2.000		1.000		
ARROWLEAF CLOVER		5.000		3.000		
HAIRY VETCH		1.000				
KUDZU	5.000	3.000				
ALFALFA	2.000					
KLEINGRASS	2.000	1.000	2.000	3.000		
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

DAIRY OPERATIONS IN THE WESTERN 1/2 OF TEXAS ARE DRY LOT







TABLE A. 35

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN WASHINGTON

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS		
	E 1/2	W 1/2	CNTIR	E 1/2	W 1/2	CNTIR
BLUEBUNCH WHEAT GRASS	22.000		10.000			
CRESTED WHEAT GRASS	10.000					
INTERMEDIATE & PUBESCENT WHEAT GRASS	12.000					
TALL WHEAT GRASS	3.000		2.000			
SMOOTH BROMEGRASS	15.000		2.000	5.000		
REED CANARYGRASS	3.000	3.000				
TIMOTHY	5.000		1.000	14.000		
ORCHARD GRASS	5.000	25.000	31.000	30.000	34.000	40.000
TALL FESCUE	5.000	23.000	25.000	10.000	15.000	5.000
FINELEAF FESCUES		3.000				
RYEGRASSES		25.000	8.000		20.000	7.000
RED CLOVER	2.000		1.000			7.000
ALSIKE CLOVER	3.000			8.000	2.000	3.000
SWEET CLOVER	1.000					
WHITE CLOVER	2.000	12.000	3.000	7.000	20.000	5.000
BIRDSFOOT TREFOIL	1.000	2.000		1.000		
ALFALFA	10.000	3.000	15.000	25.000	3.000	30.000
MEADOW FOXTAIL	1.000	1.000	2.000		1.000	3.000
BENTGRASS		3.000			5.000	
	-----	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%	100%

CNTIR REFERS TO THE CENTRAL IRRIGATED AREA OF WASHINGTON



TABLE A.37

PROPORTIONS, BY AREA, OF FORAGES GRAZED BY BEEF AND DAIRY CATTLE  
AS REPORTED BY THE STATE FORAGE SPECIALIST IN WISCONSIN

FORAGES INCLUDE	BEEF REGIONS			DAIRY REGIONS	
	N 1/2	S 1/2		W 1/4	REST
KENTUCKY BLUEGRASS	17.000	15.000		5.000	5.000
REDTOP	17.000	15.000		10.000	10.000
SMOOTH BROMEGRASS	2.000	2.000		15.000	15.000
REED CANARYGRASS		3.000			
TIMOTHY	15.000	12.000		20.000	20.000
ORCHARD GRASS	1.000				
RED CLOVER	6.000	6.000		15.000	17.000
ALSIKE CLOVER	1.000	1.000			
SWEET CLOVER	1.000	1.000			
WHITE CLOVER	5.000	5.000			
BIRDSFOOT TREFOIL	6.000	6.000			
ALFALFA				10.000	8.000
QUACKGRASS	24.000	27.000		25.000	25.000
JUNEGRASS	5.000	7.000			
	-----	-----	-----	-----	-----
	100%	100%	100%	100%	100%

HERE, ONLY THE WESTERN 1/4 OF WISCONSIN IS SEPARATED  
FROM THE REST OF THE STATE FOR DAIRY.

APPENDIX B

DATA PROVIDED BY OTHER STATES USED IN  
DEVELOPING WEIGHTED AVERAGES  
FOR GRAZED FORAGES

Table B.1. Information provided by California used in developing the California coefficients

	Relative importance	
	Beef	Dairy
Irrigated Cool Season Pastures	4	1
Mixtures of:		
Tall Fescue		
Orchardgrass		
Perennial Ryegrass		
Ladino Clover		
Strawberry Clover		
Birdsfoot Trefoil		
Red Clover		
Bermudagrass	5	-
Annual Rangelands	1	2
Great Basin Rangelands	2	-
Desert Rangelands	3	-

Table B.2. Information provided by Arizona used in developing Arizona coefficients

Area	Forage group	Proportion (percent)
1 (MLRA30)	Shrubs	40
	Perennial grasses and forbs	20
	Annual grasses and forbs	40
2 (MLRA35)	Shrubs	30
	Perennial grasses and forbs	50
	Annual grasses and forbs	20
3 (MLRA39)	Shrubs	25
	Perennial grasses and forbs	60
	Annual grasses and forbs	15
(MLR40)	Shrubs	25
	Perennial grasses and forbs	50
	Annual grasses and forbs	25

APPENDIX C

OTHER RELEVANT INFORMATION

Table C.1. Original method for developing nutrient value coefficients from NRC data for beef and dairy

Beef						
Forage	NRC Reference No.	Dry matter	Protein	Net energy Mcal/kg	Calcium	Phosphorus
-----Percentage-----						
KY Blue Grass	2-00-779	35.7	14.8	1.95	0.46	0.39
Brome	2-00-898	56.1	6.4	1.33	0.30	0.26
Timothy	2-04-905	28.1	9.6	2.28	0	0
Reed Canary	2-01-113	25.8	13.2	1.70	0.40	0.30
	Average	36.4	11.0	1.815	0.29	0.32

  

Dairy						
Forage	NRC Reference No.	Dry matter	Protein	Net energy Mcal/kg	Calcium	Phosphorus
-----Percentage-----						
KY Blue Grass	2-00-779	36.0	14.8	1.57	0.46	0.39
Brome	2-00-898	56.0	9.0	1.47	0.30	0
Timothy	2-04-905	28.0	9.1	1.40	0.25	0.25
	Average	40.0	11.0	1.48	0.337	0.213



Table C.2. State extension forage specialists who assisted in the data collection

Name	Location
Anderson, B. E.	University of Nebraska
Ball, D. M.	Auburn University, Alabama
Barnheart, S.	Iowa State University
Bedell, T.	Oregon State University
Bryan, W.	West Virginia University
Burkhart, W.	University of Nevada
Burns, J. D.	University of Tennessee
Chambliss, C. G.	University of Florida
Decker, A. M.	University of Maryland
Dougherty, C. T.	University of Kentucky
Faw, W. F.	Louisiana State University
George, M.	University of California at Davis
Glover, C. R.	New Mexico State University
Green, J. J.	North Carolina State University
Hatley, E.	Pennsylvania State University
Havstad, R. M.	Montana State University
Herbert, S. J.	University of Massachusetts
Holt, E.	Texas A&M University
Holyoake, Dr.	University of Maine
Huneycutt, Dr.	University of Arkansas

Table C.2. (continued)

Name	Location
Johnson, K.	Purdue University, Indiana
Johnson, W. J.	Washington State University
Kimbrough, E. L.	Mississippi State University
Miller, D.	University of Illinois
Mitchell, J. B.	University of New Hampshire
Nolan, C. N.	Clemson University, South Carolina
Ogden, P.	University of Arizona
Posler, L.	Kansas State University
Rohweder, D. A.	University of Wisconsin
Seaney, R. R.	Cornell University, New York
Sprague, M. A.	Rutgers University, New Jersey
Sullivan, M.	University of Rhode Island
Tesar, M. B.	Michigan State University
Van Keuren, R.	Ohio State University
Washko, W.	University of Connecticut
Wheaton, H. N.	University of Missouri
White, H. E.	V.P.I. University, Virginia
Wood, G. M.	University of Vermont

Table C.3. List of forages used in development of final nutrient supplies and the origin of the original of the nutrient values for NE, ZDM, ZP, ZC, and ZH <sup>a</sup>

Forage code	Forages	Forage code	Forages	Forage code	Forages	Forage code	Forages
101	Western Wheat Grass <sup>b</sup>	122	Smooth Bromegrass <sup>c</sup>	147	Sweet Clover <sup>d</sup>	183	Native Shrubs <sup>b,e</sup>
102	Slender Wheat Grass <sup>b</sup>	123	Native Bromegrass <sup>c</sup>	148	White Clover <sup>f</sup>	184	Winter Annuals <sup>b,e</sup>
103	Bluebunch Wheat Grass <sup>b</sup>	124	Reed Canarygrass <sup>g</sup>	149	Crimson Clover <sup>g</sup>	185	'Bush Mulky' <sup>b,e</sup>
104	Crested Wheat Grass <sup>c</sup>	125	Timothy <sup>c</sup>	150	Arrowleaf Clover <sup>b</sup>	186	Galleta Grass <sup>g</sup>
105	Intermediate & Pubescent Wheat Grass <sup>g</sup>	126	Orchard Grass <sup>c</sup>	151	Birdsfoot Trefoil <sup>g</sup>	187	Downy Bromes <sup>b,e</sup>
106	Tall Wheat Grass <sup>g</sup>	127	Tall Fescue <sup>f</sup>	152	Lespedeza <sup>f</sup>	188	Bottlebrush Squirreltail <sup>b</sup>
107	Big Bluestem <sup>c</sup>	128	Fineleaf Fescues <sup>f</sup>	153	Crownvetch <sup>f</sup>	189	Indian Ricegrass <sup>b,e</sup>
108	Little Bluestem <sup>c</sup>	129	Ryegrasses <sup>g</sup>	155	Hairy Vetch <sup>b</sup>	190	Sedge <sup>b,e</sup>
109	Sand Bluestem <sup>c</sup>	130	Bahiagrass <sup>g</sup>	156	Common Vetch <sup>b</sup>	191	Rush <sup>b,e</sup>
110	Sideoats Grama <sup>c</sup>	131	Carpet Grass <sup>b,e</sup>	159	Subterranean Clover <sup>c</sup>	192	Idaho Fescue <sup>b,e</sup>
111	Blue Grama <sup>c</sup>	132	Bermuda Grass <sup>f</sup>	160	Ball Clover <sup>b</sup>	193	Winter Cereals <sup>b,e</sup>
112	Buffalo Grass <sup>g</sup>	133	Johnsongrass <sup>b,e</sup>	162	Persian Clover <sup>b</sup>	194	Needle Grass <sup>g</sup>
113	Sand Love Grass <sup>f</sup>	134	Dallisgrass <sup>b,e</sup>	169	Forage Soybean <sup>f</sup>	195	Meadow Foxtail <sup>b</sup>
114	Weeping Love Grass <sup>b</sup>	135	Digit Grass <sup>b,e</sup>	173	Kudzu <sup>b,e</sup>	196	Bentgrass <sup>b,e</sup>
115	Switch Grass <sup>f</sup>	136	Saint Augustine Grass <sup>b</sup>	174	Sainfoin <sup>b</sup>	197	Sand Dropseed <sup>g</sup>
116	Wildryes <sup>c</sup>	139	Vaseygrass <sup>b,e</sup>	175	Alfalfa <sup>g</sup>	198	Prairie Sandreed <sup>b</sup>
117	Kentucky Bluegrass <sup>c</sup>	140	Forage Sorghums <sup>f</sup>	176	Sudangrass <sup>f</sup>	199	Quackgrass <sup>b,e</sup>
118	Mutton Bluegrass (Native) <sup>c</sup>	141	Forage Small Grains <sup>b</sup>	178	Saltgrass <sup>c</sup>	200	Junegrass <sup>b,e</sup>
119	Texas Bluegrass <sup>c</sup>	142	Spotted Burclover <sup>b</sup>	179	Millet <sup>g</sup>	201	Forbs <sup>c,e</sup>
121	Redtop <sup>g</sup>	144	Red Clover <sup>c</sup>	181	Misc (catch-all category) <sup>e,c</sup>	202	Needle & Thread <sup>g,e</sup>
		145	Alsike Clover <sup>f</sup>	182	Cheatgrass <sup>b,e</sup>	203	Kleingrass <sup>b,e</sup>

<sup>a</sup>NE = net energy (final value) provided (Mcal/kg); NE<sub>m</sub> = net energy for maintenance provided on a dry basis; NE<sub>G</sub> = net energy for gains provided on a dry basis; NE<sub>L</sub> = net energy for lactation provided on a dry basis; where NE = [(NE<sub>m</sub> + NE<sub>G</sub>)/2 + NE<sub>L</sub>]/2 (formula taken from NRC pamphlets on beef and dairy nutrient requirements); ZDM = percentage of dry matter basis; ZP = percentage of crude protein on a dry basis; ZC = % calcium on a dry basis; ZH = % phosphorus on a dry basis.

<sup>b</sup>Based on approximations to other related forages as described in Heath, et. al, and the recommendations of various state specialists.

<sup>c</sup>Based on averaging of values given in NRC data.

<sup>d</sup>Based on given NRC hay values for that forage.

<sup>e</sup>Only represents a very small quantity of the total before average in any particular area.

<sup>f</sup>Estimates of these forages provided Steve Bankheart, ISU Extension Forage Specialist and based on his experience and interpolations from NRC data.

<sup>g</sup>Taken directly from NRC tables on nutrient supplies.