FORAGE INVENTORY and ALLOCATION PLANNING Workbook

This workbook provides an organized format for creating a forage inventory to be used as a guide for planning forage allocation to targeted groups of animals. Organizing the inventories of forages and their respective qualities, for planning feeding programs will be simplified. All the necessary information will be at your fingertips. Planning may also help you maneuver around quality pitfalls or pending shortages of forage stocks.

If you would like any assistance going through the inventory process, please call one of the Team members.

Worksheets and Tables:

Table 1. New York State Average Crop Yields

Crop	Average yields:	Above Average Yields
Alfalfa or Alfalfa/grass Mix	3.0-4.0	
Grass	2.5-3.0	
Pasture	2.5-3.0	
Small Grains:		
Oats	65 bu/Ac	75-80 bu/Ac
Wheat	50 bu/Ac	70-80 bu/Ac
barley	65 bu/Ac	75 bu/Ac
Winter triticale	55 bu/Ac	
soybean	40 bu/Ac	50-55 bu/Ac
Corn Grain	90-110 bu	130+
Corn Silage**	15 T @ 35% DM	18 T+
Annual Forages:	2.5 – 4	

Managing Your Feed Inventory:
Example

I. Yearly Feed Needs (Dry Matter)

65 No. Cows X 6.5 T DM/Cow * = 422.50 Tons DM for cows (35.62 lb DM/cow/day)

40 No. Heifers X 2.75 T DM/Cow* = 110 Tons DM for heifers (15.07 lb DM/cow/day) = 16.8 cow equivalents
(.42 cow equivalent)

*includes 18-22% harvesting & fermentation losses

532.5 Total Tons needed (= 81.8 total cow equivalents)

II. Farm Inventory Of Ensiled Forage Dry Matter:

	Forage Type	Silo diameter and height	Dry matter when full	Depth removed	Dry matter removed	Dry matter remaining
SILO #1	Haylage	20 X 60'	159 tons	22 ft.	77 tons	**82 tons**
Bottom unloading						
SILO #2	Corn Silage	20X70'	198 tons	10 ft	14 tons	**184 tons**
Top unloading						

Bunk Silo Inventory:

Dimensions WxHxL X	Dry Matter T/Linear ft. =	Total Tons /	Forage % DM =	Total As Fed Tons X 2000 = Lbs / Lbs Fed/day =	Days Remaining

III. Farm Inventory Of Dry Forage:

	Forage Type	No. of bales or stacks	Wt/bale or stack	Total as fed basis	Total As fed	Dry matter	Total Dry matter
HAY STORAGE AREA #1	2nd-cut alfalfa-grass hay	3000	40 lb =	120,000lb /2000	60 tons	.89	**53.4 tons**
HAY STORAGE AREA #2	1st-cut grass hay	2000	35 lb =	70000lb /2000	35 tons	.89	**31.2 tons**

Total forage DM: 82 + 184 + 53.4 + 31.2 = **351 tons DM**

IV. Forage Inventory Summary:

Forage Type/Source	Total Tons Dry Matter		No. cow equiv.		Tons DM/ cow equivalent		DM available/ cow equivalent	Feeding period		DM/cow equiv. per day
A. Haylage	82.0	/	100	=	.82 tons	X	2,000 = 1640 lb / 225 days	=		7.3 lb
B. Corn Silage	184.0	/	100	=	1.84 tons	X	2,000 = 3680 lb / 340 days	=		10.8 lb
C. 2nd-cut MML hay	53.4	/	100	=	.534 tons	X	2,000 = 1068 lb / 225 days	=		4.75 lb
D. 1st-cut grass hay	31.2	/	100	=	.312 tons	X	2,000 = 624 lb / 225 days	=		2.8 lb

Total forage DM/cow equiv. (A + B + C+ D) = 25.7 lb/day
Forage DM needed in storage/cow (from Table 4.) = 26.8 lb/day
Subtract needed forage from DM available to get surplus or deficit = -1.1 lb/day

V. CALCULATING SURPLUS OF DEFICIT FORAGE SUPPLY FOR FEEDING PERIOD

A. To determine tons of hay surplus or deficit

1.1 Lb deficit DM/cow/day X 82 no. cow equiv. = 90.2 lb deficit/herd/day X 225 days in feeding period = 20,295 lbs total DM / 2000 = 10.2 tons DM deficit /.9 = 11.3 tons deficit as hay equivalent

Source: Extension Circular 396 Harvesting and Utilizing Silage from Penn State.

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Managing Your Feed Inventory:

I. Yearly Feed Needs (Dry Matter)

_____ No. Cows X 6.5 T DM/Cow * = _____ Tons DM for cows

_____ No. Heifers X 2.75 T DM/Cow* = _____ Tons DM for heifers

*includes 18-22% harvesting & fermentation losses _____ Total Tons needed

II. Farm Inventory Of Ensiled Forage Dry Matter:

	Forage Type	Silo diameter and height	Dry matter when full	Depth removed	DM removed	DM remaining
SILO # unloading	_____	_____	_____	_____	_____	_____
SILO # unloading	_____	_____	_____	_____	_____	_____
SILO # unloading	_____	_____	_____	_____	_____	_____
SILO # unloading	_____	_____	_____	_____	_____	_____

Bunk Silo Inventory:

Dimensions WxHxL	X	Dry Matter T/Linear ft.	=	Total Tons	/	Forage % DM	=	Total As Fed Tons X 2000 = Lbs	/ Lbs Fed/day =	Days Remaining

III. Farm Inventory Of Dry Forage:

	Forage Type	No. of bales or stacks	Wt/bale or stack	Total as fed basis	Total As fed	DM	Total DM
HAY STORAGE AREA # 1							
HAY STORAGE AREA #2							
HAY STORAGE AREA #3							
Total forage DM							

FORAGE ANALYSES (% DM)

Forage Type	Dry Matter	Crude Protein	Available Protein	ADF	NDF	NEL (Mcal/lb)
						V.

CALCULATING SURPLUS OF DEFICIT FORAGE SUPPLY FOR FEEDING PERIOD

A. To determine tons of forage surplus or deficit:

Corn Silage:

_____ Lb deficit DM/cow/day X _____no. cow equiv. = _____ lb deficit/herd/day X _____ days in feeding period = _____ lb

total DM / 2000 = _____tons DM deficit.

Haylage:

_____ Lb deficit DM/cow/day X _____no. cow equiv. = _____ lb deficit/herd/day X _____ days in feeding period = _____ lb

total DM / 2000 = _____tons DM deficit

Dry Hay:

_____ Lb deficit DM/cow/day X _____no. cow equiv. = _____ lb deficit/herd/day X _____ days in feeding period = _____ lb

total DM / 2000 = _____tons DM deficit /.9 = _____tons deficit as hay equivalent

OPTIONS TO ACQUIRE ADDITONAL NEEDED FORAGE

If your feed needs are not met by your farm's production, review the following options:

1. purchase forages
2. rent ground
3. reduce animal numbers

1. If Need to Purchase Forages: T DM Feed Needed - Production = Additional T DM Needed

Crop Needed	T DM Needed	Cost/Ton*	Total Cost
Example:Mixed hay	50	$150	$7500
_____			
_____			
_____SUM			

2. Rent Ground: Additional DM Needed/Yield per Acre = No. of Additional Acres Needed

3. Reduce Animal Numbers to Balance with Feed Available. Use the following formulas to determine cow number reduction to match available forage

Mature cows: _____DM Tons Deficit for herd/yr / 6.5 T DM needed/head/yr = _____ No. of animals needed to reduce herd by to match available forage inventory.

Heifers: _____DM Tons Deficit for herd/yr / 2.75 T DM needed/head/yr = _____ No. of animals needed to reduce herd by to match available forage inventory.

Table 1. *Approximate dry matter capacity of upright silos.*

Depth of Settled Silage (ft)	Inside diameter of silo (ft) 10	12	14	16	18	20	22	24
	Tons							
2	0	1	1	1	2	2	2	2
4	1	2	2	3	4	5	5	6
6	2	2	3	4	5	7	8	10
8	3	4	5	7	9	11	13	16
10	4	5	7	9	11	14	17	20
12	5	7	9	11	14	18	22	26
14	5	8	11	14	17	22	26	31
16	6	9	12	17	21	26	32	37
18	7	11	14	19	24	29	35	42
20	8	12	16	21	27	33	40	47
22	9	14	19+	24	30	38	48	54
24	11	15	21	27	34	43	52	61
26	12	17	23	30	38	48	58	68
28	13	19	26	35	44	53	64	76
30	15	21	29	38	47	59	71	84
32	16	23	32	41	52	65	78	93
34	18	25	34	45	57	70	85	101
36	19	28	37	48	62	76	92	109
38	21	30	41	53	67	82	100	118
40	22	32	44	57	72	89	107	127
42	24	34	47	61	77	95	115	137
44	26	37	50	65	82	102	123	146
46	27	39	53	69	88	108	131	155
48	29	42	56	74	93	115	140	166
50	31	44	60	78	99	122	148	175
52	32	47	64	83	105	129	157	186
54	34	49	67	88	111	137	165	197
56	36	51	71	93	117	144	174	207
58	38	54	74	98	123	151	183	218
60	40	56	78	102	129	159	192	228
62	To find the tons remaining in a silo after part of the silage is removed: (1) find the tons of silage when the silo was filled, (2) find the tons in a silo filled to the height equal to the depth of silage removed, (3) subtract the number of tons in Step 2 from the number of tons in Step 1.						201	239
64							210	250
66							219	260
68							228	271
70							237	282
72								293
74								305
76	Example: A 20-foot silo is filled to a settled depth of 60 feet and 22 feet were removed (1) 20 x 60 equals 159 tons, (2) 20 x 22 equals 38 tons, (3) 159 minus 38 equals 121 tons remaining.							316
78								328
80								339

Source: Adapted from Silo Dry Matter Capacity Tables by The National Silo Assoc.

Table 2 - Approximate Dry Matter Capacities of Bunker Silos (Appendix C—Pitt 1990)

Haycrop Silage

DM density is assumed to be 11.8 lb DM/ft³ (Rotz, 1989)

$$\text{Capacity, T DM} = \frac{\text{(Length, ft) X (Width, ft) X (Average height, ft) X 11.8}}{2000}$$

Corn Silage

DM density is assumed to be 17.7 lb DM/ft³ (Holter, 1983)

$$\text{Capacity, T DM} = \frac{\text{(Length, ft) X (Width, ft) X (Average height, ft) X 17.7}}{2000}$$

Determining Removal Rate from Bunker Silos, Haycrops

$$\text{Removal rate, inches/day} = \frac{\text{(Haycrop silage DM intake per cow, lb/day) X (\#. of cows)}}{\text{(Silo width, ft) X (Silage vertical depth, ft)}}$$

Determining Removal Rate from Bunker Silos, Cornsilage

$$\text{Removal rate, inches/day} = \frac{\text{(Corn silage DM intake per cow, lb/day) X (\#. of cows)}}{\text{(Silo width, ft) X (Silage vertical depth, ft) X 1.47}}$$

Source: Pitt. 1990. Silage and Hay Preservation. NRAES-5

Bunker DM Density Rules of thumb: haylage - 12# DM/ft³.
corn silage - < 10' - 12# DM/ft³.
- > 10' - 15# DM/ft³. *-jd*

Table 3 - Ag Bag Capacity Table

Bag Size	Alfalfa or CS (b)	Ear Corn (b)	Shelled Corn (b)
	tons as fed per bag		
8 x 100	80-90	70	80
8 x 150	120-140	120	130
8 x 200	170-190	164	180
9 x 135	140-160	134	150
9 x 150	160-180	162	175
9 x 200	200-225	205	230
10 x 150	200-220	180	202
10 x 200	270-300	247	278

(b) Assumes 35% DM (c) Assumes 68 - 70% DM

Table 4 - Hay Densities in Horizontal Silos

	Lb/ft³
Alfalfa	6-10
Non-Legunes	6-8
Straw	4-5

Table 5—Load Capacity of Wagons

Wagon Depth In feet	Tons of Dry Matter Length in Feet of Wagon 14	16	18	20
3	1.2	1.35	1.5	1.65
4	1.65	1.8	2.1	2.25
5	1.95	2.25	2.55	2.85
6	2.4	2.7	3.0	3.45
7	2.7	3.15	3.6	3.9

Converting Cost of Silage per ton to a Hay Basis

To evaluate costs it is helpful to put all forms of haycrop including haylage and baleage on a hay equivalent basis. Market values of hay can be found in the market section of an agricultural newspaper like Country Folks, by talking with hay brokers, or checking around the neighborhood for prices. Actual weights of baleage can vary based on bale dimensions and moisture. For the greatest accuracy a few representative bales should be weighed and moisture tests taken. You don't want to pay extra money for water. In the table that follows hay equivalent is calculated at 90% dry matter or 1800 lbs of dry matter per ton. Shows the cost conversion from baleage of two different weights and 3 different costs per bale (4'X4') to a hay equivalent basis.

Read Across ®	**1200 lb bale @ 60% DM (pounds of dry matter = 720)**				**1400 lb bale @ 60% DM (pounds of dry matter = 840)**			
Cost/bale:	$25	$50	$75		$25	$50	$75	
Cost/lb DM	$25/720 = **.035**	$50/720 = **.069**	$75/720 = **.104**		$25/840 = **.03**	$50/840 = **.060**	$75/840 = **.089**	
Read_Down	**HAY EQUIVALENT COST/TON**				**HAY EQUIVALENT COST/TON**			
Cost/Bale	Lbs DM				Cost/Bale	Lbs DM		
$25	1800	X .035	= $63		$25	1800	X .03	= $54
$50	1800	X .069	= $124		$50	1800	X .060	= $108
$75	1800	X .104	= $187		$75	1800	X .089	= $160

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Forage Analysis and Reporting *continued*

Heat damaged, indigestible protein resulting typically from excessive heating of forage during drying or fermentation. Proper moisture level of the harvested forage, and the meticulous exclusion of air from silage, are critical in order to control heating and avoid the wasteful conversion of useable protein into useless ADICP.

% Soluble Protein (Sol P or SP) and % Degradable Protein (DIP): Measure of nitrogen compounds and proteins that are rapidly digested and made available for new microbial protein production in the rumen of the cow. Enough energy must be readily available if an efficient conversion is going to occur. It is possible to feed too much or too little Sol P and DIP, or to provide too little readily fermentable energy (NSC) to efficiently utilize these protein fractions.

Forage analysis and reporting: Let's Review the *Basics*

Steve Bulkley, Area Extension Dairy Specialist

Deciding to analyze:

When should I consider forage analysis?

1. Whenever you intend to include a homegrown feedstuff in a ration for high-producing dairy cattle
    1) Whenever you contemplate purchasing a forage that is intended for feed
    2) Whenever you have reasonable cause to suspect a quality problem with a ration ingredient

Taking and submitting a representative sample:

How do I get a good sample?

Collect at least 10 equal-sized, random samples of the feed. 20 samples actually would be twice as good. This is important enough to be worth the painstaking trouble; it determines whether or not you will get your "money's worth" from the analysis.

Mix the samples well and package a one pound sub-sample for submission to the lab.

How do I handle the sample to keep it representative?
Seal the final sample air-tight in the plastic bag provided with the analysis kit and deliver it to the lab without unnecessary delay.

Freeze fresh pasture samples for 12 hours before sending them out to get the most accurate results.

Selecting an appropriate analysis:

"Wet chemistry analysis" is the traditional laboratory method. Any feedstuff can be examined by this method for nutrient composition (even manure can be analyzed by wet chemistry). Two to three days are required for results.

"NIR" (near infrared reflectance spectroscopy) analysis has been in use successfully for 20 years. It is rapid (24 hrs) and thrifty. There are specific limitations to NIR; certain feeds (eg. distillers grains) and most minerals are more accurately analyzed using wet chemistry methods.

Reading the lab report:

What *are* these numbers and what do they have to do with forage quality?

%Moisture: The amount of water contained in the feed sample. This has important implications for the fermentation of ensiled forages and the keeping qualities of dried forages.

% Dry Matter (DM): [100% - % moisture = % dry matter] This portion of the feed contains the nutrients of interest to nutritionists and cows. Everything else is just water.

% Lignin: A coarse, stemmy part of the forage plant that is indigestible. It has no nutritive value for livestock, and is, at best, a poor man's source of dietary fiber.

% Acid Detergent Fiber (ADF): Lignin plus all the other woody, indigestible portions of the feed sample.

Relative Feed Value (RFV): Useful if you're selling forage, but not detailed enough to be useful when calculating a ration. RFV is a calculated value, and is intended only as a convenient summary of the analysis results.

% NEL (net energy for lactation): Estimates the energy content of a feed when used by a cow, milking or dry. This value is not actually measured, but is calculated mathematically from some of the other results on the lab report. Energy is the nutrient required in the greatest amount, and in a variety of specific forms. Body condition score reflects NEL intake and utilization.

% TDN (total digestible nutrients): A traditional estimate of the energy value of a sample of livestock feed. A calculated value, TDN is now virtually obsolete in dairy nutrition.

% Neutral Detergent Fiber (NDF): Portion of the plant's skeletal structure that is gradually digestible for energy by cattle. Typically, hay crops contain most of their energy value in the form of NDF. NDF can be too high, indicating mature, low quality forage with a reduced energy value.

% NSC (non-structural carbohydrate): Measures sugars and starches contained in the sample that will provide energy to the animal being fed. Tends to be lowest in hay crop, intermediate in corn silage and high in grain. Too little NSC prevents efficient utilization of the protein in most feeds. Too high NSC, especially with too little effective fiber in the diet, can lead to digestive upsets in cattle.

% Crude Fat: Dietary fat is a potent energy source, but with limited application in dairy cattle. The fat content of most forages is naturally low, and rumen efficiency can be impaired by too much fat or oil in the diet.

% Crude Protein (CP): This, of course, has long been *the* popular measure of feed quality (we still speak of an "18% grain mix", for example), but protein often is secondary in importance to the energy content of the feed. Dairy nutritionists have come a long way in understanding and evaluating the protein content of feeds. Crude protein, which is calculated from the total nitrogen content of the sample, is only a starting value for measuring the protein value of a sample.

% ADICP (Acid detergent insoluble crude protein):

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