

LRNS BEEF FEEDLOT TUTORIAL

This case study is designed to learn how to use the LRNS to evaluate and improve a beef cattle feeding program, with some consideration of crop rotations and crop and manure nutrient management planning.

BACKGROUND ON CASE STUDY FARM

The case study farm is a 550 acre (223 ha)¹ farmer feeding operation marketing 950 Holstein steers each year. The farm receives 300 lb (136 kg) calves every seven weeks, which are integrated into a continuous flow operation. The cattle are fed and managed in three weight groups: light, medium and heavy (Table 3) and are fed the rations shown in Table 4. All of the forage and most of the corn is home grown. Byproduct feeds such as brewers' grains provide protein and additional energy (Table 1) and mineral supplements are fed to balance the ration for minerals (Table 2).

This version of the LRNS was designed to work with multiple groups within a single file to allow for evaluations of herd nutrient excretion and herd feed requirements. All information about a farm is stored in one file. These files are called *Simulation Data Files*. They can be found on your hard drive in the LRNS folder and have the file extension *.ncps*. Simulation data files contain all the groups (and their inputs), all the feeds (and composition) used on the farm, and rations fed to each group.

The main feed library included with the LRNS is a read only file. Feeds that the user creates are stored in the User-Created Feed Library. Feeds used on the farm, while stored as part of the simulation data file, are part of the *Feeds Collection* and can be exported as a file for use in other simulations. A component of the feeds collection is mixes. Feeds that are included in mixes can be identified in the feeds collection by the M in parenthesis at the end of their name. When a mix is created, the percentage of each feed in the mix is calculated (for example 50% corn meal, 50% soy hulls). When the mix is fed to a group, the model decomposes the mix to run the calculations. For example, if 10 lb of the corn/soy mix is fed, the model performs the calculations based on 5 lb of corn meal and 5 lb of soy hulls.

There are three ways to move around in the program: the menus, the buttons on the tool-bar, and the tree (found on the left side of the screen). This tutorial will focus primarily on using the tree and the tool-bar as these are the fastest way to move around the program. As you work through this tutorial, experiment with different ways to move around and use the method that works best for you.

¹ 1 Acre = 0.4047 hectare; 1 Lb = 0.4536 kg.

STEP 1. CREATE A NEW SIMULATION

1. Click on **File**, then **New Simulation**, from the menu. Name this simulation **Beef Feedlot tutorial**.
2. Create three animal groups.
 - Select **create animal group**, then select **growing finishing**, then name the group **light weight steers**. Then in this same screen (parameters) select the parameters for this group (units = English, ration basis = DM, level solution = 2, number in the group = 425, and days to feed = 365).
 - Select **create animal group**, then select **growing finishing**, then name the group **medium weight steers**. Use the same parameters as for the light weight steers, except the number in group = 200.
 - Select **create animal group**, then select growing finishing steers, then name the group **heavy weight steers**. Use the same parameters as for the light weight group, except number in group = 325.
 - Select the default group, then click on **delete group**.

STEP 2. CREATE A FEED LIBRARY FOR THE FARM

1. Click on the **feeds** icon from the menu at the top.
2. Click on **add feeds** in the feeds screen.
3. Select the feeds to be used on this farm from the feed categories in the feed library screen. Click on the feed numbers as listed in Tables 1 and 2. Check the display at the bottom to make sure you selected the correct ones, based on NDF and Crude Protein content for forages and the closest feed description for concentrates.
4. When finished selecting feeds, select **add feeds**.
5. Put the feeds in the order listed in Tables 1 and 2, using the up and down arrows to move the selected feed.
6. **Save the simulation**.
7. Click on the first feed, then use Table 1 to edit the name and feed composition. This is done by clicking on the cell to the left of the parameter to be changed (you may have to double click to get a white box, which lets you edit the feed). NOTE: information from feed analysis reports has been organized to be in the units needed for the model. For example, lignin has been changed from % of DM to as % of NDF.
8. **Save the simulation**.
9. Edit the remaining feeds as for the first feed.
10. **Save the simulation**.

Table1. Feed analysis (average values)

Items	Alfalfa silage	Dry shelled corn	HM corn	Wet brewers' grains
Feed number	218	406	412	502
Cost, \$/ton	32	77	59	23
Concentrate%	0	100	100	100
Forage %	100	0	0	0
DM%	35	86	72	21
NDF, % in DM	49.6			
Lignin % of NDF	15.9	...	...	...
CP, % of DM	18	...	...	...
Fat, % of DM	3.1	...	...	...
Ash, % of DM	10.5	...	...	...
Sol P, % of CP	66	...	...	...
NDFIP % of CP	12.4	...	...	...
ADFIP % of CP	6.59	...	...	...
Calcium %	1.09	...	...	...
Phosphorus %	.26	...	...	...
Magnesium %	.23	...	...	...
Potassium %	3.09	...	...	...
Sodium %	...	...	...	...
Sulfur %	...	...	...	...
Copper, mg/kg	...	...	...	...
Iron, mg/kg	...	...	...	...
Manganese, mg/kg	...	...	...	...
Zinc, mg/kg	...	...	...	...
Home grown, Y or N	Y	N	Y	N
Order	1	2	3	4

¹ Use feed library values for "..."

Table 2. Composition of mineral supplements

Item	Heavy mineral	Lt.& Med. Mineral
Feed number	831	---
Cost, \$/ton	500	500
Concentrate%	100	100
Forage %	0	0
DM%	100	100
Ash, % of DM	100	100
Calcium %	24.2	23
Phosphorus %	0	1.5
Magnesium %	1.5	1.5
Potassium %	7.1	1.1
Sodium %	15	25
Sulfur %	1.5	1.4
Cobalt, mg/kg	11.5	11.5
Copper, mg/kg	490	430
Iodine, mg/kg	63	63
Iron, mg/kg	6785	7060
Manganese, mg/kg	1180	1180
Selenium, mg/kg	0	0
Zinc, mg/kg	4730	4730
Vitamin A, IU/kg	174	200
Vitamin D, IU/kg	21	22.50
Vitamin E, IU/kg	97	97

STEP 3. DESCRIBE THE GROUPS OF ANIMALS

1. From the tree (displayed on the left), select the **light weight group**.
2. Under the light weight group, click on **description** and enter the information requested, using Table 3. Then select the next tab (**production**) and use Table 3 to choose or enter the information requested.
3. Then select the next tab (**management and environment**) at the top of your screen and use Table 3 to choose or enter the information requested.
4. Then select the next tab (**ration**) at the top of your screen and use Table 4 to choose or enter the information requested.

Table 3. Animal description, production, management and environmental inputs^{1,2}

Group	# hd	Avg Age, months	Avg wt (SBW) lb	Body Score (1-9)	Condition
Light	425	6.5	550	4	
Medium	200	10.5	900	5	
Heavy	325	14	1,175	6	

¹ Other inputs required are the same for all groups: days to feed = 365; animal type = growing/finishing; sex = steer; breed type = dairy; breeding system = straight; grade = small marbling; expected weight at 28% body fat = 1300 lb; breed = Holstein; and additive = implant + ionophore.

² Environmental inputs are: wind speed = 1 mph; previous temperature = 45 degrees F, previous humidity = 30%; current temperature = 45 degrees F, current humidity = 30%; sun exposure = 0; storm exposure = none (leave blank); hair depth = 0.25 in; mud depth = 1 in.; hide thickness = thin; hair coat condition = no mud; minimum night temperature = 45 degrees F; and facilities = conventional barn, 35 to 50 square feet/head.

Table 4. Rations fed to each group (lb/head/day)

Ingredient	Light ¹	Medium	Heavy
Alfalfa silage	4.40	4.50	4.80
Corn, HM	7.40	11.90	10.00
Corn, dry grain	-	-	6.50
Brewers grains	2.50	3.20	2.40
Light and medium Minerals	0.21	0.30	-
Heavy mineral	-	-	0.37
Totals	14.51	19.90	24.07

¹ Units are lb dry matter per day.

5. **Save the simulation.** Repeat the above steps for the remaining two groups.

Now you can review the results by clicking on **ration** under each group in the tree. You can print out the results for each group by clicking on **summary results**, then clicking on **print report**. Table 5 summarizes the results for the three groups of cattle.

Table 5. Animal Performance (unadjusted)

Group	Actual Dry matter intake, lb/day	Predicted Dry matter intake, lb/day	Actual ADG, kg/day	ME allowed ADG, lb/day	MP allowed ADG, lb/day	Rumen N Balance g/day	Peptide Balance g/day	peNDF Balance lb/day	Diet NEg MC/lb
Light	14.51	13.84	3.00	3.06	3.11	13	-7	0.6	0.52
Medium	19.90	19.83	2.80	2.91	4.07	18	-15	0.1	0.55
Heavy	24.07	24.89	2.71	2.80	4.35	22	-15	0.1	0.56

Table 5 shows ADG is being over-predicted by 2 to 4%. The first step here is to check your inputs for each group to make sure there are no entry errors. The next step is to see if ruminal or absorbed protein is limiting performance. Table 5 shows rumen N balance is positive, MP allowable gain exceeds ME allowable ADG, and effective NDF balance is positive so they do not limit performance. Peptide balance is negative; increasing it to a 0 balance would increase MP from bacteria. However, a negative balance does not limit performance in this case because we do not need more MP since MP allowable ADG equals or exceeds ME allowable ADG.

STEP 4. ADJUST INPUTS UNTIL PREDICTED AND OBSERVED PERFORMANCE ARE SIMILAR

This step is important in identifying factors affecting performance, and for obtaining accurate projections when alternative management practices and strategies are evaluated.

This step is described in [help, model biology, balancing rations](#). Since the model is overpredicting performance, we will adjust factors most likely to influence energy available for growth. We are confident the dry matter intake, feeds and feed analysis are accurate.

Since predicted ME allowable ADG is 3.3% greater than observed ADG for the heavy group, examine what is different about that group. Since dry whole corn replaces part of the high moisture corn, we will next examine the dry corn rumen digestion rates.

Click on [help, contents and index, and digestion rates](#). Note the range for dry whole corn is 5-10%/hour.

1. Under feeds in the tree, click on dry shelled corn and change the CHO B1 (%/hr) to 6 %.
2. Under the heavy group in the tree, click on *ration*, and print summary results. Note the ADG is close to actual value.
3. Under heavy group in the tree, click on ration, and print summary results. Note the ADG now agrees with the actual.
4. *Save the simulation as beef tutorial adjusted.*

Table 6 summarizes the results of these adjustments for the heavy group.

Table 6. Animal Performance, heavy group (adjusted for dry corn starch digestion rates)

Adjustment	Actual Dry matter intake, kg/day	Predicted Dry matter intake, kg/day	Actual ADG, lb/day	ME allowed ADG, kg/day	MP allowed ADG, kg/day	Rumen N Balance g/day	Peptide Balance g/day	peNDF Balance kg/day	Diet NEg MC/lb
Initial	24.07	24.89	2.71	2.80	4.35	22	-15	0.1	0.56
Dry corn rumen B1 rate	24.07	25.02	2.71	2.72	3.98	33	-7	0.1	0.55

Because MP allowable ADG exceeds ME allowable ADG, balance the medium group for protein using a feed substitution approach.

Under medium weight calves in the tree, click on *rations*. MP allowable gain exceeds ME allowable gain, so supplemental protein can be reduced. Change high moisture corn to 15.1 and brewers grains to 0. Note that ME allowable ADG is increased to 3.24, gives a -0.1 lb peNDF balance, and MP allowable ADG of 3.69 lb/d. Click on **summary report, then view**. Note the cost per day is 90 cents; this is $90/3.24 = 28$ cents per lb of ME gain. Before these changes, the cost was 94 cents per day for a 2.91 ADG, or 32 cents per lb of gain. When overhead costs of 15 cents per lb per day are added, the

cost of gain is 31 cents for the revised ration, vs. 37 cents for the current ration. Therefore the least cost gain is the revised ration. In this case, reducing excess nitrogen in the ration to reduce nitrogen excretion would also decrease cost of gain. Additionally, all of the nitrogen in the revised ration is home grown so the whole farm balance must be evaluated with each alternative to evaluate the impact on whole farm nutrient balance, which can be evaluated with comparing the whole herd annual excretion report with each scenario.

When finished balancing the diet, *Save the simulation as beef tutorial rebalanced.*

STEP 5. EVALUATE THE SENSITIVITY OF THE ANIMALS TO ENVIRONMENTAL CONDITIONS

1. Under lightweight steers in the tree, select *management and environment*. Change previous temperature to 25 (degrees F). Click the *ration* tab, view the ME allowable ADG, then print the summary report. Note the ME allowable ADG dropped from 3.06 to 2.85 lb.
2. Click the *management and environment* tab, and change current temperature to 25 (degrees F). Click the *ration* tab, view the ME allowable ADG, then print the *summary report*. Note the ADG dropped to 2.81 lb.
3. Click the *management and environment* tab, and change wind to 10 mph (4.47 m/s). Then click the *ration* tab, view the ME allowable ADG, then print the *summary report*. Note the ADG dropped 1.72 lb/day.
4. Click the *management and environment* tab, and change the hair coat to some mud on lower body. Then click the *ration* tab, view the ME allowable ADG, then print the *summary report*. Note the ADG dropped 1.40 lb.

STEP 6. EVALUATE THE OVERALL FEED REQUIREMENTS AND NUTRIENT EXCRETION.

Retrieve Beef Feedlot tutorial, which should contain all of the original inputs. Click on the *reports* icon from the top screen. Then check all 3 boxes under *animal groups* and select *herd analysis* and *feed requirements* under *herd report components*, then choose *print reports*.

Tables 7 and 8 summarize the whole herd analysis. These data can be used to compare to feed inventory needs and crop production required, and manure nutrients that will have to be managed.

Table 7. Ration Ingredients, Quantity (tons/year) for case study Farm

Ingredient	Light	Medium	Heavy	Total
Alfalfa silage	975.1	469.3	813.4	2257.8
Dry shell corn	0	0	448.3	448.3
Corn, HM	797.2	603.3	823.8	2224.2
Brewers grain	923.4	556.2	677.9	2157.4
Lt. And med. Mineral	16.3	11.0	0	27.2
Heavy mineral	0	0	21.9	21.9
Grand Total	2,711.9	1,639.7	2,785.3	7,136.9

Table 8. Summary of Animal Performance and Manure Nutrients per ha

Feed cost, \$/yr	Feed cost of ADG	ADG	Crop Acres	Nitrogen excreted, lb total and per crop acre		Phosphorus excreted, kg. total and per crop ha		Potassium excreted, lb total and per crop acre	
312,204	0.31	2.94	550	131,947	240	17,458	32	69,292	126

STEP 7. EVALUATE ALTERNATIVES IDENTIFIED BY THE FARM OWNERS

Questions the farm owners have relate to determining the best match of animals and crops on this farm. Corn silage provides more energy/acre than alfalfa or grass. How does it compare to these two in cost of gain, feed requirements, and manure nutrients to manage? The quantity of feed fed and animal performance predicted by the model agreed well compared to actual amounts fed, based on farm records. The amount of alfalfa silage and high moisture corn required matched what was produced on the farm during the base year. To answer the owner's questions, several different scenarios were evaluated with the LRNS, as follows.

Replacing alfalfa with corn silage: In addition to replacing alfalfa silage with corn silage, brewers' grains was replaced with soybean meal, and dry shelled corn replaced the high moisture corn. This was done in an attempt to optimize animal performance. The farmers have raised a concern with the performance of the Heavy Group. Dry matter intakes of this group are only 89% of that predicted by the model. The current ration uses a high percentage of high moisture corn. Research results have implicated subacute acidosis in reducing intakes on long fed cattle utilizing high moisture corn (Fox et al., 1991).

Compared to the current ration, this scenario increased animal performance and decreased cost of gain. The increased animal performance was due in part to better rumen health and increased intakes. Lowered cost of gain was due to utilizing a higher proportion of farm-produced feeds, decreasing purchased inputs and increasing animal performance. Total dry matter required for the two scenarios were virtually the same. Nutrient excretion was also improved with the corn silage scenario, projecting a noticeable decrease in the amount of N, P, and K excreted per acre.

Replacement of alfalfa with grass: To minimize soil erosion and optimize yields, growing 100% corn is not practical on most farms in New York, and perennial grass is better suited to acid soils than is alfalfa. Therefore, a third evaluation with LRNS utilized silage from an intensively managed grass production system. The projections for this scenario are intermediate to the base and corn silage scenarios. Total Feed Cost per year is higher than the corn silage scenario due to higher production cost of grass versus corn silage (\$35/ton vs. \$25/ton). With equal average daily gains for the two systems, this creates a higher cost of gain for cattle on the grass silage scenario.

While there was a reduction in N excreted per acre for grass silage compared to the base ration, it was not as great a reduction as that produced by the corn silage system.

Evaluation of the proposed crop production plan: To keep soil erosion to a minimum, the goal of the cropping plan is to keep the sod to row crop acres in a ratio of 1:2. The proposed plan calls for a total of 179 acres to be planted to a sod crop, either alfalfa or clover grass mixture. The remainder of the forage for this feedlot will come from corn silage (about 15 acres of corn will be harvested as silage). Thirty-eight acres are already committed to soybeans, leaving 318 acres of corn for grain, estimated to produce 1340 tons of corn. Total corn grain needed to annually feed 950 head of cattle is 2,671 tons, requiring the purchase of 1331 tons of dry shell corn. As would be expected due to the low level of corn silage feeding, the proposed crop plan scenario does not differ significantly from the grass silage scenario. However, the final plan has a considerably lower annual feed cost than the current program.