WHOLE FARM NUTRIENT BALANCE CALCULATOR

USER'S MANUAL

Caroline Rasmussen, Patty Ristow, Quirine M. Ketterings

MARCH 2011



Nutrient Management Spear Program

Collaboration among the Cornell University Department of Animal Science, PRODAIRY and Cornell Cooperative Extension <u>http://nmsp.cals.cornell.edu</u>

Contents

Introduction	1
Items Needed to Fill Out Sheets	1
Contact Screen	2
Farm Crop Production Screen	4
Imports	4
Exports	6
Exporting Data to Cornell Nutrient Management Spear Program	. 18
Appendix	. 19

Correct citation:

Rasmussen, C.N., P.L Ristow, and Q.M. Ketterings (2011). Whole Farm Nutrient Balance Calculator; User's Manual. Department of Animal Science. Cornell University, Ithaca NY.

Downloadable from: <u>http://nmsp.cals.cornell.edu/projects/curriculum.html</u>.

For more information contact Quirine Ketterings at the Cornell Nutrient Management Spear Program, Department of Animal Science, Cornell University, 330 Morrison Hall, Ithaca NY 14583, or e-mail: <u>qmk2@cornell.edu</u>.

Introduction

The purpose of this Microsoft Visual Basic[©] program is to assist in conducting a mass nutrient balance analysis. This software can be used to develop a mass nutrient balance for any type of livestock operation (dairy, swine, poultry, etc.), or for non-livestock farms. For non-livestock farms, ignore all questions concerning animals.

Nutrients have four basic fates: 1) they are imported to the farm in purchased products; 2) they are exported from the farm in products sold; 3) they remain on the farm to be recycled; and/or (4) they are lost to the environment. The mass nutrient balance will improve the understanding of nutrient movement onto, within, and away from the farm. A well-managed nutrient management plan may reduce purchased inputs, improve nutrient cycling, and reduce the potential for nutrient loss.

Items Needed to Fill Out Sheets

Items needed to complete the Farm Nutrient Balance Calculator check-in sheet include:

Contact Screen

- Producer name, farm name, address, phone, e-mail
- Farm information: balance year, Total Farm acres, All tillable crop and pasture acres, number of acres, perennial and annual with >10% legume, acres receiving manure
- Data collection by: name, e-mail
- Watershed: primary, secondary
- Animal information: milking and dry cows, heifers: 1-2 year, heifers less than one year, calves, bulls and steers, other livestock

Farm Crop Production

- % legume (if applicable)
- Acreage grown
- Manure application (yes/no): for legume-containing crops only
- Nutrient Analysis on dry matter (DM) basis: crude protein (CP), phosphorus (P), and potassium (K)
- Feed type or use: forage, grain, or bedding

- Inventory, %DM entered as well if you select as fed (AF)
- Yield: tons/acre

Feed Purchased

- Tons/yr
- % DM, and CP, P and K values as a % of DM
- Feed type: grain, forage or TMR
- % Forage
- Inventories (wet tons)

Purchased Fertilizers

- Tons/yr: that have been applied, do not include inventories
- %N, %P₂O₅, %K₂O

Animals Purchased

- Type (species)
- Description
- Number
- Weight/head (lbs)

Miscellaneous Purchases

- Tons/yr
- % DM, and % N, P, and K as % DM

<u>Milk Sold</u>

- Milk, lbs/year
- Milk protein (%)

<u>Animals Sold</u>

- Type
- Description
- Number
- Weight/head (lbs)

Crops Sold

- Tons/yr
- % DM, and CP, P, and K as % DM
- Forage Type: Grain, Forage, TMR
- % Forage

Other Exports

- Tons/yr
- % solids
- % wet N, P and K

Contact Screen

Producer Contact Information:

Record the producer contact information, including address, phone and email (Figure 1).

	ext Capcel				
An asterisk (*) be	fore a name signifies a required field.		- Data Collection By		
Producer Name	Joe Deere		Name		
Farm Name	Joe's Jerseys		E-Mail		
Address	1 JD Lane				
City, State, Zip	Somewhere, NY, 00000		Watershed		
hone	000 000 0000		Primary		
Email			Genesee River	*	
-111dii	id@ii.com		Secondary		
Farm Informatio	n		None	~	
* Balance Year	2008 * Total Farm Acres	100.0	Animal Information	#	weight (lbs)
*All legume and	non-legume tillable crop and pasture acres	75.0	Milking & Dry Cows	50	1100
# acre	s, perennial and annual with > 10% legume	30.0	Heifers: 1-2 yr	10	700
	Acres receiving manure	50.0	Heifers: 0-1 yr	0	0
Have vou compl	eted a business summary for the balance year	?	Calves	15	200
Cornell Dairy Fa	arm Business Summary (DFBS)	🗹 Yes	Bulls & Steers	10	1000
Farm Credit Da	ry Farm Summary	🗌 Yes	Other Livestock	10	120
Are you a Certifie	ed Organic producer?	🗌 Yes		0	
Do you practice months per year	intensive grazing (animals graze at least 3 and move to new pen every 3 days or more?	🔽 Yes		0	0
Do you have a (CNMP) (as the b	Comprehensive Nutrient Management Plan			0	
(CNMP) for the b Do you have a (alance year? Cornell Cropware plan for the balance year?	Ves	Animal Units (au) = 76.2	0	

Figure 1. Contact screen. Here the user enters information such as herd size, farm acres, and watershed.

Data Collection:

Enter the name and email address of the CCE or agency professional collecting the data (if applicable). Enter data for the calendar year January 1, 2008 to December 31, 2008.

Watershed:

Enter the watershed where most of the farm owned and rented land is located in the "Primary" box (see Figure 2). If the farm is in two watersheds, enter the watershed that has the smaller farm area in the "Secondary" box.



Figure 2. New York State Watershed Map.

Farm Information:

Enter the total farm acres (including buildings and woodlands), crop and tillable pasture acres, and the number of acres receiving manure during the balance year. Enter the average number and weight per head of animals on the farm during the balance year. On dairy and beef farms, group all mature cows (milking and dry) on the first line, enter groups of heifers on the next 3 lines, bulls and steers on the 4th line and all other livestock on the 5th line. Enter "yes" or "no" to the questions concerning the Cornell Dairy Farm Business Summary, the Farm Credit Business Summary, organic certification, intensive grazing, having a Comprehensive Nutrient Management Plan (CNMP) and having a Cornell Cropware plan.

Farm Crop Production Screen

Enter in relevant information for all crops grown and harvested on the farm, including those used for pasture and bedding (figure 3). Several types of crops and average nutrient analyses are already programmed into the calculator, and appear in a list on the right-hand side of the screen. Double-clicking one of these will put it on your list. From there, adjustments can be made to the nutrient values.

- Yield and Inventory Entered as: select the appropriate response. If "As Fed" is selected, you will need to enter the % Dry Matter in a later column. The yield and inventory values <u>must all</u> be entered in DM or AF, whichever you chose.
- Inventories: these track the "carryover" of nutrients from one year to the next and ensure that nutrients in things like stored feed are accounted for properly when dealing with multiple years of data. The ending inventory values can be used to automatically update next year's starting inventory. For the Farm Crop Production table, enter values in DM.
- For legume crops enter the percent legume in the stand. If manure was applied to the crop during the balance year, circle or select "Y".

•	Nutri	ent Manage	ement Spear	Program	Nutrient Mass B	alance Calc	ulator - [Fe	arm Crop F	Production]			. 7
Ρ	revious	Home	Next	Cancel	Delete Current R							
	FARM (PASTU	ARM CROP PRODUCTION - Enter the crop name, acres, yield (tons/a dry matter), crude protein (%dm), P, (%dm), and K (%dm), percent grain, beginning and ending inventory balances. LEGUME CROPS, ASTURE- enter the % legume, manure applied (y/n), acreage, yield, and crude protein, P and K. Enter inventory changes in tons (dm).										
		Crop	% Legume	Acres	Manure Applied	CP (%DM)	P (%DM)	К (%DM)	Feed Type	Yield & Inventory Entered as	Yield (t/a)	Haylage Baleage Dry Hay
		Dry Hay	20	20.0		16.00	0.32	2.30	 ● Forage ● Grain ● Bedding 	 Ory As Fed 	2.20	Corn Silage Small Grain Silage Corn Grain Small Grain
	•	Corn Silage	0	20.0		9.00	0.21	0.95	 ● Forage ● Grain ● Bedding 	 ○ Dry ⊙ As Fed 	15.00	Straw Pasture Other
	*								 ○ Forage ○ Grain ○ Bedding 	Ory As Fed		

Figure 3. Farm crop production screen. Note that the "manure applied" box only is accessible for fields with legume content >0%. The pre-made crop types are on the right-hand side of the page.

Imports

The imports pages tabulate nutrient sources, like animal feed, fertilizer, and livestock, which are imported to your farm - i.e. they were brought in, and not generated on-farm as would be the case for homegrown feeds or previously-acquired animals.

Feed Purchases

In the Feed Purchases screen enter various purchased products used in livestock rations. As with the crop screen, there is already a series of pre-entered common feedstuffs for easy use (figure 4).

- % Forage: for TMRs; used to calculate how much forage is brought in for the mix. The program assumes that all of the TMR (forage and concentrate portions) are purchased. If you grow forage that is added to purchased concentrates as a TMR, enter the concentrate values here, as the forage component is included on the Farm Crops page.
- Inventories: allow tracking of starting and ending supplies of feeds (in tons as-fed)

	Nutr	ient Managemen	t Spear Pro	gram Nut	rient Mass	Balance (Calculator	- [Feed Pu	rchases]		
ŀ	Previous	Home	Next C	lancel D	elete Curren	t Row					
	FEED F	PURCHASED: (grain,	hay, minerals,	etc.) Enter tł	he type of fee	ed, tons and a	analysis (%dr	ry matter).			
		Item	Tons/yr	% DM	% CP	% P	% K	Feed Type	% Forage	Agway Payback Calf Barley Grain Brewers Grain -Dry	
	Þ	Corn Mix	274.38	89.0	8.87	0.27	0.66	 ● Grain ● Forage ● TMR 		Brewers Grain -Wet Canola Meal Citrus Pulp Corn Dry -Ear 45	
		Soybean Meal	52.00	90.6	52.00	0.66	2.36	 ● Grain ● Forage ● TMR 		Corn Dry -Ear 56 Corn Dry -Grain 45 Corn Glut Feed Corn Glut Meal	
		Protein Sup	69.00	93.8	42.98	0.63	1.18	 ● Grain ● Forage ● TMR 		Corn HM -Grain Corn HM-Ear Corn -Hominy Corn Silage	
		Milk cow Min	2.60	99.6	0.00	3.22	0.04	 ● Grain ● Forage ● TMR 		Cottonseed Distillers Grain -Dry Distillers Grain -Wet Hay -Grass	=

Figure 4. Feed purchases.

<u>Fertilizer Purchases</u>

Enter the amount and analyses of all fertilizers used on the farm (figure 5). Note that, unlike the feed and crop pages, there are no columns for beginning and ending inventories. You should only enter the amount of fertilizer actually spread, and not include any bought but not used. Like the previous pages, there are pre-made fertilizers that can be quickly put into the chart.

🔜 Nut	rient Managemen	t Spear Pro	gram Nut	rient Mass	Balance C	alculator - [Fertilizer Purchases]	
Previou	is Home	Next C	iancel D	elete Current	Row		
FERT	ILIZER PURCHASED:	Enter the type	e, tons and a	inalysis as app	lied.		
						10.20.20	
	Item	Tons/yr	% N	% P2O5	% K2O	10-34-0	
	MAP	2.29	11.00	52.00	0.00	15-15-15	
	Urea	13.87	46.00	0.00	0.00	19-18-18	
	15-15-15	0.25	15.00	15.00	15.00	20-10-10	
	Potash	3.71	0.00	0.00	60.00	21-17-0	
	Ammonium Sulfate	1.80	21.00	0.00	0.00	6-24-24	
*						8-32-16	
						Ammoniated Superphe	osphate
						Ammonium Nitrate	

Figure 5. Fertilizer purchases screen.

<u>Animals Imports Screen</u>

Record the number of adults and young-stock purchased, and the average weight per head in lbs. Select species type from the drop down box (figure 6).

🔜 Nutr	rient Manag	gement	Spear Program N	utrient Mas	s Balance Calci	ulator - [Animal Imports]	
Previou	s Home		Next Cancel	Delete Curre	ntRow		
ANIMA	ALS PURCHA	SED: (pe	er year) Enter type, numl	ber and averag	e weight per head.		
	Туре	•	Description	Number	Weight/hd (lbs)		
	Goats	~	Buck	1	150		
	Dairy	*	Replacement Heifers	3	800		
▶*		*		2			
	Swine Poultry Goats	~ ~					

Figure 6. Animal imports screen.

Purchased Bedding and Other Imports

Record the number of tons, % DM, N, P and K (% DM) for all bedding material purchased or other miscellaneous imports. Do not enter farm produced bedding (figure 7).

	Nutri	ent Manag	ement Spe	ar Progran	n Nutrient /	Mass Balanc	e Calculator	- [Purchased Bedding	& Other Imports]	
Pr	evious	Home	Next	Cance	Delete O	urrent Row				
N	IISCEL	LANEOUS P	URCHASES:	Enter item, to	ons and analysi	s (%dry matter).				
Г									Corn Stalks	
		Item	Tons/yr	% DM	N (%DM)	P (%DM)	K (%DM)		Newspaper	
	<u>۲</u>	Newspaper	10	97.3	0.22	0.03	0.00		Oat Straw	
	*								Wheat Straw	
									Syracuse Fiber	

Figure 7. Purchased bedding and other imports screen.

Exports

<u>Milk Sold</u>

Enter the pounds of milk sold and the % Milk Protein, as listed on milk checks (figure 8). Make sure that the pounds produced per head looks reasonable. If not, you may want to double check on the average herd size entered in the Contacts page.

Nutri	ent Manageme	nt Spear Program Ni	utrient Mass Bala	nce Calculator - [Milk Sold]
Previous	Home	Next Cancel	Delete Current Row	
MILK SO	DLD: Enter the amo	ount and milk protein comp	osition.	
	Milk, Ibs/year	Per Head Production	Milk Protein (%)	
•	2,316,993	24,914	3.00	

Figure 8. Milk sold screen.

Animals Exports

Here enter any animals sold throughout the year, including breeding stock, cull or beef cows, etc. (figure 9). This also includes stock that die and are composted or rendered off-farm - do not include animals you compost yourself.

	Nutri	ent Mana	gement	Spear Progra	ım Nutrien	t Mass Balance (Calculator - [Animal Exports]		
F	Previous Home Next Cancel Delete Current Row								
	ANIMAL	LS SOLD: (p	er year) E	inter type, number	r and average	weight per head.			
		Тур	e	Description	Number	Weight/hd (lbs)			
	•	Dairy	~	Calves	60	90			
		Dairy	*	Dairy Culls	28	1350			
		Dairy	*	Milk cows	27	1250			
		Dairy	*	Dairy Heifers	6	1150			
	*		*						

Figure 9. Animal exports screen.

Crop Exports Screen

Enter any crops, including hay and forage or grains, which were grown on the farm and sold (not fed on-farm). The information required is similar to that for earlier crop pages (figure 10).

<u>e</u>	Nutri	ient Managem	ent Spear I	Program N	lutrient Mass	Balance Ca	lculator - [([rop Exports]			
_											
1	Previous	Home	Next	Cancel	Delete Current	Row					
	CROPS	i SOLD: (grain, ha	y, etc.) Enter I	type, tons an	d analysis (% dm)						
										Dedau Casin	
		Item	Tons/yr	% DM	CP (%DM)	P (%DM)	K (%DM)	Feed Type	% For	Canola Meal	
	Þ	Corn Dry -Grain	19.40	88.0	9.00	0.30	0.32	 ● Grain ● Forage ● TMR 		Corn Dry -Ear 45 Corn Dry -Ear 45 Corn Dry -Grain Corn HM -Grain	
		Hay Sales	131.50	100.0	16.10	0.30	2.25	◯ Grain ⊙ Forage ◯ TMR		Corn HM-Ear Corn Silage Hay -Grass Hay -Legume	
	*							◯ Grain ◯ Forage ◯ TMR		HCS -Grass HCS -Legume HCS -MML Oats	

Figure 10. Crop exports screen.

Manure, Compost, and Other Exports

Here enter any manure or compost that is produced on the farm but sent elsewhere (figure 11). This does not include manure, compost or sludge, etc. that are spread on the field of the farm itself. Note that the nutrient analysis columns ask for nutrient values in % wet rather than % DM, as this is how manure nutrient reports are often presented on the manure analyses.

🔜 Nutrient Management Spear Program Nutrient Mass Balance Calculator - [Manure & Other Exports]								
Previous Home Next Cancel Delete Current Row								
OTHER	EXPORTS: (ma	inure, compos	t, etc.) Enter to	ons, % solids and	analysis.			
	Item	Tons/yr	% Solids	N (% wet)	P (% wet)	K (% wet)		
	Liquid Manure	27,598.00	4.00	0.15	0.08	0.22		
*								

Figure 11. Manure and other exports screen.

Generating Reports and Balances

The report menu can be selected from the "Home Menu" by clicking on the "Balance Reports" button (figure 12). There are five reports that may be viewed and printed (figures 13, 14, 15, 16 and 17). They can be viewed individually by clicking on the box to the left of the report name, and then selecting "View Report," or by clicking "Select All" and then "View Report" a multitab summary report will be generated.

Ile Edit Reports	ant Spear Program Nutrient Mass B Help	alance Calculator	
Imports	Contact	Fam Crop Production	Exports
Feed Purchases	→ →		Milk Sold
Animal Imports -	-		Crop Exports
Purchased Bedding & Other Imports	→ <u></u>		Manure & Other Exports
		Balance Reports	

Figure 12. Home screen after information has been filled out. Now all the buttons are activated.

Data Entry Report

The Data Entry report is useful for verifying farm entered data (figure 13).

ReportForm				
Print Print Preview				
Entered Data Annual Nutrie	ent Mass Balance Distri	ibution of Nutrient Imports & E	ports I Itemized Nutrient Imports	& Exports (%) Itemized Nutrien
		Nutrient Mass Balar	ice	
CONTACT INFORMAT	r			
			<u> </u>	
Producer Name	Joe Deere		Data colle	ction by
Farm Name	Joe's Jerseys		Name	
Address	1 JD Lane			
City, State, Zip	Somewhere, NY, 0	000	Email	
Phone	000 000 0000			
E-Mail	jd@jj.com			
Balance Year	20	009	Waters	shed
Total farm acres		100	Primary	1990/02-1980 D
Crop and tillable past		75	Genesee River	
Legume crop acres		30	Secondary	
Acres receiving manu		50	None	
Average number of a	Animal Group		#	weight (lbs)
· · · · · · · · · · · · · · · · · · ·	Milking and Dry Cov	ws	50	1,100
	Heifers: 1-2 yr	15	10	700
	Heifers: 0-1 yr		0	0
	Heifer Calves:		15	200
<				

Figure 13. The Data Entry report is useful for verifying farm entered data.

Annual Nutrient Mass Balance

This report totals all the N, P, and K imported and exported by category (for inputs – feed, fertilizer, animals, and misc; for exports – milk, animals, crops, and misc) (figure 14). The statistics themselves are displayed three ways, and the balance (imports – exports) is calculated.

Category	N	P	K	N	P	ĸ	N	P	ĸ
Imports		tons per year		1bs per acre receiving manure per year		Ibs per total tillable acres per yes		per year	
Feed	0.71	0.07	0.18	28	3	7	19	2	5
Fertilizer	1.50	1.29	2.49	60	52	100	40	34	66
Animals	0.04	0.01	0.00	1	0	0	1	0	0
Miscellaneous	0.11	0.01	0.22	4	1	9	3	0	6
Total Imports	2.35	1.39	2.89	94	55	115	63	37	77
Exports		tons per year		1bs per acre	receiving manu	re per year	Ibsperte	otal tillable acres	per year
Milk	2.09	0.34	0.60	83	14	24	56	9	16
Animals	0.14	0.03	0.01	6	1	0	4	1	0
Crops	0.02	0.00	0.01	1	0	1	0	0	0
Miscellaneous	-	-	-	-	-	-	-	-	-
Total Exports	2.24	0.37	0.62	90	15	25	60	10	17
Difference (Import -Export)	0.11	1.01	2.26	5	41	91	3	27	60
DIAGNOSTIC S									
Mature Cows			50	50 Acres receiving manure (% tillable)			67%	per manure	per tillable
Animal Units			76	Ratio of Cows	to Heifers		1 to 0.50	acre	acre
Milk production/cow/year (lbs)			15,000	15,000 Animal Density(animal units/acre)				1.52	1.02
Total legume acres			20	20 Milk Production (lbs/acre)			15,000		
Proportion of Purchased and Fa	rm Produced F	eed							
Purchased Feed (% total feed d	ry matter)		7%	Farm Produce	d Feed (% tot	al feed dry ma	tter)		93%
Purchased Forage (% total feed	idry matter)		-	Farm Produce	ed Forage (% t	otal feed dry m	natter)		93%
Purchased Grain (% total feed of	iry matter)		7%	Farm Produce	ed Grain (% to	tal feed dry ma	tter)		-
Nutrients Remaining	N	P	К	Production Eff	ficiency		N	P	К
Per animal unit (lbs)	3	27	59	Feed Use Effi	ciency (Milk/Fe	eed) %	67	84	30
Per mature cow (Ibs)	5	41	91	Nutrients impo	orted per cwt n	nilk sold	0.63	0.37	0.77
% [(Imports-Exports)/Imports]	5	73	78	Nutrients remai	ning per ovt mil	k sold	0.03	0.27	0.60
OTHER NITROGEN CONTRIBU	JTIONS								
Source	tons/vear	lbs/tillable	Legume fixation	is an important	source of No	n many farms,	but there are m	any	
	tororycu.	acres	uncertainties as	sociated with th	is estimate. Th	e N fixation es	timate is based	on the	
Legume N Fixation	0.41	11	farm total legum	e production. If	the crop is >9	0% legume, th	e estimated N fi	ation	
Atmospheric N Deposition	0.40	11	is 60% of the cro	op N content. Fo	or crops with 9	0% or less leg	ume, the estima	ted N	
Total other N imports	0.81	21	fixation is 36% of	of the crop N cor	ntent.				
Total N Remaining	0.92	25	1						
Total N Remaining/au (lbs)	24		Atmospheric nit	rogen depositior	n is estimated	at 8 lbs per tot	al farm acre.		
Total N Remaining/cow (lbs)	37								
% Total N Remaining	29%								

Figure 14. The Annual Nutrient Mass Balance is the primary analysis report.

Output

- Tons per year: simply gives the absolute amount (in tons) of the given nutrient imported or exported. Lbs/acre receiving manure per year: divides the total pounds of nutrient imported or exported by the number of acres listed as receiving manure.
- Lbs/total tillable acres per year: divides the total pounds of nutrient imported or exported by the number of acres listed as tillable.

Diagnostics

The top rows summarize some of the information given on the first few pages of the spreadsheet. Some numbers, such as milk production and animal density, are displayed in terms of per acre receiving manure and per tillable acre. This allows some comparison of different farms of different sizes and intensities; similarly, it allows the farm to track changes if land and/or herd size change.

Animal feeds are broken down by source – imported/purchased or farm-produced. The nutrients remaining (imports – exports) are displayed in a variety of ways. Again, this puts the raw numbers (those on the top left of the report – the tons per year of imports and exports) into

perspective. The % row expresses the difference between nutrients imported and exported (i.e. remaining nutrients) as a percent of imported nutrients.

Feed use efficiency shows how much (in %) of a nutrient was sold in the milk versus how much was "put in" through feed (both imported and farm-grown). Other numbers show the pounds of nutrients imported and remaining per hundredweight of milk. Efficiencies can thus be evaluated and compared from year-to-year, even if parameters like animal numbers change.

Other Nitrogen Contributions

This section shows N balances in further detail, accounting for things like legume N fixation and atmospheric N deposition. Added to the Import – Export difference from the top segment of the report, this yields the Total N Remaining. This is then broken down by pounds per animal unit or mature cow, and then as a percent of nutrients imported.

Distribution of Nutrient Imports and Exports

This report details the proportion of imports and exports due to the different enterprises on the farm – feed, fertilizer, animals, and bedding/manure/miscellaneous (figure 15). This report summarizes the information that you put in, allowing a quick and easy way to double-check your numbers, or to print out and have on-hand.

Distribution of Nutrients (%): Joe's Jerseys 2009

DISTRIBUTION OF IMPORTED NUTRIENTS

	N	Р	K
Source		% of imports	
Feed	34%	20%	21%
Fertilizer	63%	77%	63%
Animals			
Bedding & other imports	3%	3%	16%

DISTRIBUTION OF EXPORTED NUTRIENTS

	N	Р	K
Source	% of exports		
Milk	97%	96%	98%
Animals	2%	3%	0%
Crops	1%	0%	2%
Manure & other exports			

Figure 15. The distribution of nutrient imports and exports (%) report.

Itemized Nutrient Imports and Exports (%)

This report more specifically breaks down the sources of nutrients brought in or shipped out (figure 16). The total values are the same as those on the Distribution of Nutrient Imports and Exports report.

Mass Nutrient Balance v4.3 Output: Joe's Jerseys 2009						
Itemized N, P, K imports						
Import % from purchased feed	% N	% P	% K			
Soybean Meal 44	28%	14%	19%			
Brewers Grains-Wet	6%	6%	2%			
Import % from nurchased fertilizers	% N	% P	% K			
20_10_10	63%	77%	63%			
20-10-10	0370	1170	0370			
Import % from purchased animals	% N	% P	% K			
	-	-	-			
Import % from miscellaneous imports	<u>% N</u>	<u>% P</u>	<u>% K</u>			
Wheat Straw	3%	3%	16%			
Tatal law at a	100%	1009/	1000/			
l otal imports	100%	100%	100%			
Mass Nutrient Balance v 4 3 Output: Joe's Jersevs	2009					
Itemized N.P.K exports	2005					
Export % from milk sales	% N	% P	% K			
	97%	96%	98%			
Export % from crop sales	<u>% N</u>	<u>% P</u>	<u>% K</u>			
Dry Hay	1%	0%	2%			
Event % from animal calca	0/ NI	0/ D	0/ 1/			
Export % from animal sales	<u>70 IN</u> 294	<u>70 P</u> 20/	<u>70 K</u>			
Cuil Cows	270	370	U 76			

Figure 16. Itemized Nutrient Imports and Exports (%) report.

Itemized Nutrient Imports and Exports (lbs per tillable acre)

This report presents the same information as the Itemized Nutrient Imports and Exports (%) report, but expresses the values as pounds per tillable acre (figure 17).

Itemized N, P, K imports			
	lbs per tillable acre		
Import from purchased feed	N	<u>P</u>	<u>K</u>
Soybean Meal 44	24.0	2.1	6.7
Brewers Grains-Wet	5.0	0.8	0.7
Import from purchased fertilizer 20-10-10	<u>N</u> 53.3	<u>Р</u> 11.5	<u>K</u> 22.1
Import from purchased animals	<u>N</u> -	<u>P</u> -	<u>K</u>
Import from miscellaneous imports Wheat Straw	<u>N</u> 2.9	0.4	<u>К</u> 5.7
Total Imports (Ibs/tillable acre)	85.1	14.8	35.2

Itemized N, P, K exports			
	lbs per tillable acre		
Export from milk sales	N	P	K
	65.2	10.6	18.8
Export from crop sales	N	P	K
Dry Hay	0.4	0.1	0.4
Export from animal sales	N	P	K
Cull Cows	1.4	0.3	0.1
Export from miscellaneous exports	N	P	K
	-	-	-
Total Exports (lbs/tillable acre)	67.0	10.9	19.2

Figure 17. Itemized nutrient imports and exports (lbs per tillable acre) report.

Mass Balance Calculations

Nutrient Imports

Purchased Feed:

- Nitrogen (Tons N / year) = Sum of ((tons as-fed purchased + beginning inventory - ending inventory) * % DM * CP concentration))/6.25 for each purchased feedstuff.
- Phosphorus (Tons P / year) = Sum of ((tons as-fed purchased + beginning inventory - ending inventory) * % DM* % P for each purchased feedstuff.
- Potassium (Tons K / year) = Sum of ((tons as-fed purchased + beginning inventory - ending inventory) * % DM * % K for each purchased feedstuff.

<u>Fertilizer:</u>

- Nitrogen (Tons N / year) = Sum of (tons fertilizer purchased * % N) for each purchased fertilizer.
- Phosphorus (Tons P / year) = Sum of (tons fertilizer purchased * % P₂O₅ * 0.43) for each purchased fertilizer.
- Potassium (Tons K / year) = Sum of (tons fertilizer purchased * % K₂O * 0.83) for each purchased fertilizer.

Animals Purchased:

• Provided by L. Chase (personal communication, July 6, 2006).

Species	Ν	Р	K			
	% of bodyweight					
Dairy	2.9	0.70	0.2			
Beef<1000 lbs	2.7	0.73	0.2			
Beef>= 1000 lbs	2.4	0.65	0.2			
Swine<100 lbs	2.5	0.56	0.2			
Swine=>100 lbs	2.4	0.47	0.2			
Poultry	2.8	0.58	0.2			
Goats	2.4	0.60	0.2			
Sheep	2.5	0.60	0.2			
Horses	2.9	0.70	0.2			

Table 1. Nutrient composition of livestock (N,P,K) as % of bodyweight

- Nitrogen (Tons N / year) = Sum of (number of animals * average weight in lbs * (N composition/100)) / 2000
- Phosphorus (Tons P / year) = Sum of (number of animals * average weight in lbs * (P composition/100)) / 2000
- Potassium (Tons K / year) = Sum of (number of animals * average weight in lbs * (K composition/100)) / 2000

Bedding and Miscellaneous Imports:

- Nitrogen (Tons N / year) = Sum of (weight in tons * % DM * % N)
- Phosphorus (Tons P / year) = Sum of (weight in tons * % DM * % P)
- Potassium (Tons K / year) = Sum of (weight in tons * % DM * % K)

Nutrient Exports

Milk Sold:

Milk protein reported to the producer as true protein is converted to crude protein by multiplying by 1.075 (Cornell Animal Science Dept. Mimeo 213). The N content of milk crude protein is calculated by dividing by 6.38.

- Nitrogen (Tons N / year) = ((lbs of milk sold * (milk true protein*1.075)/6.38)/ 2000
- Phosphorus (Tons P / year) = (lbs of milk sold * 0.0009)/ 2000

(Knowlton, K.F. and J. H. Herbein. 2002. Phosphorus partitioning during early lactation in dairy cows fed diets varying in phosphorus content. J. Dairy Sci. 85:1227-1236.)

• Potassium (Tons K / year) = (lbs of milk sold * 0.0016)/ 2000

(Fisher, L.J., N. Dinn, R.M. Tait and J.A. Shelford. 1994. Effect of dietary potassium on the absorption and excretion of calcium and magnesium by lactating cows. Can. J. Anim. Sci. 74:503-509.)

<u>Animals Sold:</u> See Animals Purchased

Crops Sold:

- Nitrogen (tons N / year) = Sum of (tons sold * % DM * CP concentration)/6.25
- Phosphorus (tons P / year) = Sum of (tons sold * % DM * % phosphorus).
- Potassium (tons K / year) = Sum of (tons sold * % DM * % potassium)

Manure, Compost and Other Exports:

- Nitrogen (tons N / year) = Sum of (weight in tons * % N)
- Phosphorus (tons P / year) = Sum of (weight in tons * % P)
- Potassium (tons K / year) = Sum of (weight in tons * % K)

<u>Diagnostics</u>

- Mature Cow = the number of mature cows entered on the Animal Group screen.
- Animal Units = sum of (number of animals * average weight in pounds)/1000 for each animal group.
- Ratio of cows to heifers = total number of cows (milking and dry) / total number of heifers.

- Acres receiving manure (% tillable) = (Number of acres receiving manure / total tillable acres) * 100
- Milk production/cow/year (lbs) = Milk Sold / Number of Mature Cows
- Total legume acres = sum of acres entered in Legume Crop Screen
- Animal Density (au/acre)/acres receiving manure = animal units/acres receiving manure.
- Animal Density (au/acre)/total tillable acres = animal units/ crop+tillable pasture acres.
- Milk Production/manure acre = milk sales in pounds / acres receiving manure.
- Milk Production/tillable acre = milk sales in pounds / crop+tillable pasture acres.
- Purchased Feed (% total feed DM) = total purchased feed DM/total feed DM.
- Total feed dry matter = sum (purchased feed (DM) + legume crops pasture (DM) + non legume farm crop production (DM) crops sold (DM))
- Total purchased feed (DM) = sum (tons of feed purchased * % DM/100).
- Legume crops pasture (DM) = sum (legume acres * DM yield tons/year)
- Non legume farm crop production (DM) = sum (non legume crop acres * yield ton/acre/year DM)
- Crops sold (DM) = sum (crops sold tons/year * % DM/100)
- Purchased Forage (% total feed DM) = purchased forage DM/total feed DM
- Purchased Forage (DM) = sum (tons of feed purchased * (% dry matter/100) * (% forage/100)
- Purchased Grain (% total feed DM) = purchased grain DM/ total feed DM
- Purchased Grain (DM) = sum (tons of feed purchased * (dry matter % /100) * [1-(% forage/100)].
- Farm Produced Feed (% total feed DM) = total farm produced feed/total feed DM
- Farm Produced Forage (% total feed DM) = total farm produced forage/total feed DM
- Farm Produced Grain (% total feed DM) = total farm produced grain/total feed DM
- Farm Produced Feed = sum (legume crops pasture (DM) + non legume farm crop production (DM) crops sold (DM))
- Farm Produced Forage = sum (legume crops pasture (DM) * (legume crops % forage/100) + non legume farm crop production (DM) * (non legume farm crop production % forage /100) crops sold (DM) * (crops sold % forage/100))
- Farm Produced Grain = sum (legume crops pasture (DM) * (1-(legume crops % forage/100)) + non legume farm crop production (DM) * (1-(non legume farm crop production % forage /100)) – crops sold (DM) * (1-(crops sold % forage/100)))

Nutrients Remaining

- Per animal unit (lbs) N, P and K = (Tons N, P or K * 2000)/ animal units
- Per mature cow (lbs) N, P and K = (Tons N, P or K ≈ 2000)/ mature cow
- % = [(Imports-Exports) / Imports]

Production Efficiency

- Feed Use Efficiency (Milk / Feed) N, P and K % = [(Tons N, P or K milk sold) / (Tons N, P or K farm produced + Tons N, P or K purchased)] * 100.
- Nutrients (N, P or K) imported per cwt milk sold = [Total Lbs N, P or K imported / (Lbs Milk N, P or K / 100)]

• Nutrients remaining per cwt milk sold = [(Total Lbs N, P or K imported – Total Lbs N, P or K exported) / (Lbs Milk N, P or K / 100)]

Other Nitrogen Contributions

Legume N Fixation: For each legume crop or pasture, N Fixation (tons N/year) = If legume % >90%: (0.6 * acres produced * DM yield * average CP content)/6.25 If legume % = 90% or less: (0.36 * acres produced * DM yield * average CP content)/6.25

 Atmospheric N Deposition: Atmospheric nitrogen deposition is estimated at 8 lbs N per total farm acre (tillable and non-tillable) per year: Atmospheric N Deposition (tons N/year) = total farm acres * 8

(Baumgardner, R. E. Jr., T.F. Lavery, C.M. Rogers and S.S. Isil. 2002. Estimates of atmospheric deposition of sulfur and nitrogen species: clear air status and trends network, 1990-2000. Environ. Sci Technol. 36: 2614-2629).

- Total other N imports (tons) = Legume N fixation + Atmospheric N Deposition.
- Total N remaining = N imported (feed, fertilizer, animals purchased and miscellaneous) N exported (milk, animals sold, crops sold, miscellaneous) total other N imports (legume N fixation, atmospheric N deposition)
- Total N remaining/au (lbs) = total N remaining / animal units
- Total N remaining/cow (lbs) = total N remaining / mature cows
- % Total N remaining = total N remaining / total N imported * 100

Exporting Data to Cornell Nutrient Management Spear Program

Now that the information has been entered, and you have looked at the mass nutrient balance summaries, you can send the data to Cornell University's Nutrient Management Spear Program to be added to the database of participating farms. When Cornell receives your data, it can be merged with the database of all farms participating in the study since 2005. You will receive a individual letter analyzing your data in comparison to previous years that you have participated (appendix 1). At the end of the data collection period, you will also receive an extensive report that compares your nutrient mass balance to all other farms submitting data for that balance year (appendix 2).

To export the data to Cornell, on the home menu screen, select File > Export Data for Cornell. This will convert the data into a .zip file, which is what the database will need. A small pop-up box will appear indicating that the export (file conversion) has taken place, and giving the location that the file was saved. The title of the file will be C:\MNB\farmame_year.zip.

<u>At this point, the data have not been sent to Cornell!</u> Note the location given in the pop-up, and select "Okay". To send the converted file, attach the file to an email sent to Quirine Ketterings (qmk2@cornell.edu). Be sure to attach the .zip file – when you search for the file on an email program, there will be other files with similar names (figure 18).

Select file(s) to	upload				? 🛛
Look in:	🗀 МИВ		•	000	
My Recent Documents Desktop	 Joe'sJersevs (Joe'sJerseys (2008 2008 2008.mnb_back 2008.mnbx 2008_BR 2008_DataEntry 2009 2009			
My Documents My Computer	Joe'sJerseys_: Joe'sJerseys_: Joe'sJerseys_: Joe'sJerseys_: Joe'sJerseys_: Joe'sJerseys_:	2009.mnbx 2009_BR 2009_DataEntry 2009_DoN 2009_ItemizedLbs 2009_ItemizedPC			
	<	IIII		19	>
My Network Places	File name: Files of type:	All Files (*.*)		•	Open Cancel

Figure 18. Identifying the correct file to email. You may find multiple files with similar names when attaching a file for email, but the ones you want are .zip files (circled in red). Note the multicolored icon to the left of the filename, indicating a .zip file. Moving the mouse over the filename will cause pop-up text to appear, indicating the file type.

Appendix

Appendix 1: Individual homework farm letter

Appendix 2: Comparison homework farm letter