Cornell Nutrient Management Spear Program

Whole Farm Nutrient Mass Balance Input Form Instructions

January 21, 2024

INTRODUCTION

The purpose of this input form is to collect the necessary data for developing a whole-farm nutrient mass balance. This form can be used to develop a nutrient mass 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. Sections in blue in the form are intended for greenhouse gas (GHG) estimation which are not required for the nutrient mass balance. For more information about the GHG estimation, please see page 4. Send completed form to Quirine Ketterings (qmk2@cornell.edu) or Olivia Godber (ofg6@cornell.edu).

FARM CHARACTERISTICS

Producer Contact Information:

Record the producer contact information, including address, county, phone, and email (if available).

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, 2024 to December 31, 2024.

Watershed:

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

Drainage Basins of New York State

Soil Type:

Enter the predominant soil type of the farm owned and rented land in the "Primary" box. If there are multiple soil types, enter the soil type with the largest farm area in the "Primary" box, and the soil type with the second largest farm area in the "Secondary" box.

Farm Information:

Total farm acres: Enter the total owned and rented farm acres (including buildings and woodlands).

All legume and non-legume tillable crop and pasture acres: Enter the total number of crop and potentially tillable pasture acres owned and rented.

Legume acres (perennial and annual) >10% legume: Enter all crop and tillable pasture acres, both annual and perennial that have more than 10% legume plant content.

Acres receiving manure (crop and pasture): Enter the total number of acres owned and rented that receive manure either by mechanical spreading and/or animal grazing.

Milk marketing co-operative: Enter the milk marketing co-operative that you belong to *(optional)*.

Check the boxes to indicate "yes" in answer 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 Cropware Plan.

Animal Information:

Enter the average number and weight per head of animals on the farm during the balance year. On dairy farms, enter the main dairy cow breed, or breeds, the cow cull rate, and the average somatic cell count (SCC) for the year. If raising heifers off-farm, please indicate the period of time they are raised off-farm for the corresponding animal group, the number that are raised off-farm, and whether or not feed and manure is handled by the farm. If so, please indicate the feed and manure handling in the corresponding sections later in the form.

***For GHGs only**

Enter the max pen stocking density by percentage.

FARM CROP PRODUCTION

Enter all crop and pasture production. Include crops grown for feed and for off-farm sale and whether they were used for "Forage", "Grain", or "Bedding". Enter the percent legume in the stand. If a legume % greater than 0 is entered, check the box if manure was also spread (mechanically or by grazing livestock) on the same acreage. Enter the number of acres, the crude protein (CP), phosphorus (P),potassium (K) and NDF content of the harvested crop (% dry matter). If you choose to enter the yield and inventory balances as dry matter, you can enter 100% in the DM% cell. If you enter the yield per acre and inventories in as-fed tons, enter the harvested crop dry matter content as a percentage. If there is a change in the beginning and ending calendar year inventory of a crop produced for feed or sale, record the beginning and ending year inventory. Enter the average yield in tons (dry matter or as-fed, as selected in the previous column) per acre. If you enter the yield on a dry matter basis, also enter beginning and ending year inventories on a dry matter basis. If you entered the yield on an as-fed basis, enter the inventory on the same as-fed basis.

***For GHGs only**

Enter homegrown feeds fed to animals for the assessed year with their corresponding total amount fed, CP, NDF, DM, and what percent of the total feed was given to the specific animal groups. Representative diets may also be submitted if this is easier.

NUTRIENT IMPORTS

Feeds Purchased:

Enter the type of feed, tons purchased per year, and the percentages of dry matter, crude protein, P, K, and NDF. If there is a change in the beginning and ending calendar year purchased feed inventory, record the beginning and ending year inventory in tons as-fed.

***For GHGs only**

Enter the location or distance the purchased feed was bought from (not where the feed was grown) and what percent of the total feed was given to the specific animal groups. Also enter any feed additives fed.

Purchased fertilizers:

Enter the fertilizer type, tons purchased per year, and the percentages of N, P_2O_5, and K_2O.

***For GHGs only**

Enter the location or distance the purchased fertilizer was bought from (not where the fertilizer was produced)

Purchased animals:

Enter the number of adults, young stock, and any other animals purchased, and the average weight per head in lbs. Any animals that return to the farm after a period off-farm should be included here, i.e. heifers or dry cows.

***For GHGs only**

Enter the location or distance the purchased animal was bought from (not where the animal was raised).

Bedding, manure and miscellaneous imports:

Enter the number of tons, percent dry matter, N, P, and K (% dry matter) for all bedding material purchased, and manure or other miscellaneous imports. Do not enter farm produced bedding. For manure imports, enter the quantity as tons per year or gallons per year, and % solids. Enter the N, P and K as sampled as this is the format commonly used to report compost and manure analyses. Enter the units that the manure analysis is reported as (%, lbs per ton, or lbs per 1000 gallons). A manure analysis may also be submitted if this is easier.

***For GHGs only**

Enter the location or distance the purchased item was bought from (not where the item was produced).

NUTRIENT EXPORTS

Milk sold:

Enter the annual total amount of milk sold (in lbs), the average percent milk protein, average percent milk fat, and average milk urea nitrogen (MUN), as reported on the milk check. Please include any direct milk sales from the farm.

***For GHGs only**

Enter the number of milkings per day, time out of the pen, and distance to milking parlor.

Animals exported:

Enter the number and average live weight per head of all animals sold or exported from the farm.

Crops sold:

Enter the type of crop sold, its quantity, and the percentages of dry matter, crude protein (% dry matter), P (% dry matter), and K (% dry matter). If a total mixed ration is sold, enter the proportion of the mix which is forage.

Manure, compost, and other exports:

Record any other significant products that were sold or given away, such as manure, compost, etc. Enter the quantity, and % solids. Enter the N, P and K as sampled as this is the format commonly used to report compost and manure analyses. Enter the units that the manure analysis is reported as (%, lbs per ton, or lbs per 1000 gallons). A manure analysis may also be submitted if this is easier.

ADDITIONAL INFORMATION FOR GREENHOUSE GAS ESTIMATION

If you are interested in calculating the greenhouse gas emissions (sometimes referred to as carbon footprint) for your farm, please complete the following information. A second report will be provided with estimates of the carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions from your farm, the source of these emissions (e.g. crop production, manure management), and potential opportunities to reduce emissions on your farm. As we collect more data on greenhouse gas emissions, we aim to identify "win-win" farm management opportunities that will help to lower both nutrient balances and greenhouse gas emissions without negative impacts on production or economics of the farm.

Manure analysis:

If available, please submit a copy of any manure analyses you have. If you are unable to submit a copy of the analysis, enter the total N, inorganic/ammonium N, P and K content of manure used on farm as sampled, as this is the format commonly used to report compost and manure analyses. Enter the units that the manure analysis is reported as (e.g. %, lbs per ton, or lbs per 1000 gallons).

Manure applications

For each crop, provide details on the manure applications received, including the manure storage, the application rate (either total applied to all fields for that crop, or an average application rate per acre), the application method ("broadcast/surface applied/not incorporated", "incorporated within 24 hours" or "injected"), and the timing ("Spring", "Summer", "Fall", "Winter"). If multiple storages, methods, or timings are used for a specific crop, enter each one on a different row. This will result in multiple rows for that crop. If you have an updated nutrient management plan with **actual** application rates you can submit this and we can calculate the applications for you.

Fertilizer application:

For each crop, provide details on the purchased fertilizer applications received, including the %N, $\%P_2O_5$ and $\%K_2O$, the application rate (either total applied to all fields for that crop, or an average application rate per acre), and the application method "broadcast/surface applied/not incorporated", "incorporated within 24 hours" or "injected/subsurface"). If multiple fertilizers, methods, or timings are used for a

specific crop, enter each one on a different row. This will result in multiple rows for that crop. If an enhanced efficiency fertilizer, or protected N source is used, specify the type, e.g. nitrification inhibitor, urease inhibitor, slow release fertilizer. Product name can be specified if type is unknown. If you have an updated nutrient management plan with **actual** application rates you can submit this and we can calculate the applications.

Crop rotation, tillage practices, and cover crops

Enter the typical crop rotation for the farm. Specify the most intensive tillage practice from "conventional", "reduced", or "no till" for each year of the rotation, and the relevant cover crop information. Enter cover crop height, approximate cover, termination date, and termination method for each year of the rotation. If you have different crop rotations on the farm, for example due to cropland being in different locations, complete as many crop rotation tables as needed to describe all crop rotations on the farm. For each crop rotation table, specify the number of acres it includes.

Energy and fuel use

State all energy and fuel used for field and farm activities. Include any fuel used by contractors. Energy generated on farm and sold should be entered as an export in the table.

Manure handling, manure storage/treatment, and grazing

Manure grouping guidelines

Pens on the farm can be condensed into "groups" and reported on the group sheet, rather than reporting information for each pen individually. Multiple pens can be combined into a single group sheet *if all pens meet the following criteria:*

1. The pens are of the **same type** (freestall, tiestall, open lot, etc.).
2. Animals in these pens have the **same grazing management** (if applicable), e.g. days with grazing access and hours per day on pasture.
3. Pens are bedded with the **same type of bedding**.
4. **Manure** from the pens is **managed in the same way**, e.g., you cannot combine two lactating pens where one pen's manure is daily spread, and the other goes to liquid storage.

In other words, if the responses on the group sheet are *the same for multiple pens,* you can combine those pens into a single group sheet (just remember to update animal totals!)

Example: A barn contains 6 pens:

Pen name	Pen type	Animal type	Bedding	Manure
Transition pen	Deep-bedded pack	Lactating	Sawdust; 1 ton/month	Scraped out to compost
High lactating	Freestall	Lactating	Sand	Flushed to slurry storage
Late lactating	Freestall	Lactating	Sand	Flushed to slurry storage
Hospital pen	Deep-bedded pack	Lactating	Sawdust; 2 tons/month	Scraped out to compost
Bred heifer pen	Freestall	Heifers >1 year old	Sand	Flushed to slurry storage

The transition pen and hospital pen can be combined into one manure management group/sheet. The high lactating, late lactating and heifer pen can be combined into another manure management group/sheet. All four lactating pens **cannot** be combined into one group/sheet because they have different beddings and different manure removal/management. The number of lactating cows vs. heifers in the combined group would need to be given.

Group sheet instructions

Complete as many "group sheets" as needed based on the guidelines above.

A. Represents pen number(s) or name(s): Optional; list the names or IDs of pens that this group/sheet represents.

B. Pen type: Select the pen type that animals are housed in. For individual calf housing, select "Freestall".

- **"Open lot"**: State how many times per week the lot is harrowed (manure broken up and spread across lot surface to facilitate drying). State typical clean-out dates (e.g., manure is cleaned out of the pen on March 1st, June 15th, and October 31st).
- **Compost "bedded pack"**: State how many times per week the pack is tilled or mixed. State typical clean-out dates (e.g., the entire pack is cleaned out of the pen on January 1st and June 1st).

C. Typical number of animals: Give the typical or average number of animals housed in this group. If more than one animal type is included, give the total number of each animal type (e.g. 150 heifers and 50 dry cows).

D. % of animals grazing: For each animal type in the group, give the number or percent of animals that have grazing access (e.g. a group has 200 heifers, and 100 of them have grazing access, state 50% of heifers).

E. Grazing days per year: For each animal type in the group, give the number of days per year with grazing access.

F. Grazing hours/day: For each animal type in the group, state how many hours of the day they have grazing access during the grazing season.

G. Cleaning method: Select how manure is cleaned from this group. Select more than one if needed. Manual scraping includes use of a skid steer.

H. Bedding type: Select the bedding type used in this group. Give the amount used (e.g. tons/year). You can also give your bedding inventory allocation (e.g. 60% of total sand purchased). If more than one type of bedding is used, state in the comment box how the multiple bedding types are used (e.g., straw for 4 months in winter, sawdust for the rest of the year).

I. Manure treatment/storage: Select the manure treatment and/or storage that manure from this group is moved to. In the comment box, indicate the name/ID of the storage. If manure goes through multiple stages, label them in order or give details in the comment boxes.

- **Solid liquid separation**: Only select for mechanical-type separators (screw press, roller press, centrifuge, etc). Gravity-based separators (weeping walls, settling basins, etc.) should not be included. State the type of separator. If you have information on the solid removal rate, include this. State if separated solids are exported (e.g. sold), composted, field-applied (spread), or recycled as bedding.
- **Anaerobic digestion**: State **what type of digester** (continuous stirred tank reactor, plug flow, covered anaerobic lagoon, etc.), and the **approximate age of the digester** in years.

EXAMPLE:

I. Manure treatment/storage:	J. Removal/emptying timing:	Comment:
☒ Liquid manure storage, no cover – *stage 3*	*Pump down in April and October*	
☐ Liquid manure storage, cover		
☐ Liquid manure storage, cover and flare		
☐ Solid storage		
☐ Daily spread	N/A	
☐ Composting		☐ Static ☐ Active windrow ☐ Passive windrow
☒ Solid/liquid separation- *Stage 1*	N/A	Type: *Screw Press* Solids: ☐ Exported☐ Composted ☒ Spread ☐ Bedding
☐ Anaerobic digester- *Stage 2*		Type: *CSTR* Age: *3yrs*
☐ Other (specify):_____		

If only some of the manure goes through the separator or digester (for example), make a note.

EXAMPLE:

I. Manure treatment/storage:	J. Removal/emptying timing:	Comment:
☒ Liquid manure storage, no cover – *stage 1, 30% + stage 3 (from digester)*	*Pumpdown in April and October*	
☐ Liquid manure storage, cover		
☐ Liquid manure storage, cover and flare		
☐ Solid storage		
☐ Daily spread	N/A	
☐ Composting		☐ Static ☐ Active windrow ☐ Passive windrow
☒ Solid/liquid separation- *stage 1, 70%*	N/A	Type: *Screw Press* Solids: ☐ Exported☐ Composted ☒ Spread ☐ Bedding
☒ Anaerobic digester- *stage 2 (from separator)*		Type: *CSTR* Age: *3yrs*
☐ Other (specify):_____		

J. Removal: For each manure storage, state *when* during the calendar year manure is removed. E.g., a liquid storage is pumped down and field applied every 365 days on approximately May 1st; a liquid storage is pumped down every 6 months, on April 1st and October 1st; solid manure stacks are field applied every 3 months; compost is exported (sold) annually.