

Manure Nutrient and Land Requirement Estimator Spreadsheet Instructions

Version 1.0

This spreadsheet estimates a) excretion of nutrients and solids based upon ASAE Standard D384.2 and b) land requirements based upon USDA Natural Resources Conservation Service publication Agricultural Waste Management Field Handbook. This booklet provides instructions for using this spreadsheet.

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The most current version of the spreadsheet is available at:
<http://go.unl.edu/nut-inv>

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Software Requirements

The spreadsheet file was developed for Microsoft Excel 2000® or later. The file is about 2.4 MB in size. Because of the substantial use of macros for many operations, it will be difficult to adapt many of the features of this MS Excel spreadsheet to another spreadsheet product.

Introduction

Purpose

The Manure Nutrient and Land Requirement Estimator spreadsheet is designed to estimate the quantity of manure nitrogen, phosphorus, and solids excreted, based upon procedures in *American Society of Agricultural and Biological Engineers Standard D384.2, Manure Production and Characteristics*. Typical or average estimates of manure excretion are commonly inaccurate due to differences in animal performance or feeding program. This spreadsheet will produce a farm-specific estimate of manure excretion relevant to a wide range of dietary options and animal performance levels commonly observed in commercial production. The equations used in this spreadsheet are the result of a two-year study by a team of animal scientists and agricultural engineers targeting methods to improve estimates of animal nutrient excretion and provide tools for integrating animal feeding choices and performance into comprehensive nutrient management planning processes.

This spreadsheet also will estimate a land base for managing the excreted nutrients. This tool uses procedures described in Chapter 11, Waste Utilization of the USDA Natural Resources Conservation Service publication, *Agricultural Waste Management Field Handbook*.¹ It will assist the user in estimating nutrient losses during storage and nutrient availability during land application. The resulting crop available nutrients are then balanced against the nutrient requirements of an individual farm's cropping system based on crop removal estimates. From this procedure an estimate of approximate land requirements for managing available nitrogen and phosphorus is made, based upon this information.

Caution

This planning procedure is designed to estimate land access requirements of manure nutrients. It is not a nutrient management plan. Other procedures and software tools should be used to determine field specific manure and fertilizer application rates. This tool is not intended for that purpose.

Overview of Process

This spreadsheet follows a five-step process to complete a farm-specific estimate of excretion and an appropriate land base for managing the nutrients in manure. Those steps are illustrated on the first page of the *Start Worksheet*. Associated with each step is a button that will take the user to the appropriate worksheet for that step. Once completed, a "Return" button brings the user back to this *Start Worksheet* to remind the user of the next step in the process. As each step is completed, a brief summary of the results of that step will be illustrated in blue on the *Start* worksheet.

Step 1 allows the user to identify the farm and consultant's contact information. It also asks the user to identify the sources of manure from the animal feeding operation. Up to four unique manure sources can be tracked by this program.

Step 2 provides the opportunity to enter the farm-specific information critical to estimating nutrient and solids excretion. Animal performance and feed program information is necessary if a farm specific estimate is to be made. For situations where such information is not available, an option is available for default entries which will estimate excretion for a "typical" animal, as defined in 2003. A unique data entry form is used for each animal species. To access that animal specific data entry form, click on the species name relevant to an individual farm. The program has the capability of tracking multiple species on an individual farm.

Step 3 allows the user to review the estimate of manure excretion. Manure excretion is summarized for nitrogen, elemental phosphorus (multiply by 2.29 for a P_2O_5 equivalent), total solids, volatile solids, manure weight, and manure volume (if a slurry or liquid manure). Manure excretion is summarized in both English and metric units.

Step 4 is used to estimate the retention of nitrogen and phosphorus 1) after losses occurring in the animal housing and manure storage and 2) after accounting for the crop availability of the manure nutrients. Default estimates of these two adjustments are available, based upon USDA Natural Resource Conservation Service procedures. The user has the opportunity to adjust these values to match accepted state or local estimates.

Step 5 uses three worksheets for estimating land requirements. The land requirements for managing both nitrogen and phosphorus are computed separately. A similar calculation is computed separately for 1) manure, 2) runoff from an open lot that is collected in a holding pond, and 3) sludge that collects in an anaerobic lagoon (if not regularly agitated).

¹Available online at policy.nrcs.usda.gov/viewerFS.aspx?hid=21430

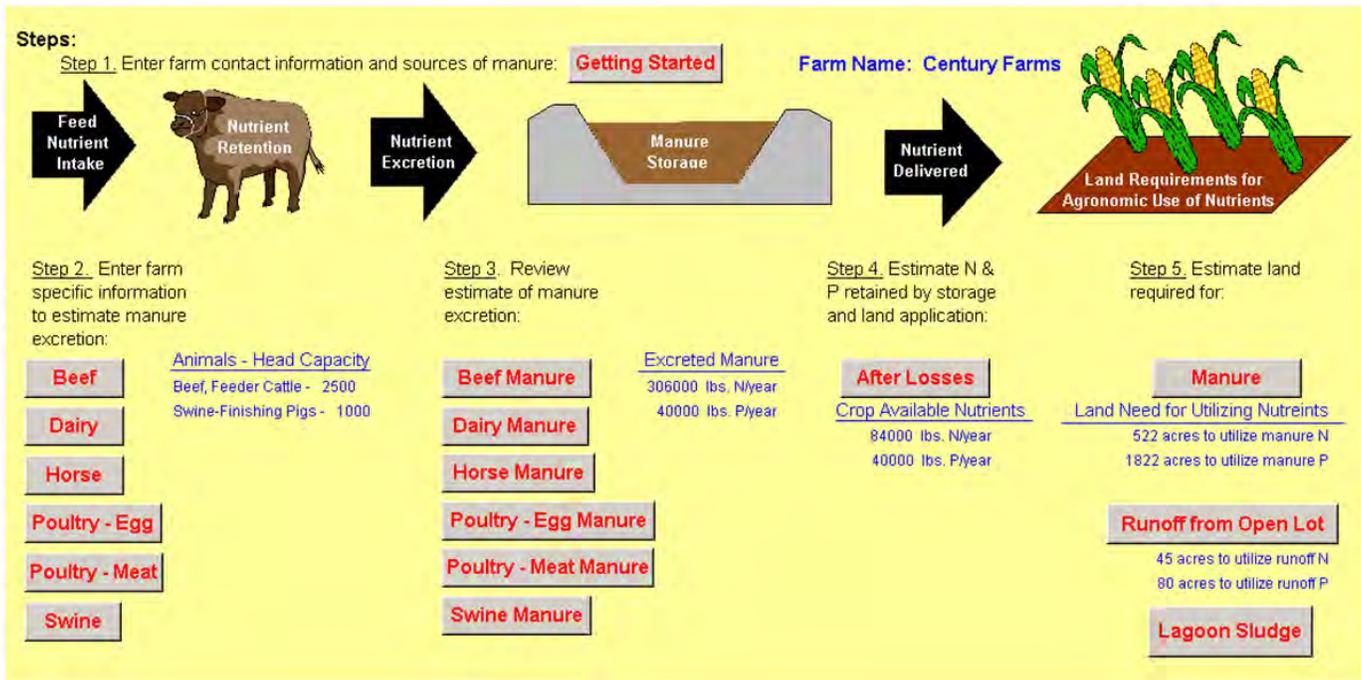


Figure 1. Process for using the *Manure Nutrient and Land Requirement Estimator* spreadsheet.

Worksheets for Completing Calculations

To accomplish this, twelve Excel worksheets are contained within the Microsoft Excel® file “Nutrient and Land Estimator.” They may be accessed by clicking on the appropriate “Name Tab” found at the bottom of each worksheet (*Figure 1*). The purpose of these worksheets are:

- Start** To describe the purpose of the worksheet, record the contact information for the producer’s operation and identify manure sources from this operation.
- Beef** These species-specific worksheets estimate the excretion of total solids, volatile solids, nitrogen and phosphorus.
- Dairy** In addition, based upon user supplied input of end product moisture content, an estimate of total volume is made for slurry and liquid systems. In addition, this worksheet allows comparison of alternative feeding programs for their impact on nutrient excretion.
- Horse**
- Poultry-Egg**
- Poultry-Meat**
- Swine**

- After Losses** To adjust excreted nitrogen and phosphorus estimates of the species-specific worksheets based on estimates of storage and land application losses. Excreted N and P are adjusted to represent crop available N and P.
- Land-Manure** To compare crop available N and P in the manure with the nutrient removal rates of individual fields to determine when sufficient land base is accessible to utilize the nutrients in manure.
- Land-Runoff** To follow similar procedures as used in the *Land-Manure Worksheet* for estimating the land requirements for managing the N and P in runoff from an open lot system (assumes approximately 5 percent of excreted nutrients are contained in the runoff) and the P accumulated in the sludge within an anaerobic lagoon (assumes approximately 65 percent of excreted P is retained in the sludge).
- Land-Sludge**
- Summary** To provide a summary of critical information from previous worksheets.

The “Manure Nutrient and Land Requirement Estimator” spreadsheet consists of 12 worksheets. Individual worksheets perform unique tasks such as estimating the manure excreted by dairy cows (*Dairy Worksheet*) or estimating the nutrients retained in the manure storage (*After Losses Worksheet*). Individual worksheets are accessed by clicking on the name of the worksheet found near the bottom of your screen.

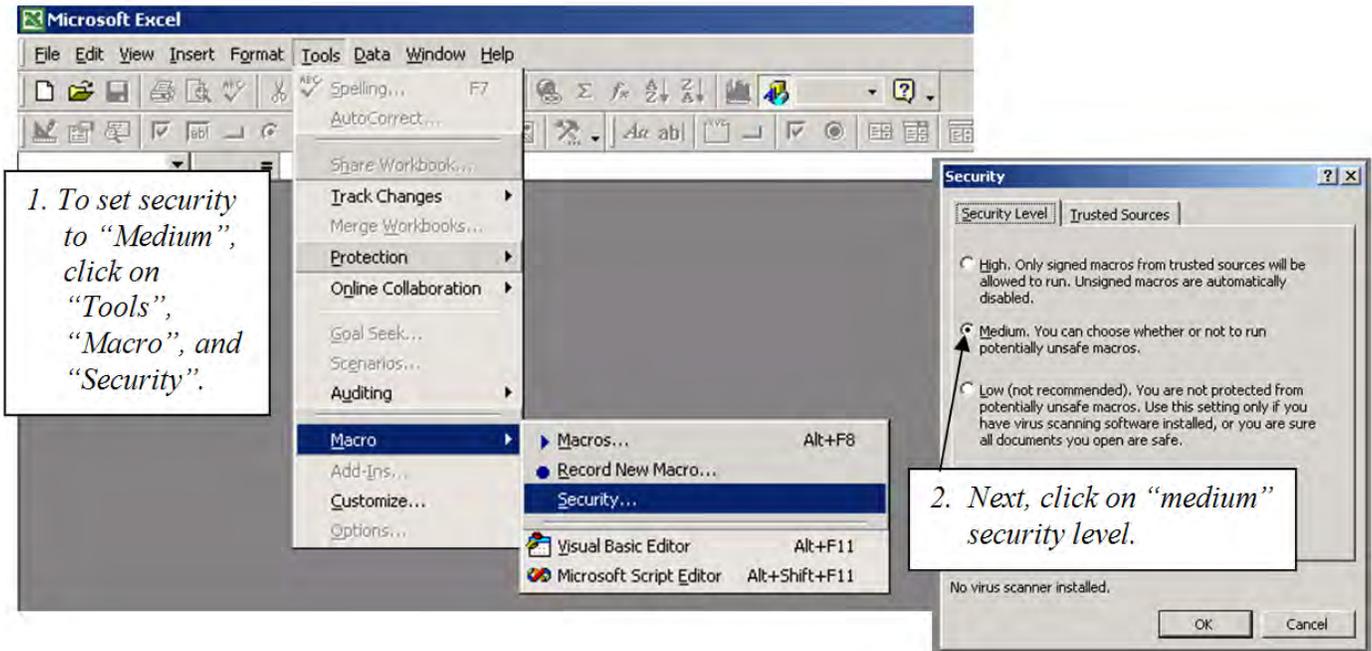


Figure 2. Process to enable the use of macros.

Instructions

1. **Activating Macros.** This spreadsheet contains many macros performing a wide variety of functions. Without these macros, many of the critical spreadsheet functions will be lost. Two steps are necessary to allow the use of these macros:

- a. **Enabling Use of Macros** (Figure 2). When Excel is opened (without the Nutrient and Land Estimator application), the security level for Excel must be set to “Medium.” To do this, click on “Tools” on the menu bar, then “Macro,” and then “Security.” This will expose the security window. Click on the “Medium” setting.
- b. **Open the file “Nutrient and Land Estimator.”** Then click on the “Enable Macros” button (Figure 3). Once the file is open, test the

functioning of the macros by clicking any of the buttons on the spreadsheet. If they do not work, closed the file and repeat Step 1a.

2. **Save to New File Name.** The first thing you should do after opening this file is make a copy with a new name. Click on “file” and “save as.” In the “file name” box, replace “Nutrient & Land Estimator” with a new name (e.g. “Nutrient & Land Estimator for John Doe”). This file should be saved periodically as each worksheet is completed to prevent loss from unexpected computer difficulties.
3. **Improve Screen View.** It is best to adjust the information that fits into a single screen to ensure that you can see all yellow background (User Viewing Area) within the left to right limits of the screen. Try these steps to adjust your viewing area:

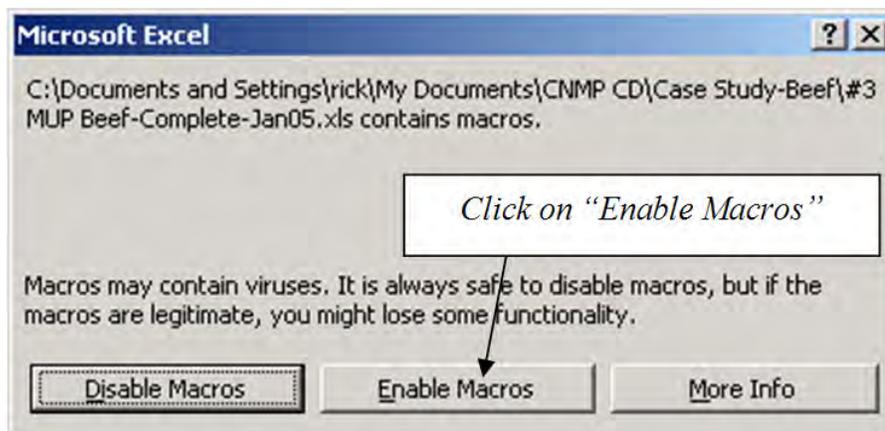


Figure 3. Final step to enable the use of macros.

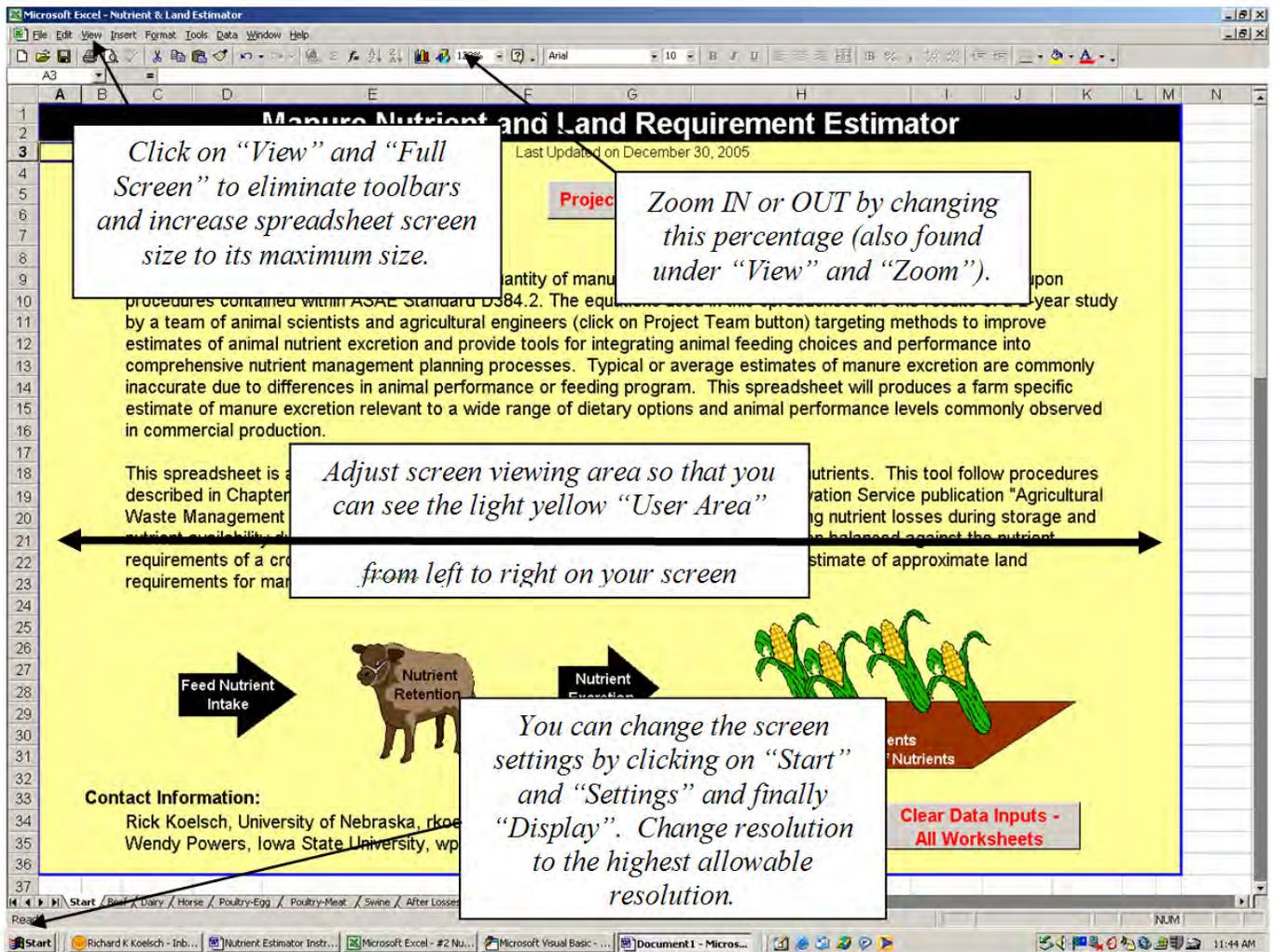


Figure 4. Adjusting the user viewing area.

- a. Click on “View” and then “Zoom.” Adjust the “Percent Zoom” to your personal preference.
- b. To maximize the viewing area, select “View” from the menu bar and then “Full Screen.” The unnecessary tool bars should disappear.
- c. Adjust the screen resolution by clicking on “Start” (lower left corner of most computer desktops), then “Settings,” then “Display,” and then “Settings” again. You can adjust screen size by going to a higher resolution such as 1280 x 1024 or 1400 x 1050. Generally the higher resolution will produce better viewing. If the text is difficult to read, increase its size with the “Zoom” option described in Step a above. This spreadsheet was created with the screen setting at 1400 x 1050.
4. For some worksheets, the entire contents may not appear on screen. Additional screen information can be viewed by clicking on the “Up” and “Down” arrows on the scroll bar at the right side of the screen and the “Left” and “Right” arrows at the bottom right corner of the screen, or use the scroll wheel on the mouse, if available.
5. Color codes are used to assist the user with these worksheets.

Aqua or light blue cells contain producer information. These locations are not protected and can be changed or updated as necessary.

Light yellow regions define spreadsheet areas for viewing by the user. Generally, there is no reason for most users to leave the light yellow regions of individual worksheets. Light yellow regions are protected from accidental changes.

White regions of the worksheet are used by the spreadsheet developer to calculate results and define user functions. Generally, most users will not need to view these regions.

Caution

Some computer monitors may be limited in the amount of information that can be displayed on a single screen.

Grey rectangles with red text are buttons for assisting with a variety of actions such as printing.



6. When you've finished reviewing the information on the *Start* worksheet, move to the appropriate species-specific worksheet by clicking on the appropriate tab at the bottom of the page or "Species-Specific" button under Step 2.
7. This would be an appropriate time to save your file to a new name. The "Save As" selection under the "File" option on the menu bar will allow you to change the name of the file and retain the original spreadsheet without changes for future use.

Start Worksheet

Start Beef Dairy Horse Poultry-Egg Poultry-Meat Swine After Losses Land-Manure Land-Runoff Land-Sludge Summary

Manure Nutrient and Land Requirement Estimator

Version 1.0 Last Updated on March 13, 2006

Instructions **Project Team** **Getting Started** **Clear All Worksheets**

Purpose:
 This spreadsheet estimates the quantity of manure nitrogen, phosphorus, and solids excreted based upon procedures contained within ASAE Standard D384.2. Typical or average estimates of manure excretion are commonly inaccurate due to differences in animal performance or feeding program. This spreadsheet will produce a farm specific estimate of manure excretion relevant to a wide range of dietary options and animal performance levels commonly observed in commercial production. The equations used in this spreadsheet are the results of a 2-year study by a team of animal scientists and agricultural engineers (click on Project Team button) targeting methods to improve estimates of animal nutrient excretion and provide tools for integrating animal feeding choices and performance into comprehensive nutrient management planning processes.

This spreadsheet also estimates a land base for managing the excreted nutrients. This tool follows procedures described in Chapter 11 on "Waste Utilization" of the USDA Natural Resources Conservation Service publication "Agricultural Waste Management Field Handbook". The spreadsheet assists in estimating nutrient retained during storage and land application. The resulting crop available nutrients are then balanced against the nutrient requirements of a crop based upon crop nutrient removal estimates. This procedure produces an estimate of approximate land requirements for managing available nitrogen and phosphorus.

Steps:
Step 1. Enter farm contact information and sources of manure: **Getting Started**

Step 2. Enter farm specific information to estimate manure excretion:

Step 3. Review estimate of manure excretion:

Step 4. Estimate N & P retained by storage and land application:

Step 5. Estimate land required for:

Feed Nutrient Intake → **Nutrient Retention** → **Nutrient Excretion** → **Manure Storage** → **Nutrient Delivered** → **Land Requirements for Agronomic Use of Nutrients**

Beef **Dairy** **Horse** **Poultry - Egg** **Poultry - Meat** **Swine**

Animals - Head Capacity
 Beef, Feeder Cattle - 2500
 Swine-Finishing Pigs - 1000

Excreted Manure
 306000 lbs. N/year
 40000 lbs. P/year

After Losses
Crop Available Nutrients
 84000 lbs. N/year
 28000 lbs. P/year

Manure
Land Need for Utilizing Nutrients
 560 acres to utilize manure N
 Insufficient land identified for P

Runoff from Open Lot
 45 acres to utilize runoff N
 55 acres to utilize runoff P

Lagoon Sludge

Contact Information:
 Rick Knelsch, University of Nebraska, rknelsch1@unl.edu, 402/472-4051

Start / Beef / Dairy / Horse / Poultry-Egg / Poultry-Meat / Swine / After Losses / Land-Manure / Land-Runoff / Land-Sludge / Summary / Lookup Tab

Figure 5. Sample page from the *Start* worksheet.

When the spreadsheet is started, the *Start* worksheet with the spreadsheet's purpose should be visible (Figure 5). If this screen is not visible, then click on the *Start* worksheet button (lower left corner of the screen) and use the scroll bars to move to the upper left corner of the worksheet. The *Start* worksheet has four pages for your use.

Introduction

The Introduction page gives a brief overview of the spreadsheet's purpose.

Instructions

The Instructions page provides a summary of procedures for

- 1) setting up an improved screen view,
- 2) color coding of the spreadsheet cells,

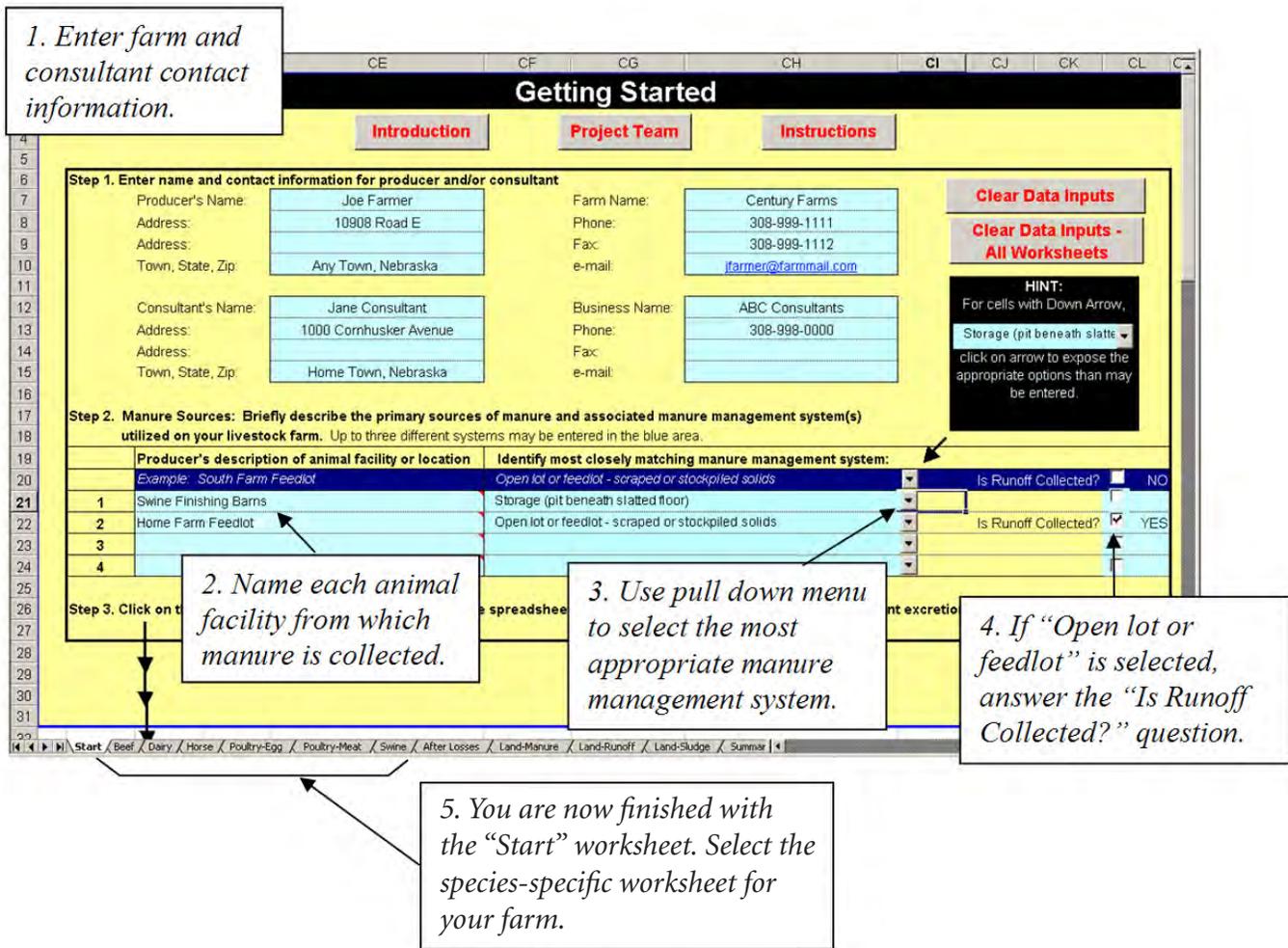


Figure 6. The Getting Started page provides a space to provide content information for the form and for a consultant.

- 3) layout of individual pages within the species-specific worksheets, and
- 4) overview of the five screens for estimating land requirements and summarizing the calculated results of this spreadsheet.

- 2) identify critical information about each of the facilities from which manure is collected.

Getting Started

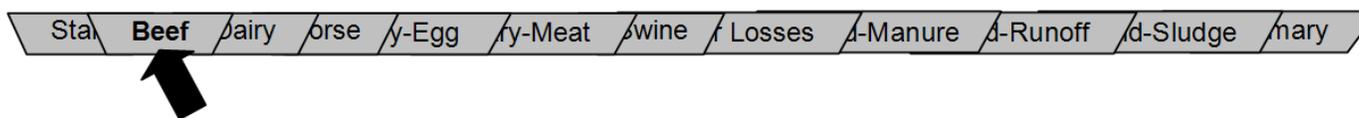
The Getting Started page provides space for the user to define contact information for the farm and the consultant working with the farm, if appropriate. The producer's name and the farm name is repeated on all subsequent printouts so as to distinguish the results specific to an individual farm. The user must enter information about each animal facility from which manure is collected and will be tracked by this spreadsheet (Figure 6). Enter information requested in Steps 2 through 4 (essential for later calculation).

Project Team The Project Team page lists the individuals who contributed to the development of the American Society of Agricultural and Biological Engineering standard upon which this spreadsheet's estimates of manure excretion is based.

Getting Started The Getting Started page allows the user to 1) define contact information for the farm and contributing consultant, and

Reminder: Have you saved your work recently?

Species-Specific Worksheet Instructions



Purpose

Each species-specific worksheet will allow the user to enter farm specific ration and animal performance data needed to estimate the mass of manure solids, nitrogen and phosphorus excreted by an individual group of animals. Each worksheet also provides a tool for comparing the change in nutrient excretion for alternative feed nutrient concentrations.

Species-Specific Worksheet Layout

All species-specific worksheets contain five separate pages of information laid out horizontally. These worksheets can be accessed by clicking on the buttons illustrated in *Figure 7* below or by scrolling to the right and left. The left edge for each page in a species-specific worksheet is typically found in column...

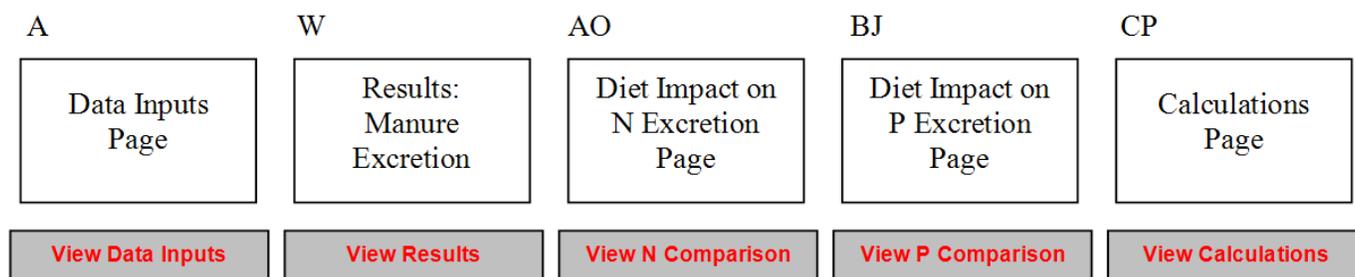


Figure 7. Each species-specific worksheet contains five pages of information.

Data Inputs Page provides a space for entry of all animal performance, feed program and manure management system information.

Results of Calculations Page summarizes the estimates of excretion of nitrogen, phosphorus, total solids and volatile solids. It also estimates manure mass and volume.

Diet Impact on N Excretion Page allows the user to manipulate concentration of crude protein in the diet and review the impact on excretion.

Diet Impact on P Excretion Page allows the user to manipulate concentration of phosphorus in the diet and review the impact on excretion.

Calculation Page is used to perform the calculations leading to the “Results: Manure Excretion” contents.

Instructions for Data Input

1. **Conditions to be evaluated.** Describe the farm or conditions that will be evaluated in cell B6.
2. **Before entering any data,** perform the following two tasks:
 - a. Select whether performance and feed data is to be in English or metric units by clicking on the arrow to the right of the cell “English or Metric” (typically under “Step 2. Enter performance data”) and selecting one of the two options.
 - b. Select whether feed measurements are to be entered on a wet or dry basis by clicking on the arrow to the right of the cell “Wet or Dry Basis?” (typically under “Step 3. Enter ration information”) and selecting one of the two options.
3. **Default Inputs.** If farm specific information is not available for animal performance or ration information entries, typical or default values can be entered by clicking on the “Default” button found with each species specific page. Values will be entered for a “typical” animal as defined in the ASABE

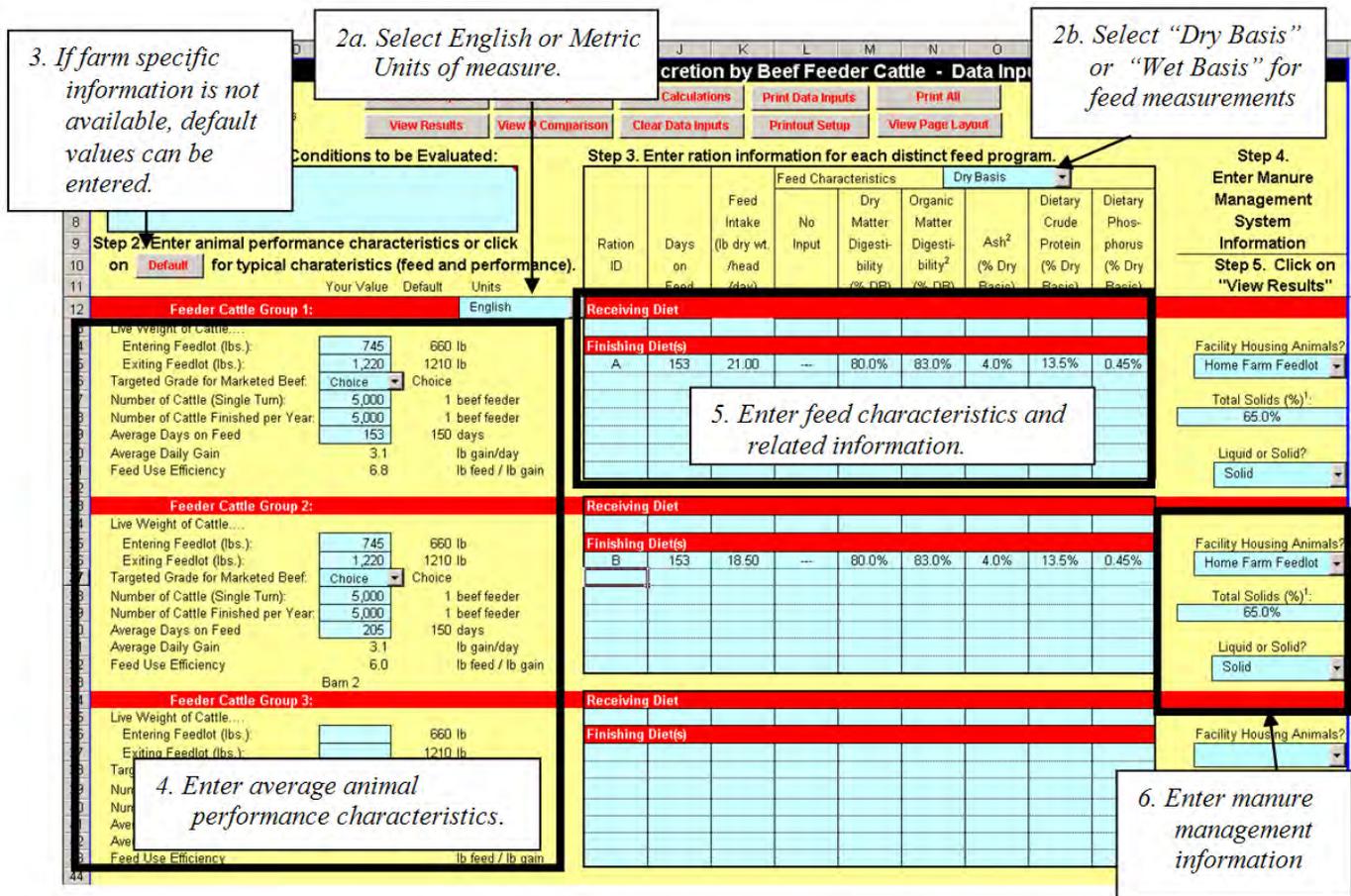


Figure 8. Data Input Page of the Species-Specific worksheet allows the user to provide data specific to the farming operation.

(American Society of Agricultural and Biological Engineers) Standard D384.2.

- Animal Performance Inputs.** Each species-specific worksheet has a slightly different layout and some differences in data inputs. Data inputs relative to animal performance are entered on the left side of all data input pages. Space is available to allow more than one group of animals from the same species to be characterized at one time. For example, a feedlot may bring both yearlings at 750 lbs and calves at 600 lbs into the feedlot. Because of the differences in feeding period, average feed intake, and performance, these two distinct groups should be entered separately.
- Feed Nutrient Intake.** The center of all data input pages contains space for entering characteristics such as days on feed, average daily feed intake and nutrient concentration. Some species data input pages will request dry matter digestibility and

organic matter digestibility (optional). All species pages allow for more than one diet to be fed to a group of animals. For the beef cattle example, a transition diet may be fed for 10 days and a finishing ration may be fed for the next 150 days. Both diets would be entered on a separate line. Each diet that is unique in its crude protein or phosphorus concentration should be entered separately.

- Manure Management System Information.** The Data Inputs Page always requests three data inputs about the manure management system including, 1) facility housing animals, 2) manure total solids content (from a manure analysis report), and 3) liquid/slurry or solid type of manure. This data is entered on the right side of the data inputs page.
- When finished,** click on "Return" to jump to the Start page.

N and P Available After Storage and Land Application Losses

Start	Beef	Dairy	Horse	Layer-Egg	Layer-Meat	After Losses	Manure	Runoff	Sludge	Other
-------	------	-------	-------	-----------	------------	---------------------	--------	--------	--------	-------



Purpose

The *After Losses* worksheet converts an estimate of excreted N and P to crop available N and P.

Instructions for Tables 1 and 2

1. If you are at the *Start* page, you are ready for Step 4. Click on the “After Losses” button. If you are at any other location, you can click on the “After Losses” tab at the bottom of the page.
2. The total manure nutrients excreted as estimated in the *Species-Specific* worksheet is summarized in Column E for each of four potential facilities.
3. An estimate of nutrients retained after losses is illustrated in Columns F and G. This estimate is based on the selected Manure Management System listed in Column D (user entered in *Start* and *Species-specific* worksheets). If the user prefers to use another estimate of nutrients retained, that value may be entered in the aqua colored cells immediately below the assumed value estimated by the spreadsheet. A calculation of nutrients in storage after losses will be based on the user input value. If no user value is available, then the calculations default to the estimate made by the spreadsheet.

Note that if the user identifies an open lot manure management system for one or more of the animal facilities, then an estimate is made of the nutrients collected in the runoff. The spreadsheet assumes that 5 percent of the excreted nutrients are retained in the runoff collection system. The user can enter another value in the aqua colored cell immediately below the assumed value.

4. An estimate is made of nitrogen retained after land application in Columns H through M. The user may supply information on
 - a) application method,
 - b) days between application and incorporation (only required if manure is surface applied), and
 - c) soil conditions (only required if manure is surface applied).

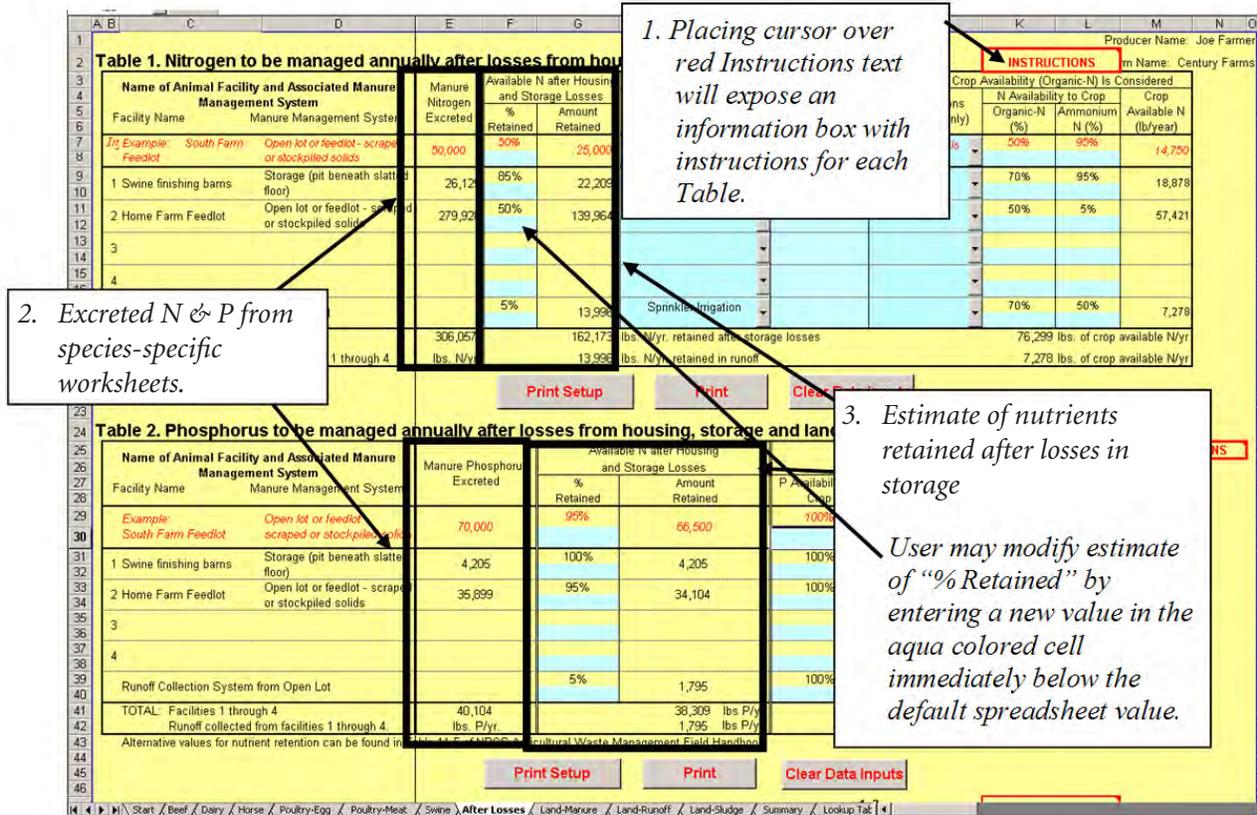
From these inputs, the spreadsheet estimates an organic and ammonium nitrogen availability and calculates a crop available nitrogen value. Users also can replace the assumed organic and ammonium nitrogen retention values with their own percent estimate in Columns K and L. The calculation of crop available N will then be based on the user inputs.

Caution

The organic nitrogen availability value in Column K is a summation of organic nitrogen that will become available over a four-year period following a single manure application. This estimate should not be used to prepare an annual nutrient plan as it will overestimate the nitrogen availability for a single year.

The land requirement estimated in subsequent worksheets will actually be more than what is needed in any one year. However, over a four-year period, the estimates of N-based land requirements will be equal to the total land the producer should utilize to avoid excess N application.

Table 2 follows a similar procedure for estimating P retention. Both the P retained in the storage and after land application losses is based upon the Manure Management System. As in *Table 1*, the default estimate of P retained can be replaced with a user value by typing in the desired retention value in the aqua colored cell immediately below the value assigned by the spreadsheet.



3b. An "Application Method" must be selected for each Animal Facility.

3c. If manure is surface applied, a "Days-Application to Incorporation" and a Soil Conditions values must be entered.

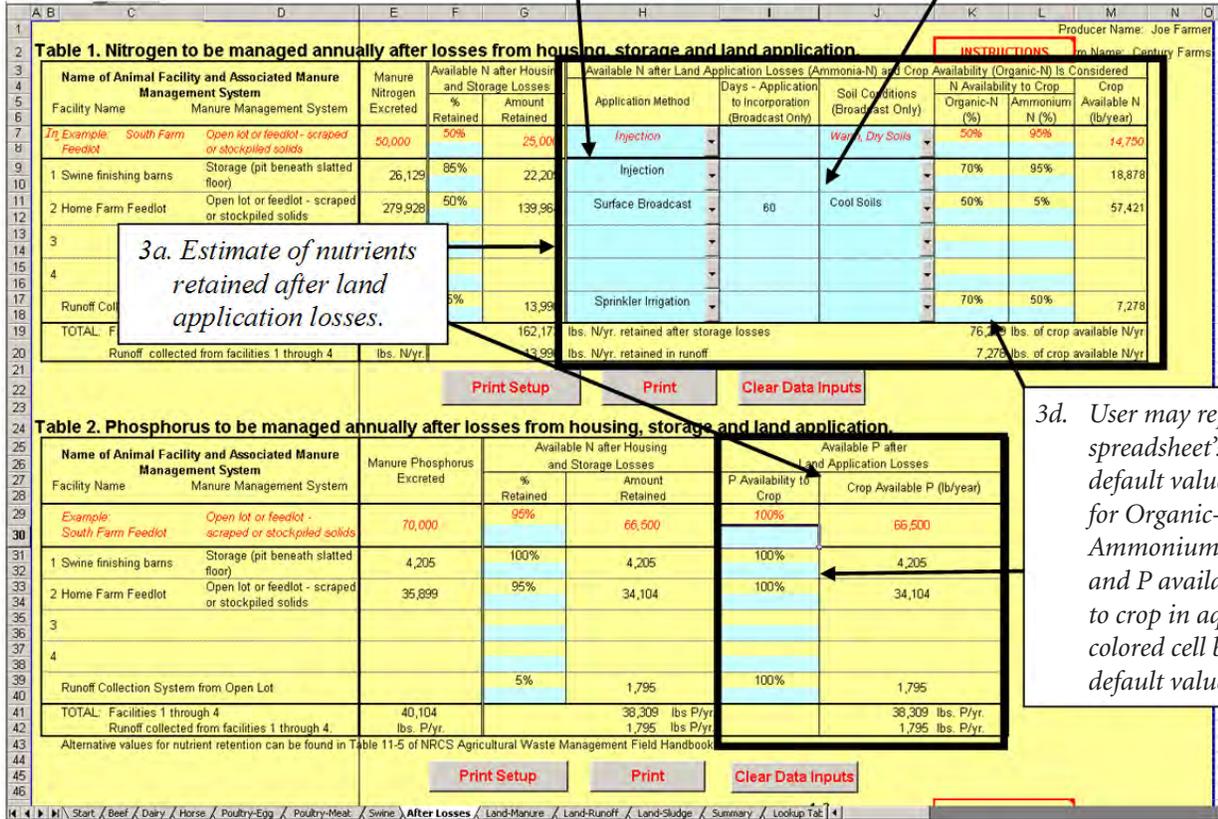


Figure 11. Sample page for estimating nutrients available after losses.

Table 3 Instructions

If a single cell or multiple cell anaerobic lagoon is selected as the manure management system for one of the four animal facilities, then *Table 3* will estimate the phosphorus retained in the sludge accumulating in the bottom of the lagoon. The user will need to identify the time between successive removals of sludge from the lagoon. The worksheet will estimate the approximate amount of phosphorus that has accumulated during that time. This estimate assumes that 65 percent of the phosphorus entering an anaerobic lagoon will settle and be found in the sludge. After completing this page, you may jump to the *Start* page by clicking on “Return.”

Caution

Recognize that many factors affect manure nutrient availability. The estimates contained within this spreadsheet represent a reasonable estimate for typical conditions but may not be representative of individual situations.

Both ammonium and organic N availability during land application are dependent upon local climate. If local recommendations are available, they should be substituted for default values used by this spreadsheet. Individual state recommendations may vary from the estimates used in this worksheet. The NRCS Agricultural Waste Management Field Handbook served as the primary reference for the assumptions made in the *After Losses, Land Base, and Sludge* worksheets.

Table 3. Phosphorus retained as settled solids or sludge by an anaerobic treatment lagoon. ^{1, 2}				
If an anaerobic lagoon option is identified in Table 2, Table 3 will automatically calculate phosphorus accumulation. Enter the anticipated years between settled solids removal in aqua colored cell.				
	Total Pounds Produced Annually (Table 1)	Years Between Sludge Removal	% Retained in Lagoon	Total P in settled solids
P ₂ O ₅ in settled solids or lagoon sludge	138,019	10	65%	897,124

1. Phosphorus split between effluent (Table 2) and settled solids (Table 3) applies to an anaerobic lagoon with a permanent pool and no agitation during effluent removal.
 2. This calculation does not apply to manure storage facilities and

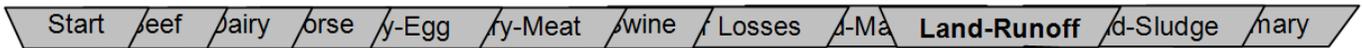
Enter years between sludge removal.

Estimate of P in sludge is made for anaerobic lagoons only.

Figure 12. Sample page for phosphorus retained in anerobic lagoon sludge.

Reminder: Have you saved your work recently?

Land Requirements to Utilize “Manure” Nutrients



You are now ready for Step 5, *Estimating Land Requirements*. If you are on the *Start* page, click on the “Manure” button. If you are at any other location, click on “Land-manure” at the bottom of the page.

Purpose

This worksheet will estimate the quantity of nutrients used by an existing land base if manure is applied at an agronomic rate as determined by either nitrogen or phosphorus. This worksheet also may be used to determine the necessary land base for agronomic utilization of the nutrients in manure.

Caution

This planning procedure is designed to estimate land access requirements of manure nutrients. It is not a nutrient management plan. Other procedures and software tools should be used to determine field specific manure and fertilizer application rates. This tool is not intended for that purpose.

Instructions

1. Enter individual field data for each field to receive manure, including field ID (Column B), crop acres (Column C), crop grown (Column E) and expected yield (Column F).

Table 4. Land requirements if manure nutrients are utilized

3. User can replace default crop removal rates for N & P.

4a. The approximate nutrient requirements and remaining nutrients are next estimated.

1. Individual field cropping information is entered here.

2. Enter sum of all nutrient credits

4b. If sufficient land is identified to utilize all of the crop available nutrients, then a total land requirement is calculated here.

Individual Field Data				Crop Nutrient Credits from Other Sources (lbs./acre)		Nitrogen After Losses			Phosphorus (P ₂ O ₅) After Losses ³		
Field ID	Crop Acres	Crop	Yield units	N	P ₂ O ₅	Approximate N Required (lbs./acre) ²	Manure N Use by Field (lbs.)	Remaining Nutrients (lbs.)	P ₂ O ₅ Removal Rate (lbs./acre)	Manure P ₂ O ₅ Use by Field (lbs.)	Remaining Nutrients (lbs.)
Home 80	74	Corn	125 bu/ac			122	9,024	67,275	38	2,825	84,903
Pivot 1	130	Corn	180 bu/ac	30		176	18,927	48,348	55	7,148	77,755
East Quarter	140	Soybeans	45 bu/ac			96	13,381	34,967	36	4,983	72,772
Dad's Quarter	138	Corn Silage	24 tons/a			216	29,808	5,159	76	10,538	62,234
Neighbor's Corn - N needs	40	Corn	160 bu/ac			156	6,243	0	49	1,955	60,279
Neighbor's Corn - P needs	1300	Corn	160 bu/ac			156			49	63,535	0
Summary							76,299	0		87,728	0
							522 acres to utilize N			1,822 acres to utilize P	

Figure 13. This worksheet page provides an estimate of how much land is needed for the agronomic utilization of nutrients in manure.

If you prefer not to list individual fields, all acres of land in a similar crop and with a similar yield may be substituted for individual fields. For example, a farm in a corn-soybean rotation might have one entry for corn and a second for soybeans if most fields yield similarly. A farm with only irrigated and dryland corn production might list two fields, one for irrigated corn and a second for dryland corn.

2. Sum all other nutrient credits and enter that sum for N (Column H) and P_2O_5 (Column I). Other nutrient credits may include commercial fertilizer, irrigation water, and legume credits.
3. If you do not agree with the default nutrient requirements for various crops, you may enter your own values for N (Column L) and P_2O_5 (Column P).

4. The nutrient requirements of each field will be deducted from the crop available N or P. An estimate of remaining N and P is listed in Columns N and R, respectively. The goal is to identify sufficient land so that no remaining nutrients are listed in these columns. When sufficient land has been identified to utilize an individual nutrient at an agronomic rate, a total land requirement will be listed in row 45. In *Figure 13*, the farm did not have sufficient land to manage all of the N or P. By adding 40 acres of neighbors' corn land, sufficient land was identified to utilize the nitrogen. However, by identifying an additional 1,300 acres of neighbors' corn crop, sufficient land is available for management of the phosphorus.
5. When finished, click on *Return* and jump to the *Start* page.

Reminder: Have you saved your work recently?

Land Requirements to Utilize Runoff Nutrients

Start / Beef / Dairy / Horse / Pig-Egg / Pig-Meat / Swine / Losses / Land-Manure / **Land-Runoff** / Field-Sludge / Summary



If you are at the *Start* page, click on “Runoff from Open Lots” button. If you are at any other location, click on “Land-Runoff” tab at the bottom of the worksheet.

Purpose

This worksheet will estimate the quantity of nutrients utilized by an existing land base if collected runoff from an open lot system is applied at an agronomic rate as determined by either nitrogen or phosphorus. This worksheet will determine the necessary land base for agronomic utilization of the nutrients in runoff.

Caution

This worksheet assumes that all of the nutrients in the runoff are applied as irrigation water. In reality, a significant portion of the nutrients will settle out as solids in a settling basin or in the holding pond. This procedure overestimates the land required for the liquid portion of nutrients in the runoff from an open lot system.

Instructions

Follow the same procedures for this worksheet as are used for the *Land-Manure* worksheet described on pages 14-15.

Table 5. Land requirements if manure nutrients collected from feedlot runoff are distributed according to crop nutrient removal rates.¹

Producer Name: Joe Farmer
Farm Name: Century Farms

Individual Field Data				Crop Nutrient Credits from Other Sources (lbs./acre)		Nitrogen After Losses			Phosphorus (P ₂ O ₅) After Losses ³				
Field ID	Crop Acres	Crop	Yield units	N	P ₂ O ₅	Approximate N Required (lbs./acre) ²		Manure N Use by Field (lbs.)	7,278 lb. Remaining Nutrients (lbs.)	P ₂ O ₅ Removal Rate (lbs./acre)		4,110 lb. Remaining Nutrients (lbs.)	
						Book Value	Your Value			Book Value	Your Value		
Pivot 2	45	Com	175 bu/ac			171		7,682	0	53		2,405	1,705
Pivot 2	35	Com	175 bu/ac			171				53		1,871	0
Summary								7,278	0			4,110	0

45 acres to utilize N 80 acres to utilize P

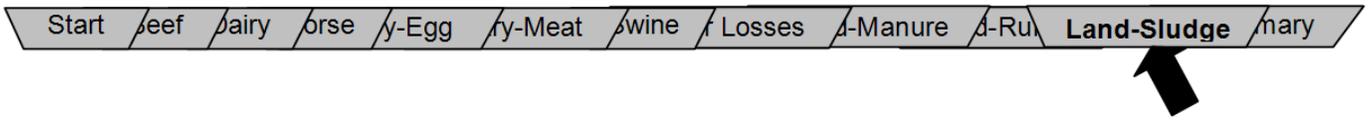
1. Caution: Crop removal rates may not accurately estimate nutrient needs and are used strictly for advanced planning purposes when soil test data is not available. Individual year manure and fertilizer application rates should be estimated based upon a comprehensive nutrient budget that includes soil testing, crediting of residual soil nutrients, and crediting of nitrogen from legumes and irrigation water. Refer to state land grant university, USDA Natural Resource Conservation Service, or environmental regulatory agency resources for assistance in developing a nutrient budget.

2. Approximate N Required is estimated by multiplying crop removal of nitrogen by a crop nitrogen efficiency factor. Crop nitrogen efficiency is assumed to be 1.3 for corn, small grains and forages; 2.0 for warm season grasses; 1.0 for cool season grasses; 0.6 for soybeans; and 0.5 for other legumes. Also assumes that soybeans will remove 2 lbs. of N per bushel and that all other legumes will remove 50% of the crops nitrogen content.

3. Phosphorus estimates reported in previous tables as elemental P have been converted to a P₂O₅ equivalent (elemental P X 2.29).

Figure 14. This worksheet page estimates the land-base for agronomic utilization of nutrients in collected open lot runoff.

Land Requirements to Utilize “Sludge” Phosphorus



Purpose

This worksheet estimates the land requirement if anaerobic lagoon sludge is applied at an agronomic rate based upon phosphorus. This worksheet should be used only if an anaerobic lagoon (storage with a permanent treatment pool) is part of the manure management system.

Caution

The land used for application of sludge should not be the same land that is receiving regular manure application. Additional land, possibly belonging to a neighbor, will need to be identified.

1. Enter individual field data for each field to receive sludge including Field ID (Column C), Acres (Column D), Crop (Column F), and Expected Yield (Column G).
2. If you do not agree with the P_2O_5 crop removal rates, you may enter your own values (Column J).
3. Enter the number of years of phosphorus supply to be applied at one time (Column I). A phosphorus application sufficient to meet crop needs for three to five years may be acceptable. For fields with low soil phosphorus levels, higher rates might be considered to build soil P and organic matter levels.
4. To estimate the change in soil phosphorus level, an initial soil P level may be entered in Column O (optional).
5. After checking the information entered, you are ready to move to the next worksheet. Click on the “Summary” worksheet tab.

Instructions

If you are at the *Start* page, click on the “Lagoon Sludge” button. If you are at any other location, click on the “Land-Sludge” tab at the bottom of the page.

Table 6. Land requirements for utilization of phosphorus from accumulated sludge in an anaerobic lagoon.

Individual Field Data				Phosphorus (P_2O_5) Available in Sludge				Soil Phosphorus Levels ³	
Field ID	Crop Acres	Crop	Yield units	P_2O_5 Removal Rate (lbs./acre)	P_2O_5 Application Rate ² (lbs./acre)	Sludge P_2O_5 Use by Field (lbs.) ²	Remainin P_2O_5 (lbs.)	Initial P Level (ppm)	Final P Level (ppm)
Neighbor's Corn	225	Corn	160 bu/a	49	5	55,400	38,900	20	30
Neighbor's Soybeans	225	Soybeans	45 bu/a	36	5	40,300	0	20	27

Callouts:

- 1. Enter field specific cropping information. (Points to Field ID, Crop, Acres)
- 2. Default P_2O_5 crop removal rate can be modified by user. (Points to P_2O_5 Removal Rate)
- 3. User defines the application rate based upon the number of years crop P removal that will be supplied by a single sludge application. (Points to P_2O_5 Application Rate)
- 4. Enter initial soil P level. (Points to Initial P Level)

Additional Callout: Note approximate changes in soil P levels resulting from application. (Points to Final P Level)

Figure 15. This worksheet page estimates land requirements for using phosphorus from accumulated sludge in an anaerobic lagoon.

Summary Report for all Worksheets

Start Beef Dairy Porse P-y-Egg P-y-Meat P-wine P-Losses P-Manure P-Runoff P-d-Si **Summary**



Purpose

This worksheet summarizes the results of the previous worksheets.

Instructions

Click on "Summary" at the bottom of any worksheet to move to the *Summary* worksheet.

Add comments to the aqua colored box that summarize the situation evaluated. This will be helpful when comparing alternative situations (e.g. alternative diets). A copy of the *Summary* worksheet for all worksheets including the *Summary* worksheet can be printed by clicking on the appropriate button illustrated below.

Print Summary

Print All

Summary of Nutrient Excretion, Nutrient Remaining After Storage and Field Losses, and Land Requirements For Agronomic Application						
Producer's Name:	Joe Farmer	Address:	1359 Road H	Phone:	308/659-9000	
Farm Name:	Century Farms	Address:		Fax:	308/659-9001	
		Town:	Anytown, NE 68999	e-mail:	jfarmer@farmmail.com	
Contact Person Who Completed Worksheet:	Jane Consultant			Phone:	402/365-1000	
Herd/Flock Summary:					Notes on Livestock System (e.g. Feed Program, Animal Performance, Animal Housing)	
Species and Animal Facility	One-Time Capacity	Animals Finished per Year	Average Weight (kg)	Land requirements assuming that no distillers grains are used in cattle diet and no phytase is used in swine ration.		
Beef, Feeder Cattle: Home Farm Feedlot	2,500	5,000	983			
Swine-Finishing Pigs: Swine finishing barns	1,000	2,500	155			
Nutrient Excretion by Livestock Summary						
1. Swine finishing barns	26,129 lbs. N/year			4,205 lbs. P/year		
2. Home Farm Feedlot	279,928 lbs. N/year			35,899 lbs. P/year		
3.						
4.						
TOTAL	306,057 lbs. N/year			40,104 lbs. P/yr.		
Nutrients Remaining After Storage Losses						
	Amount Retained	% Retained		Amount Retained	% Retained	
1. Swine finishing barns	22,209 lbs. N/year	85%		4,205 lbs. P/year	100%	
2. Home Farm Feedlot	139,964 lbs. N/year	50%		34,104 lbs. P/year	95%	
3.						
4.						
Collected Runoff	13,996 lbs. N/year	5%		1,795 lbs. P/year	5%	
TOTAL	162,173 lbs. N/year			38,309 lbs. P/yr.		
Nutrients Remaining After Field Application Losses						
	Amount Retained	% Retained		Amount Retained	% Retained	
		Org-N	NH ₄ -N			
1. Swine finishing barns	18,878 lbs. N/year	70%	95%	4,205 lbs. P/year	100%	
2. Home Farm Feedlot	57,421 lbs. N/year	50%	5%	34,104 lbs. P/year	100%	
3.						
4.						
Collected Runoff	7,278 lbs. N/year	70%	50%	1,795 lbs. P/year	100%	
TOTAL	76,299 lbs. N/year			38,309 lbs. P/yr.		
Crop Land Requirements if Manure Nutrients are Distributed According to Crop Nutrient Removal Rates (Land Base worksheet).						
Land Base Identified	Nitrogen			P ₂ O ₅		
1,822 ac	Available	Utilized	Remaining	Available	Utilized	Remaining
	76,299 lb	76,299 lb	0 lb	87,728 lb	87,728 lb	0 lb
	522 acres to utilize N			1,822 acres to utilize P		
Crop Land Requirements if Runoff Nutrients are Distributed According to Crop Nutrient Removal Rates (Land Runoff worksheet).						
Land Base Identified	Nitrogen			P ₂ O ₅		
80 ac	Available	Utilized	Remaining	Available	Utilized	Remaining
	7,278 lb	7,278 lb	0 lb	4,110 lb	4,110 lb	0 lb
	45 acres to utilize N			80 acres to utilize P		
Crop Land Requirements for Accumulated Phosphorus in Settled Solids and Sludge of an Anaerobic Lagoon						
Land Base Identified	P ₂ O ₅					
0 ac	Available	Utilized	Remaining			
	0 lb	0 lb	0 lb			
	0 acres to utilize P					

Figure 16. This worksheet page provides a summary of nutrient excretion, nutrient levels after storage and field losses, and land requirements for agronomic application.