



Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky

A Project by the Animal Waste Focus Group¹ of the Environmental and Natural Resources Issues Task Force

Introduction

Farmers have routinely used animal manure to provide essential plant nutrients (namely nitrogen, phosphate, and potash) and to improve soil quality. Applying manure to the land remains today as a proven, environmentally sound method for recycling nutrients to the soil. However, evolving agricultural technology and new environmental concerns have added numerous constraints to this age-old practice.

Crop and animal production systems have become more specialized during the past few decades. Livestock and poultry operations are fewer in number but larger in size. Some animal operations are now concentrated in certain geographical regions. These changes in animal production have led many to question whether these larger animal operations will produce more manure than the current agricultural land base can use.

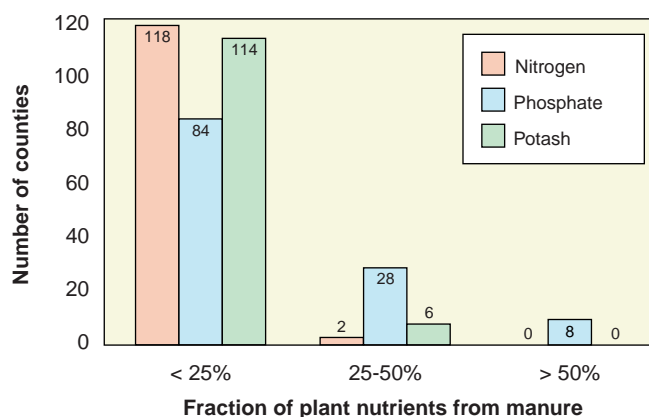
The amount of manure needed for a crop or pasture is best determined on a farm-by-farm basis. On a broad scale, however, available manure nutrients and typical nutrient removals by plants can be estimated. University of Kentucky Extension personnel recently completed this type of broad (county-by-county) assessment. This publication provides a summary of that work.

Results

Results for each county are presented as color-coded maps (Figures 1, 2, and 3) in this publication. Following are a few summary points from those maps:

- Statewide, Kentucky has a vast acreage of crops and grazed forages. In nearly all Kentucky counties, less than one-half of the total crop and forage land base would be needed for land application of manure currently produced by livestock and poultry. The following bar chart groups counties according to the fraction of total nutrients removed by crops and forages that could be supplied by manure:

Proportion of nutrients removed annually by crops and forages that could be supplied by livestock and poultry manure.



- Manure from livestock and poultry could supply less than 25% of the nitrogen removed annually by crops and forages in each of 118 counties (Figure 1).
- Crops and forages in each of 84 counties have the capacity to remove more than 2 million additional pounds of nitrogen above the amount that could be supplied by manure (Figure 1).
- Livestock and poultry manure could supply 25% or less of the phosphate removed annually by crops and forages in each of 84 counties (Figure 2). Animal manure in each of eight counties could provide greater than 50% of the phosphate removed annually by crops and forages.
- After accounting for the phosphate in livestock and poultry manure, crops and forages in each of 57 counties have the capacity to remove more than 1 million additional pounds of phosphate (Figure 2).
- Less than 25% of the potash removed yearly by crops and forages could be supplied by livestock and poultry manure in each of 114 counties (Figure 3).

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- In addition to potash that could be supplied by manure, crops and forages in each of 101 counties have the capacity to remove more than 1 million additional pounds of potash (Figure 3).
- A majority of counties with limited potential to use additional manure nutrients are located in the eastern part of the state and currently have relatively limited animal and crop production.

Using the Results

What are potential uses of the assessment?

The assessment results are only a snapshot of potential manure nutrient use on a relatively large scale (a countywide basis) and do not provide for evaluations at the individual farm level. Due to the broad nature of the assessment, prudence must be used when drawing conclusions from the results.

The assessment may be most useful as a benchmark of the potential of current manure utilization for a county or region of the state. When used in this manner, the assessment results may help:

- Provide overall perspective and serve as a starting point for discussions of current or future livestock and poultry production within a county or area.
- Evaluate areas where new or expanded animal operations are proposed.
- Identify areas where alternative uses of animal manure should be explored. For example, if a county's crop and forage production is limited, manure utilization options other than for plant growth may need to be considered.
- Provide insight into the concentration of livestock and poultry in Kentucky relative to crop and forage production.

The assessment does not take into account the manure management practices currently being used on individual farms and should not be used to:

- Define the potential for or place restrictions on any county's future livestock or poultry production. This information should only be used as a starting point for discussions concerning potential for expansion of existing animal enterprises or the opportunity for new ones.
- Conclude that livestock or poultry production either does or does not cause environmental problems in any county or region. No assessment of environmental impact can be made from the nutrient production and removal estimates presented here. The environmental impact of livestock and poultry operations within a county or area is dependent on manure management practices at the individual farm level.

How the Study Was Done

The assessment was based on a procedure developed by the Natural Resources Conservation Service (NRCS). It involved comparing the amount of manure nutrients produced annually by livestock and poultry to the amount of these nutrients removed from the land by crop and forage production each year. From this comparison, the apparent nutrient balance within each Kentucky county was estimated.

Animal inventories and crop production estimates for each county were obtained from the 1997-1998 Kentucky Agricultural Statistics report, the 1997 U.S. Census of Agriculture, and industry surveys. Animal species included were beef cattle, dairy cattle, swine, and poultry. Crop and forage production estimates were included for corn, corn silage, soybean, winter wheat, sorghum, barley, alfalfa hay, all other types of hay, burley tobacco, dark fire-cured and air-cured tobacco, and forage from grazed pastureland.

Amounts of nitrogen, phosphate, and potash excreted annually by livestock and poultry were estimated using average manure production and manure nutrient content values published by the American Society of Agricultural Engineers and the NRCS. These estimates were adjusted to account for manure and manure nutrient losses that typically occur during collection and storage of manure.

Annual removal of nitrogen, phosphate, and potash by crops and forages was estimated from data developed at the University of Kentucky and data reported by the NRCS.

A detailed discussion of the methods and assumptions used in assessment can be found in the Cooperative Extension Service publication *Assessment of the Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky* (IP-56).

If the estimated percentage for a county shows that current nutrient production in animal manure is close to or greater than nutrient removal by crops and forages, has that county reached or exceeded the level of animal production it can support?

The assessment does not account for all factors that influence a county's true balance of nutrients. Therefore, although the assessment may indicate livestock and poultry currently in place in a county are producing all the manure nutrients its crops and forages can remove, the county's farms may have the ability to use additional manure nutrients and should be examined more closely.

As an example of how other factors can be important, consider the estimates for Muhlenberg County, which indicate that manure from livestock and poultry could supply 134% (an excess of 443,282 pounds) of the phosphate removed annually by the county's crops and forages. However, the following factors illustrate that there is substantial potential to effectively use the apparent surplus of manure phosphate:

- Much of the manure produced in Muhlenberg County is handled as a solid and is routinely transported to various off-site destinations, including some out of the county.
- The assessment shows that in nearby counties, crop and forage phosphate removal exceeds manure phosphate production by over 20 million pounds.
- Local strip mine reclamation projects, a large land area not included in the crop and forage land base of this assessment, have been used for much of the manure produced in Muhlenberg County.

Therefore, it cannot be unequivocally stated that the limits of animal production have been reached in Muhlenberg County.

Other Factors to Consider

A simple countywide calculation of nutrients produced and nutrients removed does not provide a complete manure management picture. Developing solutions that are technically sound, environmentally responsible, and economically viable will require a cooperative effort between the agricultural community, local and state officials, regulators, University personnel, and citizen groups. To effectively evaluate potential developments in animal production, the following questions should be addressed on a farm-by-farm basis:

- Is an adequate amount of suitable land (based on the crops and forages to be grown and soil fertility levels) available to use the manure nutrients that will be generated by animals?
- What is the potential for transporting surplus animal manure to nutrient-deficit areas?
- Will manure be used solely for crop and forage production, or are there alternatives for manure that will (or could) be used?
- Are more intensive cropping practices or alternative crops available that could use above-average quantities of nutrients?
- Can new technologies be applied to reduce the expected output of manure nutrients?

Current Regulations

Regulations are currently in place to ensure animal operations use manure in an environmentally sound manner. The following highlights major environmental regulations:

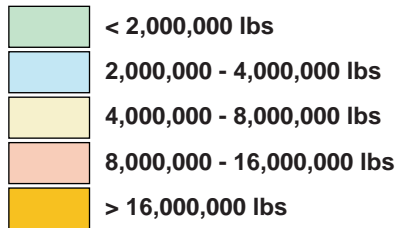
- **Kentucky No Discharge Operational Permit (KNDOP; 401 KAR 5:005)**—Animal operations that collect and store manure as a liquid are required to obtain an operating permit (KNDOP) from the Kentucky Division of Water. As part of the permitting process, operations must show that sufficient land is available to fully use the manure nutrients that will be produced by the operation.
- **The Kentucky Agricultural Water Quality Plan**—All Kentucky farms are required to develop an Agricultural Water Quality Plan. Plans for animal enterprises must include a system of manure management that ensures manure nutrients are used in a manner that protects the environment.
- **Permits for Swine Feeding Operations (401 KAR 5:009)**—The Natural Resources and Environmental Protection Cabinet made this regulation effective in 1998. It sets forth conditions for the construction and operation of new or expanded swine feeding operations larger than 1,000 swine units. It is subject to action by the Kentucky Legislature in 2000.
- **Environmental Performance Standards (401 KAR 47:030)**—Through permit-by-rule, poultry operations are subject to this solid waste regulation, which sets minimum environmental standards for the treatment, storage, recycling, and disposal of solid wastes.

Summary

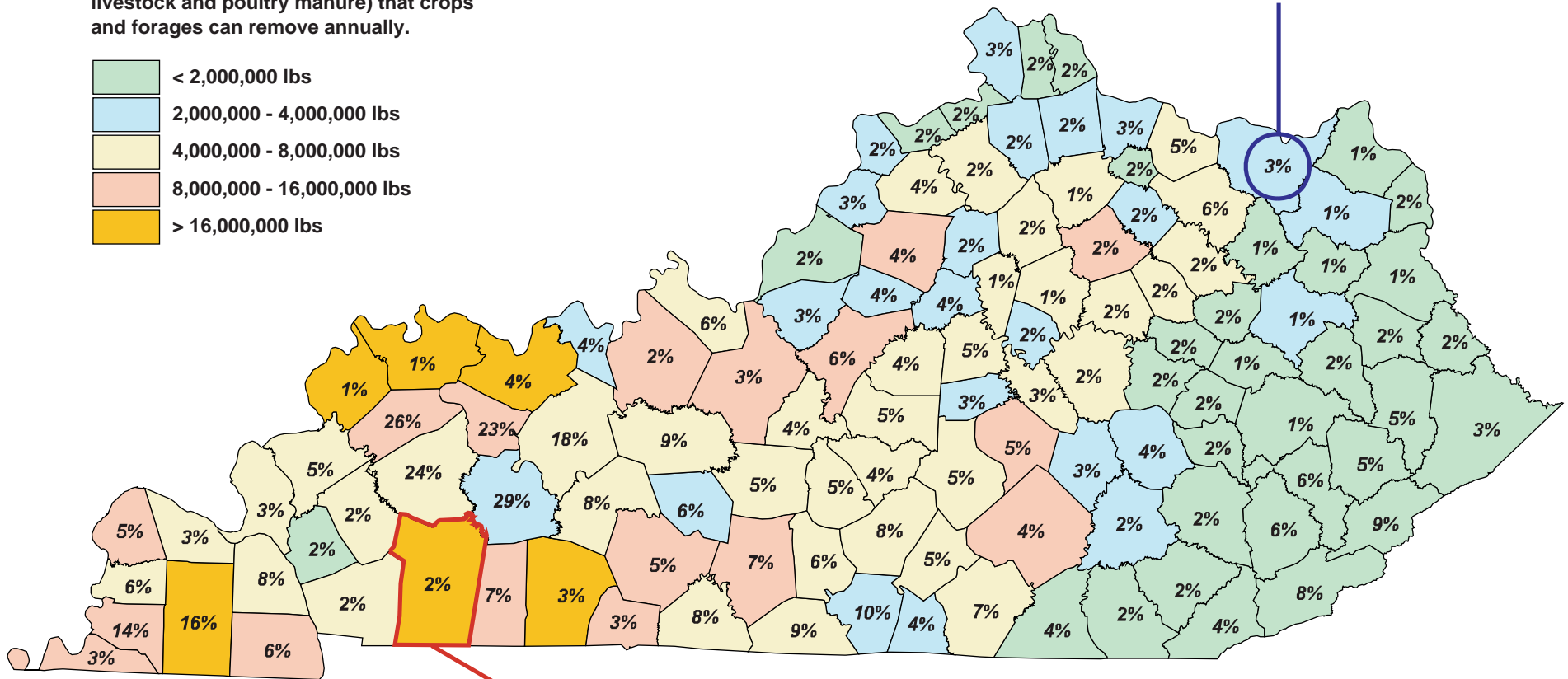
These estimates provide, for each Kentucky county, a snapshot comparison of nutrients supplied by manure and nutrient removal by crops and forages. For a majority of counties, nutrients from animal manure are insufficient to meet the nutrient removal capacities of crops and forages. However, more information and data collection is needed to gain a better understanding of each county's true nutrient balance.

Figure 1. Nitrogen Supplied by Manure Relative to the Amount Removed by Crops and Forages

Amount of additional nitrogen (above the amount currently supplied by livestock and poultry manure) that crops and forages can remove annually.



Values shown for each county represent estimated nitrogen available from manure as a percentage of total nitrogen removed by crops and forages.



EXAMPLE: Livestock and poultry in Christian County produce enough manure nitrogen to supply 2% of the nitrogen that is removed annually by crops and forages. To fully meet the nitrogen removal potential of the crops and forages, more than 16,000,000 additional pounds of nitrogen would be needed.

NOTES:

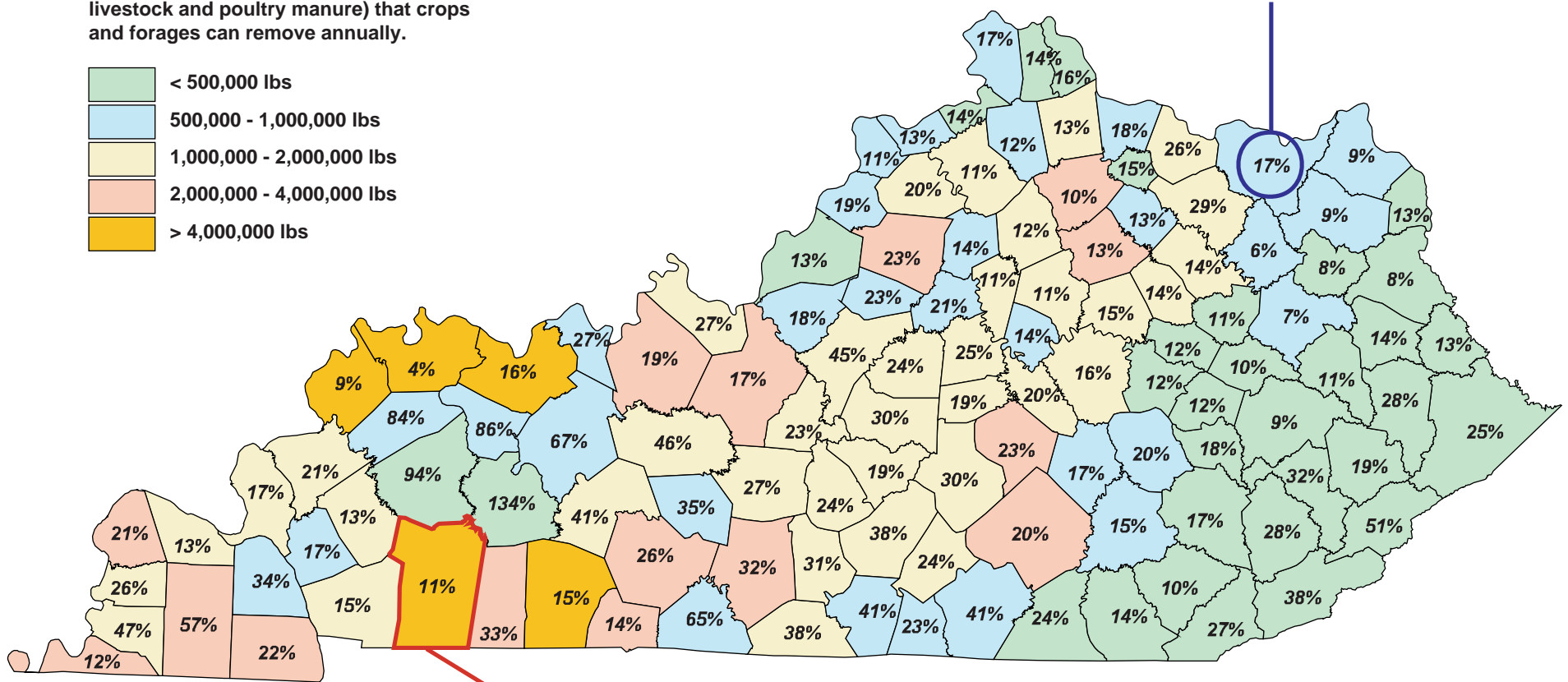
- (1) Nutrient removal refers to the amount of a nutrient removed from the land when crops are harvested and forages are grazed.
- (2) Countywide estimates of nutrient removal potential should not be used alone to evaluate the potential environmental impact of animal production.

Figure 2. Phosphate Supplied by Manure Relative to the Amount Removed by Crops and Forages

Amount of additional phosphate (above the amount currently supplied by livestock and poultry manure) that crops and forages can remove annually.



Values shown for each county represent estimated phosphate available from manure as a percentage of total phosphate removed by crops and forages.



EXAMPLE: Livestock and poultry in Christian County produce enough manure phosphate to supply 11% of the phosphate that is removed annually by crops and forages. To fully meet the phosphate removal potential of the crops and forages, more than 4,000,000 additional pounds of phosphate would be needed.

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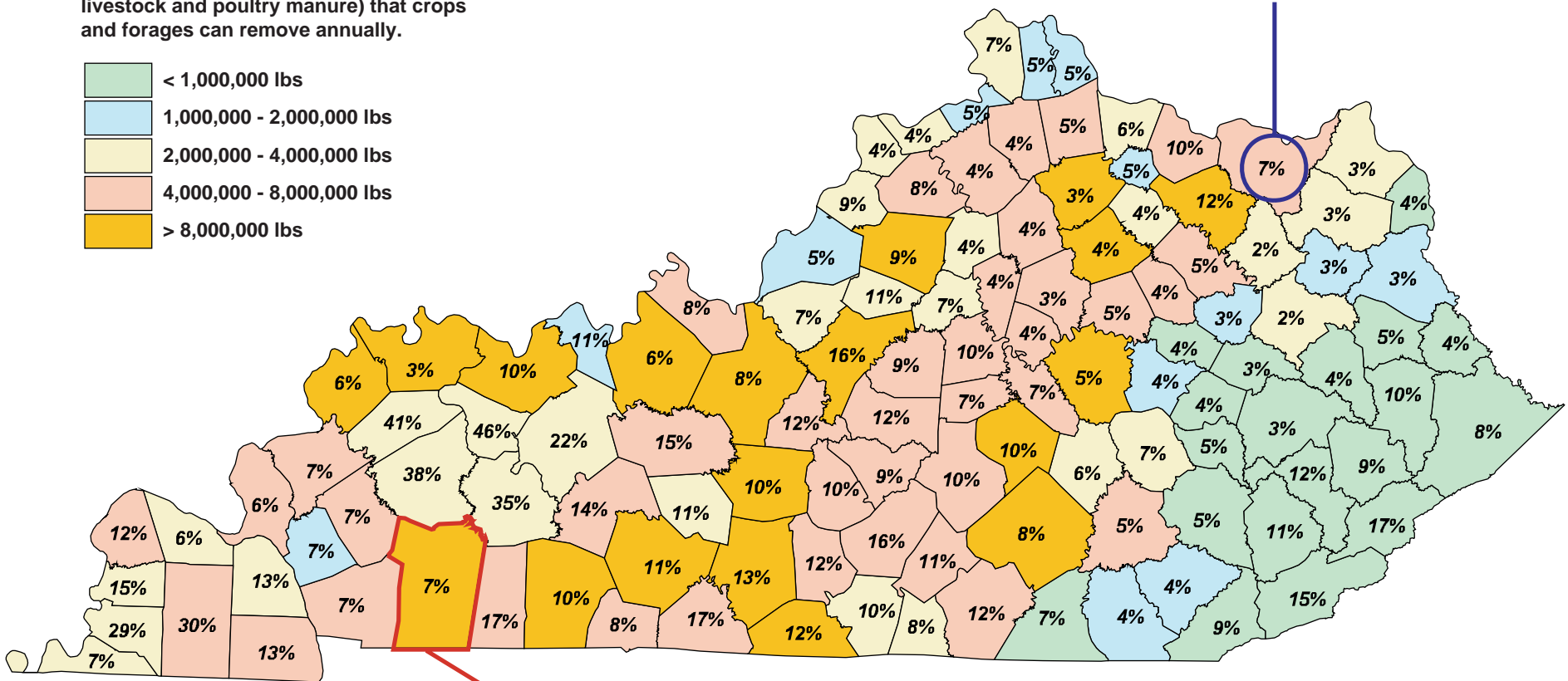
- (1) Nutrient removal refers to the amount of a nutrient removed from the land when crops are harvested and forages are grazed.
- (2) Countywide estimates of nutrient removal potential should not be used alone to evaluate the potential environmental impact of animal production.

Figure 3. Potash Supplied by Manure Relative to the Amount Removed by Crops and Forages

Amount of additional potash (above the amount currently supplied by livestock and poultry manure) that crops and forages can remove annually.



Values shown for each county represent estimated potash available from manure as a percentage of total potash removed by crops and forages.



EXAMPLE: Livestock and poultry in Christian County produce enough manure potash to supply 7% of the potash that is removed annually by crops and forages. To fully meet the potash removal potential of the crops and forages, more than 8,000,000 additional pounds of potash would be needed.

NOTES:

- (1) Nutrient removal refers to the amount of a nutrient removed from the land when crops are harvested and forages are grazed.
- (2) Countywide estimates of nutrient removal potential should not be used alone to evaluate the potential environmental impact of animal production.