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Perceptions of Barriers and Benefits of Manure Use in Cropping Systems

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Summary of Implications

Animal agriculture is tasked with recycling the nitrogen and phosphorus in manures in an environmentally sound manner, typically as a soil fertility amendment, which often requires voluntary transfer of manures to crop farms on which there may be little or no history of manure use. The ability of manure to compete with commercially available fertilizers is essential for this transfer. A survey was conducted of farmers' and their advisors' perceptions of the benefits and barriers to manure use in crops. There exists a strong recognition of manure's agronomic, yield, and soil health benefits. However, many challenges associated with manure frequently become barriers to manure use. The survey identified four challenges most likely to prevent manure recycling, including: 1) transportation costs, 2) odor, 3) logistical barriers (e.g. labor availability), and 4) some agronomic questions that will need to be addressed to encourage an expanded role of manure in more cropland.

Introduction

Manure nutrient recycling is critical to the sustainability of the agricultural sector. Many environmental organizations, businesses, and governmental organizations champion the benefits of a "circular economy" for improving sustainability. Agriculture can potentially recycle critical nutrients from animal feed to animal proteins to manure to soils and back to animal feed, applying the idea of a circular economy to

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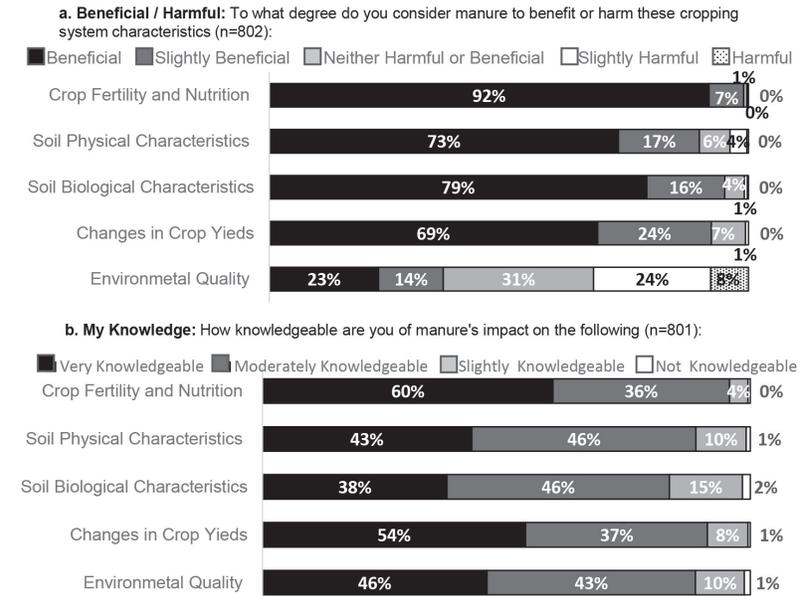


Figure 1. Perceptions and level of knowledge about factors commonly believed to offer benefits to crops or soils.

manage nitrogen (N) and phosphorus (P). Agriculture's circular economy requires establishing recycling loops for manure nutrients transferred to independent crop farms. Whether recycling of nutrients is completed within a single farm or involves multiple separate agricultural enterprises, this circular agricultural economy for nutrients is essential. More information about agriculture's circular economy may be found at <https://go.unl.edu/agcircle>

Procedures

A faculty team from University of Nebraska, University of Minnesota, and Iowa State University is collaborating to deliver Extension programming focused on the "Value of Manure". The team partnered with a stakeholder advisory group to implement a survey conducted in early 2020 to quantify *perceptions of the benefits and barriers to manure use in cropping systems among farmers and their advisors*. The survey was promoted by The Fertilizer Institute,

American Agronomy Society's Certified Crop Advisor program, Manure Manager magazine, and additional partners within our three states.

Results

Completed surveys were received from 957 respondents nationwide. The results more heavily represent the Corn Belt and High Plains regions, professionals advising on retail agronomy products and services and technical services, and individuals with a history of manure use in their crop fertility program management or advising. Voluntary participation likely resulted in some bias in the survey. A more detailed description of those responding are found at <https://go.unl.edu/manurevaluesurvey>.

Benefits of Manure Use

Questions asked of survey participants relative to manure benefits targeted:

Table 1. The following is a list of Top Ten challenges to using manure in cropping systems and the regularity of these challenges being identified as a frequent barrier (either real or perceived) preventing manure use.

Top Ten Challenges		Response Count	% of Responses
Economic	Transportation and application costs	693	90%
Neighbor	Odors	597	78%
Logistical	Timeliness of application	555	72%
Logistical	Field conditions limiting application	508	66%
Logistical	Time/labor requirements	486	63%
Agronomic	Application equipment compaction	435	57%
Agronomic	Poor uniformity of application	391	51%
Regulatory	Regulations	381	50%
Agronomic	Weed seed from manure	366	48%
Economic	Initial costs for adding manure	355	46%

Not shown here are 23 additional challenges that were available to be selected. A more detailed listing of challenges and frequency of responses is found at <https://go.unl.edu/manurevaluesurvey>.

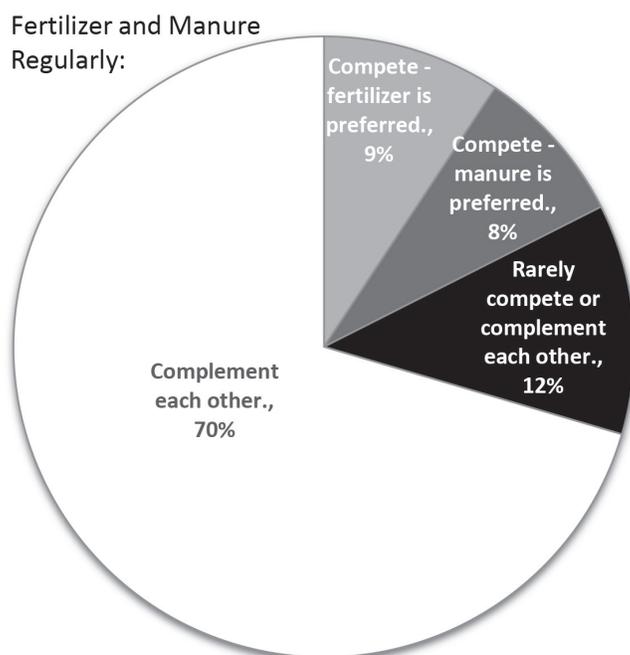


Figure 2. Survey participants responses to what they personally believe is most true in their management decisions (or recommendations) with respect to use of manure and fertilizer in cropping programs?

- Degree participant considers manure to benefit or harm five cropping system characteristic including a) crop fertility and nutrition, b) soil physical characteristics, c) soil biological characteristics, d) changes in crop yield, and e) environmental quality (e.g. erosion, runoff, and nutrient loss to water);
 - Level of knowledge of participant for manure's impact on each cropping system characteristic.
- Manure was rated as "beneficial" for crop fertility and nutrition by 92% of respondents (Figure 1a). Most surveyed largely agreed that it is beneficial to soil physical (73%) and biological (79%) properties and

crop yield (69%), as well. A much smaller portion (37%) agreed that manure is at least slightly beneficial to environmental quality, described in our survey primarily as manure impact on water quality. Thirty two percent perceived manure as at least slightly harmful and 31% indicated it is neither harmful nor beneficial (Figure 1a).

These perceptions of manure as a valued product by those participating in the survey provides a peer group within agriculture which may be influential for promoting the recycling of manure into fields with little or no manure history. However, it is possible that farmers and their advisors may not have the understanding about manure's potential soil and water quality benefits when applied at agronomic rates. Thus, the negative perception of manure's water quality risks continues to persist in rural communities, impeding its expanded recycling in cropland.

Respondents identified as very to moderately knowledgeable (85% to 96%) about the same five Potential Benefits listed in Figure 1b. Somewhat surprising is that a similar level of knowledge was exhibited towards the environmental quality topic as other potential benefits, possibly an awareness of the environmental risks but possibly not the environmental benefits of manure. For the remaining four Potential Benefits evaluated, those surveyed indicate a positive impression and high level of knowledge of those benefits.

Barriers to Manure Use

Conversations with the stakeholder advisory group revealed many potential challenges to manure use in cropping systems, which was assembled into five broad categories: 1) agronomic, 2) economic, 3) community, 4) regulatory, and 5) logistical challenges. A critical purpose of the survey was to identify those challenges that are commonly identified as preventing manure use on some fields. A review of the top ten barriers to manure use in crop fields (Table 1) revealed concerns within all five of the broad categories, suggesting that an array of challenges may ultimately prevent manure's use.

Highest among these risks was an *economic challenge* related to the transportation and application costs of manure (90%

of responses). Just outside the top ten list was the initial cost of adding manure to the fertility program (46%), likely associated with equipment investments. Overcoming economic questions will be critical to expanded manure use.

Neighbor and rural community concerns with odor was the second most common challenge (78%), while water quality impairment and increased traffic, and active opposition to livestock agriculture, were each identified by more than 40% of respondents. Minimizing odor impacts and possibly other rural community concerns need to be addressed for successful manure transfers.

Logistical challenges identified included timeliness of application (72%), field conditions limiting application (66%), and time/labor requirements (63%). *Agronomic challenges* included soil compaction (57%) and poor application uniformity (51%). The challenge of manure for delivering fertility at the right rate and right time compared with conventional fertilizer appears to be a significant impediment to manure use on a broader scope.

The only *regulatory challenge* within the “top ten barriers” list was regulation of manure application practices (50%), such as setbacks. Other commonly identified regulatory challenges included cost of compliance (43%) and local zoning restrictions for odor (41%) were just outside the top ten challenges.

Finally, survey participants were asked to identify which of the following statements were most true in their management decisions (or recommendations) with respect to use of manure and fertilizer (see Figure 2):

- Fertilizer and manure regularly compete with fertilizer typically being preferred (9% selected);

- Fertilizer and manure regularly compete with manure typically being preferred (8% selected);
- Fertilizer and manure are typically used independently and rarely are in competitive or complementary roles (12% selected); or
- Fertilizer and manure regularly complement each other in crop fertility programs (70% selected).

The complementary roles of fertilizer and manure have been documented by two meta-analysis studies as providing the largest average yield increases (averaging from 13% to 18% across all reporting studies). Recognition of the value of co-applying manure and fertilizer and the resulting potential yield benefits could be a powerful argument for expanding manure use in cropland with no previous history.

Summary of Observations

- A strong recognition of manure’s fertility, yield, and soil health benefits currently exists among those farmers and advisors who have some history of manure use.
- Manure’s water quality benefits are not broadly accepted. This potential benefit of manure, if applied at agronomic rates, may be over-shadowed by negative water quality perceptions from historical over-application of manure.
- The perceived imbalance of manure’s benefits against the rather long list of potential risks is a likely reason why many fields are not receiving animal manures. Management strategies and technologies, technical services and education are needed to overcome critical barriers including:

- Economic questions (economic benefits versus costs for transfer of manure to distant fields);
- Odor impacts and possibly other rural community concerns;
- Logistical and agronomic challenges associated with the delivery of manure fertility at the right rate and time within the limited available windows of opportunity; and
- Additional regulatory oversight of manure versus fertilizer (perceived and real).
- Respondents largely perceive manure and fertilizer as complementary components of a crop fertility program. Recognition of the value of co-applying manure and fertilizer and the resulting potential yield benefits could be a powerful argument for expanding manure use in cropland with no previous history.

A more complete summary of the survey results can be found at <https://go.unl.edu/manurevaluesurvey>.

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