



# Manure Is Better FOR WATER QUALITY + SOIL HEALTH

## THE SCOOP ON MANURE

- Manure increases the amount of water soil can hold, which reduces nutrient run-off
- Manure better restores the health of soil by increasing organic matter
- Using manure as a crop fertilizer, along with injecting manure, is a key part of Iowa's overall effort to reduce nutrient loss into water sources

**Pig manure actually improves soil health and better protects water quality? Impossible, you say? Well, in the words of ESPN sports announcer Lee Corso, "Not so fast, my friend!"**

In fact, numerous studies confirm that is exactly what happens when farmers switch from commercial fertilizer to swine manure. Dr. Dan Andersen, assistant professor in Agricultural and Biosystems Engineering at Iowa State University says, "Manure application is often credited with improving physical soil properties (organic matter) and associated benefits such as reduced runoff and erosion."

"Since soil organic matter can serve as a significant source of fertility," Dr. Andersen says, "this has led to increased interest in understanding the mechanisms that stabilize organic carbon within soils and management practices that promote building soil carbon levels."

And repeated use of manure helps build up the soil health even more. "One study," Dr. Andersen explains, "found that five years of manure or compost application increased hydraulic conductivity, porosity and that available water-holding capacity of the soil by 85 and 56 percent for the compost and manure application treatments respectively, compared to controls." In short, the more farmers use manure for their fertility needs, the more their soil health improves.

"Many other studies," Dr. Andersen continues, "have reported similar increases in soil water retention."

Jimmy Chin echoes Dr. Andersen's findings on the value of animal manure in rebuilding soil health and reducing nutrient runoff. Chin's research report on a University of North Carolina Chapel Hill study he conducted in Wisconsin revealed that nutrient runoff was a major contributor to the green water (caused by algal blooms) found in two Wisconsin lakes."

"Part of the solution to reducing that runoff," Chin says, "might be found in the farmers' use of crop-nutrient additives. Our research indicates that switching from chemical fertilizer to manure could significantly decrease the amount of total phosphorus in Wisconsin's surface waters."

"Using water quality and farming data from four states," Chin continues, "we estimate that a one percent increase in farm acres using manure instead of fertilizer would lead to a 0.019 mg/L decrease in total phosphorus levels."



**"OUR RESEARCH INDICATES THAT SWITCHING FROM CHEMICAL FERTILIZER TO MANURE COULD SIGNIFICANTLY DECREASE THE AMOUNT OF TOTAL PHOSPHORUS IN WISCONSIN'S SURFACE WATERS."  
-JIMMY CHIN**



Iowa State University's recommendations for reducing nutrient loss from farmland also includes using manure, citing a 46 percent reduction of phosphorus loss if there is a runoff event shortly after application, such as a heavy rain. Swine manure also reduces the nitrogen loss by four percent versus fields fertilized by commercial products.

*How can this be?* "The answer may lie in the beneficial attributes of manure," Chin says. "Because livestock manure consists of organic matter, manure applications can improve a variety of soil characteristics, including increased water infiltration rates and water-holding capacity that help reduce runoff."

Chin cites one study that "showed how cropland treated with poultry litter took eight times longer than untreated cropland to begin runoff after rainfall. Using manure to replace highly soluble chemical fertilizer may also explain why farmland treated with manure experiences decreased rates of runoff."



## DID YOU KNOW?

25%

OF IOWA'S  
CROPLAND  
IS FERTILIZED  
BY MANURE.

Farmers in Iowa have a need for the nutrients in manure (nitrogen, phosphorus, potassium, sulfur, and numerous others) to help support crop production, and manure is a natural, organic fertilizer. Around 25 percent of Iowa's cropland is fertilized by manure.

## DID YOU KNOW?

7%  
YIELD  
BOOST

Manure increases crop yield for farmers, boasting a 7% yield boost thanks to the benefits of increased organic matter and the added micronutrients.



## RESTORING ORGANIC MATTER

Dr. Andersen points to the need for increasing soil organic matter based on research indicating organic matter content in the prairie regions of the U.S. have declined by 50-90 percent since the land was first cultivated. For Iowa soils, this is approximately a decline in organic matter from 10 percent to around 5 percent—a 50 percent decrease!

Another study cited by Dr. Andersen examined changes in soil water content. It found that application of hog manure increased soil water content 3 percent during the growing seasons compared to soils not treated with manure.

"These improvements in soil water-holding capacity and storage have been attributed to several factors," Dr. Andersen says. "They include soil aggregation and structure improvements, an increase in total porosity, the direct effect of the addition of high specific surface area material and even changes in soil texture."

"By applying manure," Dr. Andersen says, "we are adding to the amount of organic residue the soil receives and also adjusting the array and quantity of specific organic compounds that are processed by soil microorganisms."

"In general, the amount of land applied organic residue (manure) is small in comparison to the amount of crop residue returned to the soil," Dr. Andersen says. "Yet reports of manure impacts on soil tilth and organic matter levels persist."

"It's possible," Dr. Andersen believes, "for small increases in carbon inputs to cause larger increases in soil organic carbon levels. So despite the relatively low levels of organic matter addition, manures may have the ability to improve soil aggregation, aggregate stability and tilth."

## SEVEN WAYS MANURE IMPROVES WATER QUALITY

- 1 MANURE IMPROVES SOIL HEALTH**  
Because manure increases the organic matter in the soil, manure is better for soil health, agricultural sustainability and improving the tolerance of soils to occurrences of drought or heavy rainfall. Scientists and agriculturalists alike agree farmers need to find ways to increase soil organic matter as a way to improve soil tilth and structure.
- 2 MANURE IMPROVES THE SOIL'S ABILITY TO HOLD WATER**  
Soil organic matter is related to many important soil hydraulic properties, which means how easily water moves through the soil. Because manure increases the organic matter in soil, the structure is improved and the soil becomes more porous, allowing the soil to hold more water (rain), thus reducing water "running off" and potentially carrying nutrients into a water source.
- 3 MANURE IMPROVES THE SOIL'S STRUCTURE**  
Manure application improves soil physical properties and the health of the soil, which improves the soil structure. Soils with good structure are less likely to experience runoff and erosion. (Gilley and Risse, 2000; Wortmann and Walters, 2006)
- 4 USING MANURE DECREASES PHOSPHORUS NUTRIENT LOSS FROM FARMLAND**  
Iowa State University's recommendations for reducing nutrient loss from farmland includes using manure, citing a 46 percent reduction of phosphorus loss, if the application takes place just before a rainfall or wind event that can carry the nutrients off-field. If, however, the manure is incorporated into the soil profile, it becomes protected from the transport mechanisms of wind and water.



### 5 USING MANURE ENSURES FARMERS HAVE A SPECIFIC NUTRIENT PLAN FOR THEIR FIELD

No farmer is going to waste money investing in nutrients they don't need, however, any field utilizing pig manure for fertilizer is required by law to have a field-specific manure management plan. This plan precisely identifies when it will be applied, where it will be applied and at what rate. This regulation on Iowa's pig farmers ensures the crop farmers who utilize the nutrients have a field-specific plan based on the data provided in both manure samples and soil samples.



- 6 USING MANURE ENSURES NUTRIENTS ARE APPLIED AT THE RIGHT RATES**  
Manure application is regulated, on a nitrogen basis, and—depending on soil type—both a nitrogen and phosphorus basis, and farmers take both manure samples and soil samples to determine application rates. Iowa's pig farmers must follow strict rules for manure application. It is illegal to over-apply manure.

- 7 MANURE APPLICATION METHODS (INJECTION) BETTER SAFEGUARD WATER SOURCES FROM PHOSPHORUS RUN-OFF**  
Manure applicators use highly calibrated (and expensive!) application equipment to ensure proper rates are applied to the field. Application rate is based on the manure management plan and is typically one-tenth to two-tenths of an inch of liquid manure, injected 6-8 inches deep into the soil.

*According to Iowa State University's recommendations on reducing nutrient loss, placing nutrients by injection decreases phosphorus runoff by 24 percent because the nutrients are not exposed to rain or wind, which could carry the nutrient off the field.*

**MANURE IS INJECTED  
6-8 INCHES BELOW THE SOIL**

## PRECISION AGRICULTURE TOOLS DRIVES CONTINUOUS IMPROVEMENT

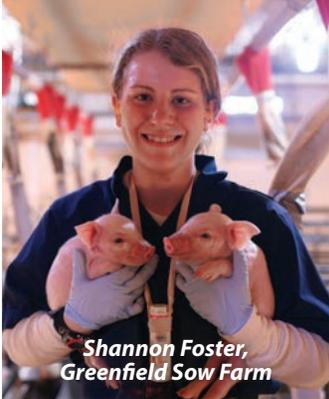
Geographical Information System (GIS) software allows pig farmers the ability to view the manure source and the neighboring fields receiving the nutrients. Every parcel of ground is mapped into the system, including creeks, building sites, terraces or tile outlets.

Aerial imagery is used as the base maps and layers are then added for contours, county tile lines, flood area, water sources and public areas. GIS technology ensures manure is applied responsibly and in compliance with all state regulations.





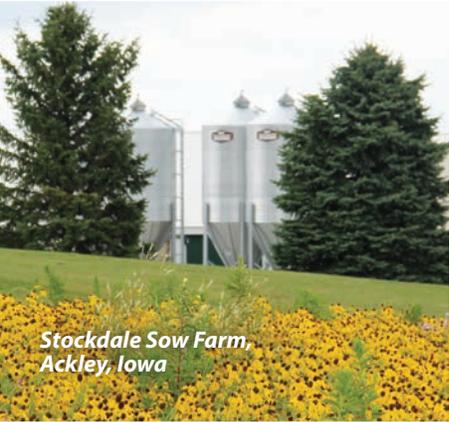
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**Shannon Foster,  
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**Don Stahl, Ackley, Iowa**



**Stockdale Sow Farm,  
Ackley, Iowa**



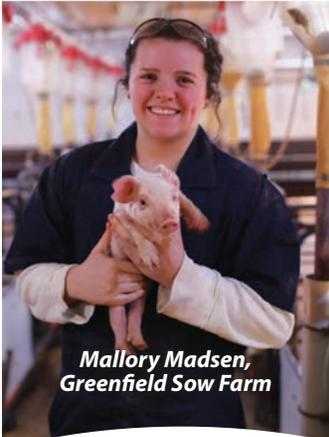
**Gooseneck trailer**



**Buckeye, Iowa**



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**Environmental Services Team**



**Churdan, Iowa**

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