

# BIOCHAR IMPROVES MANURE MANAGEMENT

Good for  
the animals.  
Good for the  
environment.



Farm animal manure can be a useful amendment to build soil organic matter and provide important nutrients for crops. Yet too much manure could be problematic and become a source of excess nutrients and odors. Agricultural non-point nutrient pollution can contribute to the contamination of waterbodies.<sup>1</sup>

Biochar promises to improve both nutrient management and reduce odors from manure. When biochar is blended into the solid fraction of manure, it can significantly improve the capture of excess nutrients and reduce odors. In livestock operations, biochar is useful for managing odors of manure and flies.<sup>2</sup>

Biochar can also bind nutrients from the liquid fraction of manure. Upcycling nutrients from farms by using biochar can create a more valuable and nutrient-dense manure compost product that may be added back to farm fields.

Reducing manure odors through biochar manure composting improves air quality and health for animals.

Various benefits come from using biochar to manage manure:

- **Creates a nutrient rich soil amendment**
- **Reduces odors<sup>4</sup>**
- **Improves animal health<sup>5</sup>**
- **Controls nitrogen (N) and phosphorous (P) in runoff**
- **Stores carbon in ground as soil amendment**
- **Reduces greenhouse gases by as much as 79%<sup>6</sup>**

## Economic benefits

Given that most animal agricultural operations have excess nutrients, using biochar to capture and store nutrients as a compost-fertilizer could be a source of new revenue for farmers as a replacement of petroleum-based fertilizers. From 2016 to 2018, Kelpie Wilson conducted a series of on-farm biochar trials in Oregon working with the USDA.<sup>3</sup>

Here's what farmers said:

Troy Michaels of Michaels Ranch, Days Creek, OR noted that adding biochar directly to the barn produced a composted manure that had ten times the nitrate content of plain manure. "It is definitely worthwhile and more effective to add the biochar in the floor of the barn and have the animals mix and deposit on it. The increase in nitrate should be really beneficial."

"We were very impressed by the odor reducing power of biochar. It sure has improved our barns. When you dig into the floor, it looks like it's composting really well. Instead of the plate of waste hay and alfalfa, it's nice compost," said Suzanne Willow of Willow-Witt Farm, Ashland, OR.

Manure disposal costs farmers unnecessary expense and time. By introducing biochar, manure can be converted into a product that can be used on the farm or sold as a fertilizer.

## Environmental benefits

Farms of all types are being challenged to reduce nutrient runoff to protect waterways. Farmers are also interested in reducing manure odors both during stockpiling and field application. Using biochar to manage manure addresses these issues.



Biochar in feed

## Knowledge evolving

Researchers and farmers are exploring many ways to use biochar in animal husbandry. Some applications being discussed:

- **Adding to feed, which is common practice in Europe and Japan**
- **Putting biochar in bedding**
- **Studying biochar's effect on milk production**
- **Capturing wastewater phosphorous**

## CASE HISTORY: POULTRY

**CHALLENGE/OPPORTUNITY:** Ammonia build-up in chicken houses creates an unhealthy environment for the animals and can result in water pollution.

**SOLUTION/APPROACH:** Focused on making engineered renewable carbon products, enviraPAC offers pre- and post-stage biochar to the poultry industry. In the pre-treatment stage, the goal is to control ammonia, which builds up in chicken houses that can have 25,000 birds each. Biochar interrupts ammonia formation while also preventing crust formation in the litter and enhances bird health.

Once litter is removed from the house, it is often stored in piles. When it rains, nitrogen-containing material is washed out of the piles, becoming a major source of water pollution. Biochar mixed into the used litter will adsorb nitrogen (hence reducing nutrient runoff) and

results in an inoculated compost product with a pH in the 7 to 8 range, making it a superior fertilizer product.

**RESULTS:** enviraPAC biochar is standardized and consistent, so it produces reliable results.

Biochar's ability to reduce nitrogen runoff was also shown in a recent study by University of California Merced<sup>6</sup>. The researcher investigated biochar additions to dairy manure and found a 79% reduction in methane emissions after adding one ton of biochar per 15 tons of manure (about 6% biochar on a wet basis) or 0.9 tons of biochar per 3.37 dry tons of manure (nearly 20% biochar on a dry basis), they found. In addition to creating a more nitrogen rich compost, it also reduced greenhouse gas emissions.



## CASE HISTORY: CATTLE

**CHALLENGE/OPPORTUNITY:** Commercial rancher Troy Michaels raises grass-fed beef and lamb on his 756-acre Oregon family farm. Over time, soils become more acidic. Lime is expensive to buy and apply, so Michaels decided to evaluate biochar to raise soil pH and decrease his costs.

**SOLUTION/APPROACH:** He used high-carbon boiler ash biochar from a nearby sawmill as a liming agent. The 28% fixed carbon biochar has a pH of 8.4 and a calcium carbonate equivalent of over 25%. He evaluated four options: just biochar, just manure, a biochar-manure mixture, and no treatment.<sup>7</sup>

**RESULTS:** Preliminary data suggests that after the composting process was finished, the biochar and manure mix was higher in N than the manure pile alone, which indicates that less N was lost to the system during decomposition. He continues to use biochar because of its great results.

Troy Michael's experience creating a more nutrient rich soil amendment is consistent with findings from other biochar-manure combinations. In 2022, researchers at the University of Iowa studied whether biochar combined with manure slurries had agronomic benefit when applied to soils.<sup>8</sup> They found that biochar manure combinations can deliver 604 pounds of P per acre and 675 pounds of N per acre, reducing the costs of inorganic N and P for crop fertilization on farmland.

## CASE HISTORY: BEEF CATTLE MANURE MANAGEMENT

**CHALLENGE/OPPORTUNITY:** Typical beef feedlot finishing diets in the U.S. combine high inclusions of concentrate (grains) with a variety of byproducts, crop residues, and forages that incorporate high quantities of N, P, and soluble salts. Less than 15% of N and P are retained by the animal with the remaining N and P excreted in the manure. Applying biochar to the feedlot pen surface is one proposed method to improve manure nutrient capture of N and P.

**SOLUTION/APPROACH:** Dr. Andrea Watson and her colleagues at the University of Nebraska-Lincoln studied the impacts of biochar addition to feedlot pen soil surfaces on manure nutrient capture.<sup>9</sup> The first trial from December to June 2020 used 150 cattle. A second trial from June to November 2020 used 80 cattle.

The biochar amendment had the effect of grabbing onto N. "In both experiments, biochar addition to the pen surface tended ( $P = 0.07$ ) to increase manure N as a percent of manure dry matter" however the results were not statistically significant.

**RESULTS:** The addition of biochar to the pens (at 25 to 31 kilograms of biochar per animal) resulted in a significant increase in "Average Daily Weight Gain" and the final body weight of the cattle in the summer experiment. Researchers speculated that the reason for the significant increases were related to moisture content. The biochar-amended pens dried out more quickly following rain events compared to the control pens because the biochar absorbed moisture and led to less mud. The biochar effects on moisture content of manure in cattle feedlots was also reported in a study by Maharjan and Wilke (2021) that added 30% C biochar made from sugar beets at a rate of 568 kilograms per steer. A significant reduction in moisture content (and mud formation) was measured in the biochar amended pens compared to control pens.<sup>10</sup>



## Conclusions

Research and real world applications show that biochar when combined with manure can have significant economic, social and environmental benefits. Biochar can capture nutrients from farm manure and runoff, save farmers money on fertilizers, and reduce greenhouse gas emissions.

## Helpful resources

- To promote the wider use of biochar at the farm scale, the USDA Natural Resource Conservation Service (NRCS) has new incentive programs to cost share the production of biochar. The program is called the **Code 336 soil carbon amendment program**. [nrcs.usda.gov/sites/default/files/2022-11/336-NHCP-CPS-Soil-Carbon-Amendment-2022.pdf](https://nrcs.usda.gov/sites/default/files/2022-11/336-NHCP-CPS-Soil-Carbon-Amendment-2022.pdf)
- The **US Biochar Initiative** has a helpful video introducing the USDA NRCS program. [youtube.com/watch?v=d0EK5s9xOcw](https://youtube.com/watch?v=d0EK5s9xOcw)
- The **2022 Inflation Reduction Act** provides an additional \$19.5 billion over five years for climate smart agriculture. The new funds are designed to generate climate mitigation benefits at the farm and ranch scales, expand access to financial and technical assistance for producers to advance conservation on their farm, ranch, or forest land through practices like cover cropping, conservation tillage, wetland restoration, prescribed grazing, nutrient management, tree planting and more. [nrcs.usda.gov/about/priorities/inflation-reduction-act](https://nrcs.usda.gov/about/priorities/inflation-reduction-act)

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For more information, please visit  
US Biochar Initiative: [biochar-us.org](https://biochar-us.org)

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