Sustainability Strategies for Swine-Crop Integration

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Purpose

To present evidence-based practices that improve sustainability outcomes while maintaining productivity.

Importance

There are many opportunities for pig farms to become more sustainable without sacrificing productivity. One of the most important strategies is nutrient recycling, the use of manure as natural fertilizer to improve soil health and reduce dependence on synthetic fertilizers. Farmers can also adopt practices like crop rotation, cover cropping, and conservation tillage to conserve nutrients, build soil structure, and store carbon in the ground.

New technologies provide additional tools. Biogas systems can capture methane from manure and convert it into renewable energy. Precision agriculture allows farmers to apply fertilizer more carefully, reducing waste and environment impact. Taken together, these strategies not only lower emissions and protect natural resources, but also strengthen the resilience and efficiency of farming systems, ensuring they remain productive for future generations.

Strategies for Improvement

Nutrient Management

Careful nutrient management is one of the most effective ways to reduce environmental impacts. Precision application of manure and fertilizers ensures that nutrients go where crops can use them most effectively. Feeding pigs “ideal protein” diets reduces nitrogen excretion, lowering the amount of excess nutrients in manure. Phosphorus recovery methods, such as capturing it from wastewater of using manure ash, provide new ways to recycle this essential nutrient and reduce runoff.

Soil Conservation

Protecting and improving soil is central to sustainability. Practices such as reduced or no-tillage help build soil organic carbon and reduce erosion. Cover crops like rye or radish capture leftover nitrogen, preventing leaching into waterways. Crop rotations, such as alternating corn and soybeans, balance nutrient use and improve long-term soil fertility. These strategies strengthen soil health while reducing greenhouse gas emissions from crop production.

Manure Treatment Technologies

New technologies offer solutions to make manure management more sustainable. Anaerobic digestion captures methane from manure, turning it into renewable biogas while producing a nutrient-rich digestate that can replace synthetic fertilizers. Composting, when done with an adequate carbon-to-nitrogen balance, stabilizes nutrients and reduces odors. Mixing manure with biochar can further improve soil carbon storage and limit emissions. Together, these technologies turn a waste product into a valuable resource.

Circular Bioeconomy Approach

Sustainability is most effective when livestock and crop systems are integrated. Recycling nutrients from pigs back into the soil closes the loop between animals and crops. Co-products such as biogas, compost, and biochar add economic value while reducing environmental impacts. This circular approach not only cuts greenhouse gas emissions, but also helps farms become more resilient in the face of climate change.

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Practical Applications

Adopting these strategies delivers measurable benefits. Replacing even part of synthetic fertilizer with manure can reduce nitrous oxide emissions by 14-60% (Kong et al., 2021). Digestate from anaerobic digestion cuts fertilizer needs, while conservation practices like cover cropping and no-tillage improve soil resilience. Collectively, these approaches lower the greenhouse gas footprint of pork production and ensure a more sustainable future for farming.

Key Takeaways

- Precision nutrient management reduces waste; "ideal protein" diets lower nitrogen excretion
- Phosphorus can be recovered from wastewater or manure ash, reducing runoff risks
- Conservation practices (i.e., no-till, cover crops, and crop rotations) protect soil and improve carbon storage
- Manure technologies (i.e., anaerobic digestion, composting, and biochar) turn waste into valuable co-products
- Circular bioeconomy approaches integrate crops and livestock, recycling nutrients and creating co-products like biogas and compost
- Partial replacement of synthetic fertilizer with manure reduces nitrous oxide emissions by 14-60% (Kong et al., 2021)
- These strategies lower greenhouse gasses, protect soil and water

Literature Cited

Kong, D., Y. Jin, K. Yu, D. P. Swaney, S. Liu, and J. Zou. 2021. Low N2O emissions from wheat in a wheat-rice double cropping system due to manure substitution are associated with changes in the abundance of functional microbes. Agric Ecosyst Environ. 311:107318. doi:https://doi.org/10.1016/j.agee.2021.107318.

This work was supported by the National Pork Board grant #22-092.

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