

Mass balance analysis of nutrient flow in swine hoop structures and associated composting systems

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This paper describes the objectives, design, and three years of results from a field study examining the nutrient losses from bedded swine structures and an associated composting site. Nutrient mass balances have been completed on five groups of pigs in naturally ventilated hoop structures, with an additional five cycles of composting at the outdoor windrow composting site. Soil core nutrient analysis and mass balances on nutrients in the swine production system and composting piles have been used to assess losses to the environment. Mass balance analysis of nutrient flows in swine hoop structures indicated a 50 to 60% loss of excreted N from the bedded manure pack. While some of these N emissions are in the form of ammonia, the heterogeneous nature of the bedded pack facilitates nitrification/denitrification, leading to substantial losses of N₂ and N₂O, the latter a potent greenhouse gas. Although these conditions could also result in significant methane generation, methanotropic organisms in the aerobic surface regions appear to reduce CH₄ emissions. For gas emission measurements, the tracer-ratio method was used to examine the magnitude of these emissions over time. A computerized data acquisition and control system sampled the tracer (SF₆), NO₂, NH₃, and CH₄ using an automated sampling system. Resulting emission factors show seasonal variations that are influenced by ambient temperature, pig growth phase, and the characteristics of the bedded pack. Losses during composting are dominated by leachate and runoff. Impermeable composting surfaces, along with runoff management using vegetative filters or other appropriate methods. These and other low-cost, practical management strategies can help insure that hoop manure provides maximum agronomic benefits while minimizing environmental risks.