# An Investigation of Innovative Manure Management Techniques to Reduce Watershed Nitrate and Phosphorus Contamination

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## ABSTRACT

Excess nitrogen and phosphorus runoff from manure runoff into watersheds has impaired many water bodies and resulted in eutrophication of the Gulf of Mexico. Animal manure is directly land applied, but many other innovative manure management techniques including composting, constructed wetlands, and vegetative filter strips could be utilized to reduce phosphorus and nitrate watershed contamination. Manure can be utilized as a fertilizer, providing required nutrients for plant growth. Composting stabilizes the manure for land application, decreasing the excess nitrogen and phosphorus runoff to the watershed. Constructive wetlands also provide plants with phosphorus and nitrogen required for plant growth, but is done in an aquatic environment. The final wetland effluent N and P concentration is reduced to appropriate levels that will not cause nutrient overloading to the area watershed. Vegetative filter strips, also utilizing plant absorption, are strips of dense grass planted adjacent to areas with animal manure and rely on sedimentation and infiltration to reduce nutrient concentrations from the runoff. All three systems can potentially reduce nitrogen and phosphorus concentrations to adjacent watersheds, but the most appropriate system is dependant on land and labor requirements for operation. Future implementation of any new manure management techniques will be dependant on new environmental legislation.

**KEY WORDS:** manure management, phosphorus, nitrate, animal waste

## INTRODUCTION

The farming industry has evolved over the past century from an integrated self-sufficient livestock/crop system, utilizing livestock manure as fertilizer, food, and feed, into an industry with two separate specialized crop and livestock systems. The continued diverging trend of the crop/livestock industries and urbanization of our economy have resulted in large, centralized, and concentrated livestock operations. The large volumes of animal waste produced at these operations require waste management techniques that will minimize the environmental impact of the manure disposal to the surrounding watershed. Runoff from feedlots, containing excess phosphorus and nitrate, has resulted in the contamination of surface and groundwater sources worldwide. Phosphorus and nitrogen are essential nutrients for biological growth; however, excessive nutrient loading to receiving waters can result in eutrophication.

Eutrophic water bodies are nutrient rich, which can lead to excessive growth of certain aquatic spices such as phytoplankton. Large algae blooms at the surface limit the amount of light available to other species in the environment and consume the available dissolved oxygen. Eutrophication is a serious threat to the general health and diversity of the water body and the various inhabiting plant and animal species. Excessive phytoplankton and macroalgae growth in Florida's costal estuaries has severally restricted the growth of the sea grass beds. Populations of shrimp, snails, and other invertebrates inhabiting the grass have declined, directly affecting the predator population. The ecological effects of eutropihication are visible throughout the Gulf of Mexico and are extremely severe near the mouth of the Mississippi River where excessive nitrogen loading created a hypoxic zone averaging 14,178 $km^2$ from 1985-2000. (US EPA, 2004) This dead area is attributed to high nitrogen loading into the Mississippi River from animal waste and fertilizer runoff. Nitrogen is the generally the limiting nutrient is marine systems, while phosphorus is limiting in freshwater systems. The effects of nitrogen loading into freshwater streams from agricultural runoff are generally not visible until the freshwater converges into a marine environment. Excess phosphorus, however, is attributed to eutrophication in freshwater systems including Clear Lake in north central Iowa.