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Managing waste to protect soil, water, and air

Agriculture can produce a lot of waste, such as manure and crop residue. Traditional ways of disposing of and treating waste take time, space and money, and can cause soil, water and air pollution. Improving waste management is key to the economic and environmental sustainability of agriculture. Scientists at land-grant universities across the United States are finding innovative ways to manage agricultural waste in a cost-effective and environmentally friendly manner.

Here are some examples:

- Runoff of excess phosphorus from manure applied to farmland is the largest contributor to water quality degradation in Lake Champlain. Manure contains nutrients such as nitrogen and phosphorus that help plants grow, but many farmers don't actually need the phosphorus. A new technology tested by **Vermont** Extension removed about 85% of phosphorus from manure, giving farmers who only need nitrogen a better fertilizer option. Based on these results, the U.S. Natural Resources Conservation Service is considering including this technology in their financial assistance programs. If adopted throughout the region, this technology could dramatically improve water quality in the Lake Champlain Basin without affecting crop yields.
- Researchers in **North Carolina** designed a cost-effective biological process to recover energy, nutrients and water from agricultural and food wastes, including cattle manure, swine wastewater and corn stover, and turn them into beneficial byproducts such as biogas and fertilizer. Researchers also developed a computational tool to assess and manage waste-based biorefineries. Increased use of waste-based biorefineries could cut down on waste, reduce reliance on imported energy and fertilizer and improve the environmental and economic sustainability of agricultural production.
- Studies at multiple land-grant universities found new ways to create and use biochar (a charcoal-like substance) from chicken feathers, crawfish shells, corn stalks and many other kinds of agricultural waste. Studies by scientists in **Alabama** and **Arkansas** discovered ways to use biochar in wastewater treatment and to remove pollutants from farm runoff, and **Iowa** researchers found that biochar can

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mitigate odors and other emissions from manure that can have adverse effects on animals, farm workers, and nearby residents. Researchers in **North Carolina** showed that biochar can be used to make supercapacitors to store and release energy and protective gear that blocks X-rays, gamma rays, and other types of radiation.

- When livestock die, farmers often compost the animal carcasses to recycle nutrients; however, many farmers are not aware of the best composting methods and tools to prevent the spread of animal disease pathogens. Scientists in **Illinois** found that using the right temperature is key to killing disease-causing bacteria. In addition, adding woodchips enriched with biochar can speed up carcass compost times and reduce the amount of liquid that seeps into the environment. Following Extension workshops, more farmers are willing to use biochar to compost animal carcasses and have the knowledge and skills to do so properly. Appropriate animal composting methods will help contain diseases like African swine fever and avian influenza that have led to sickness and death of livestock worldwide and affected global trade and meat and poultry prices.

Reducing and managing residential waste

Residential waste can also be a serious threat to environmental and human health. Land-grant universities are playing a key role in reducing and managing residential waste and the impacts it can have. For example:

- **Alabama** researchers are helping reduce and manage pharmaceutical waste, which can contaminate soil and water and harm plants, animals, and people. University-led drug takeback drives collected 4,075 pounds of unwanted and unused prescription and over-the-counter medication from across the state in 2019. Over half of the program's participants indicated they would no longer throw away medicines and would purchase drugs in smaller quantities to avoid waste.
- In **Florida**, Extension programs have increased government officials' and residents' understanding of laws and maintenance for septic systems, which are common in Florida and a major source of well water contamination. So far, 59 of the participating homeowners have pumped their septic tanks, preventing an estimated 1,003 pounds of nitrogen from leaching into groundwater, and many more participants plan to pump their tanks soon.
- In **Texas**, Extension educators helped residents repair or replace failing septic systems, install stormwater management structures, set up pet waste stations and improve manure management on farms. These waste management practices improve water quality, reduce water treatment costs, and protect public health, recreation, and aquatic habitats.