

Amazing cows hold promise in pioneering sustainable food systems of the future

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Dr. Zhengxia Dou, Professor of Agricultural Systems, sees the "unique biological processes" of livestock as a key component to sustainable, regenerative agro-food systems. Credit: University of Pennsylvania

In today's climate change narrative, animal-based agriculture often endures criticism for its alleged contributions to the global problem. With some naysayers ranking the industry second only to the population explosion as a root contributor to global warming and other weather-related devastation, the concern for how food is—and can be—produced has become even more pressing.

In reality, farmers across all facets of animal agriculture—beef, dairy, poultry, and pork—have long-since embraced evolving techniques to produce meat, milk, and eggs as efficiently and sustainably as possible, minimizing agriculture's climate-contributing footprint in the process.

Even still, agriculture critics routinely point fingers at the industry and the animals that it is comprised of, even going as far as calling out cows for the [implications of their bovine burps](#).

But researchers at the University of Pennsylvania's School of Veterinary Medicine (Penn Vet) are finding that these cow "culprits"—and other livestock found in animal agriculture—are actually critical partners in developing sustainable, regenerative agro-[food systems](#).

"Animals are natural bioprocessors," says Zhengxia Dou, Ph.D., Professor of Agricultural Systems at Penn Vet, noting that livestock's unique and 'indispensable' natural biological processes enable them to consume plant and food residues that are either indigestible by humans, unpalatable to people, or are no longer salable for any of a number of reasons. Dou refers to these residues as IUUB (indigestible, unpalatable, or unsellable biomass); for example, the surge of processing byproducts generated by the increased popularity of plant-based foods in consumers' diets.

"By maximizing the use of IUUB, the livestock sector of agriculture actually contributes to this societal issue in a very positive way," says Dou.

The animals consuming IUUB are a key component to the wholesomeness of our food system, as well as to our own diets. "Without them, we would not be able to convert otherwise wasted biomass into nutritious meat, milk, and eggs." she emphasizes.

Right now, Dou's team at Penn Vet is in the process of conducting a dairy focused project called "The Amazing Cow." Funded by the Pennsylvania Department of Agriculture, the study documents the types, amounts, and variations of IUUB fed on [dairy farms](#), characterizing important nutritional attributes and giving producers informed insights on how IUUB feedstuffs could be implemented on their farms.

These promising feedstuffs come in many forms. A dairy operation in Lancaster County receives daily deliveries of apple waste from a processing facility that supplies apple slices for school lunches. Another local dairy gets three truckloads of vegetable and fruit discards, along with expired bread products, each week that originate from area distribution centers. No longer salable or desirable for consumers, these foodstuffs become feed for cattle rather than going to a landfill. Other producers across Pennsylvania have discovered the benefits of brewer's waste—the huge quantities of sour mash that result from the production of beer—as a viable source of feed.

On a national scale, livestock are consuming millions of pounds of otherwise unusable IUUB created in the production of various everyday products like soybean and canola oils, orange juice, ethanol, and more.

Even post-consumer food waste generated in restaurants and consumer households can be converted into safe and nutritious feed for livestock. A pilot project in California ([Sustainable Alternative Feed Enterprises, SAFE](#)) has developed treatment technologies to serve that purpose.

Dou's team is working with SAFE. Her lab systematically collected and tested the feed samples derived from consumer food waste for feed safety evaluation, analyzing important factors such as mycotoxins, heavy metals, pesticides, microbial contaminants, and nutrition parameters.

Besides empowering farmers to make sustainable, but sensible, animal

husbandry decisions, Dou's team sees their circular, agrofood system model as a key to providing consumers with a healthy diet while reducing the issues some associate solely with livestock production.

Refining the model has opened doors to new sustainable applications, too. "Working with area farmers as well as a large fruit and vegetable wholesale centers, we have recognized some practical issues that need to be addressed in order to grow the adoption of this model further—primarily the logistics of transport and costs, and the safe use of the materials on the farm, given their perishable natures," Dou says. "This has challenged us to look for even more sustainable solutions."

Addressing some of these challenges has spurred Dou's team to tackle a new initiative to develop innovative technologies that would unlock the precious resources embodied in highly perishable IUUB materials. Dou says this initiative consists of creating an IUUB database, conducting research trials, and assessing relevant nutritional, environmental, and climate impacts. "Collaborators from a number of Chinese institutions are interested as well," she adds.

Dou's circular agro-food system model doesn't just focus on utilizing what goes into an animal, but also what comes out. Improving the practices of recycling manure back to cropland remains a key consideration. The management impact is twofold: the value of manure nutrients for growing crops, and mitigation of water quality issues from spreading manure.

"Pennsylvania was the first state in the country to have a nutrient management law," Dou says proudly. Today, nearly all states have nutrient management laws or regulations in place. A variety of best management practices have been developed by agricultural scientists and extension experts and made available for field adoption by farmers.

Dou notes that, even before implementing tactile manure management, producers can (and often do) adopt precision feeding strategies to optimize nutrient intake for high productivity while minimizing nutrient excretion in manure.

"Livestock farming is an integral part in our agrofood system," Dou concludes. "These animals can and do have a positive impact on our society, and they have a fantastic story to tell. Producers and those who are in the know need to get out there and share that story."

Provided by University of Pennsylvania

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