

Agricultural Evolution

Technology continues to advance,
alter the industry.

by Kindra Gordon, field editor

People have been brewing coffee for more than 500 years, but if you go into a kitchen today to look at how it's made, you'll probably see a process that bears little resemblance to the methods used a generation ago. The messy, communal coffee pot has largely been replaced in offices and homes by the cup-at-a-time, pod-style brewing pioneered by Keurig® in the 1990s.

What has this change meant for this uber-successful company? K-Cups® now come in more than 200 flavors and sell for about 50¢ apiece. That's 10 times the cost

per cup of coffee brewed by traditional methods, but consumers are willing to pay for the speed and convenience.

The business lesson to be learned: Coffee is a product that has a long history, but innovation has added value and changed the whole experience.

Every industry faces evolution. What might agriculture look like in the future? How can efficiency and value be added to the process of raising crops and livestock? Here's a sampling of some of the innovations that lie ahead:

Send in the drones

Small unmanned aerial vehicles (UAVs), better known as drones, hold great promise for agriculture, Kansas State University (K-State) agronomist Kevin Price told farmers at the American Farm Bureau Federation (AFBF) Annual Convention this winter.

Agriculture applications for drones in development include data collection on crop health, vigor and yields; tracking the spread of invasive plant species; measuring the amount and type of biomass in pastures and rangelands; and monitoring cattle feedlots. Data collection of field images by cameras mounted on drones is extremely accurate to within 1 inch (in.), Price says.

"The biggest challenge is extracting useful data from the 'tons' of it that is collected," Price says. "New software needs to be created that can take data and transform it into useful information."

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35 Keys to Success
Consumer Relations

►Just as technological advances have changed the way we make coffee, advances in agriculture are constantly changing the way we farm and ranch.

Drone technology continues to develop rapidly while costs are declining. Price anticipates the economic potential of drones is tremendous in terms of precision agriculture, but will not be realized without approval from the Federal Aviation Administration (FAA). States with the most agriculture stand to reap the greatest benefits from the technology, he says.

“About 80% of economic income from drone technology will be in agriculture,” Price predicts. He suggests that by the year 2025 UAVs have the potential to be an \$82 billion industry. In the future, farmers and ranchers will be able to monitor their land in ways they have never been able to do before, he says.

The Tallgrass Prairie National Preserve, Strong City, Kan., has nearly 11,000 acres of the preserve’s range leased to ranchers for grazing. It has begun working with drones to get biomass estimates on the rangeland with the hope of using the information to adjust stocking rates and duration of grazing on an annual basis.

Far-fetched food science

Can 3D printing be used to create a steak in the future? Will consumers really buy “breathable” supplements and foods? It may sound far-fetched, but both ideas are being explored and could soon be reality.

In fact, AeroShot Energy is already in the marketplace with caffeine that can be inhaled. Created by Harvard University professor David Edwards, the product is already available in about 20,000 stores nationwide, including CVS. It comes in small plastic tubes with bright caps. Next up, the company is working on breathable vitamins and supplements — and breathable foods, like chocolate and pizza.

Modern Meadow, a company started by father-son duo Gabor and Andras Forgacs in 2011, is experimenting with 3D printing and tissue engineering to “print” animal products in hopes of addressing environmental, animal-welfare and food-shortage concerns.

They just might accomplish their goal. Five years ago the duo helped start Organovo, a firm that has found success making human tissue for pharmaceutical research and other medical applications.

Currently, they’ve focused on leather — with meat a longer-term project. They’ve already earned grants from the National Science Foundation (NSF) and USDA.

Additional food-science developments in the works include the WikiCell, an edible “nutritional skin” that eliminates the need for packaging on products such as ice cream, yogurt and juice; and Freight Farms, which converts shipping containers into stackable,

Waste not, want not

Making plastic from cow manure is another innovation being explored. University of Idaho civil engineers have developed a way to convert manure into a biodegradable plastic using naturally occurring bacteria to ferment the manure. The process results in the compound polyhydroxyalkanoate, or PHA. The biodegradable plastic can be used for planting pots for the nursery industry, plastic bottles, garbage bags and more. Once the plastic is thrown away, it can be fed to the bacteria again to make more plastic.

The Idaho researchers have been testing this process at the university’s small research dairy. They’ve found that 10 gallons of wet manure each day can be “recycled” into 2-5 pounds of plastic. The researchers see great potential for this untapped biomass resource.

modular mini-farms, reducing the footprint required for growing crops and allowing for locally grown produce in urban areas.

Also being monitored are AquAdvantage® Atlantic salmon, which could be the first transgenic animal product approved for human consumption in the United States. Created by circulating a growth hormone year-round, this species is quicker to produce and consumes less food per pound of product than wild salmon. These salmon are now in the advanced regulatory

Will consumers really buy “breathable” supplements and foods?

review process by the Food and Drug Administration (FDA).

Additionally, Enviropigs were developed with the ability to digest and metabolize natural phosphorus (P) in their feed, which is not common in non-genetically engineered swine. Enviropigs have a genome supplemented with a gene from *E. coli* that produces phytase exclusively in the salivary glands. The increased phytase production in these pigs will enhance the environment by decreasing commercial phytase production and limiting the excretion of undigested phosphorus. It is said to improve the health of the animal by improving nutrient utilization and bone strength.

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Is it legal to fly drones on your farm?

While the appeal of using unmanned aerial systems by farmers and growers to aid in farm operations is growing in popularity, before you launch a drone over your crops to gauge field conditions, be aware that doing so could result in a hefty fine from the Federal Aviation Administration (FAA).

So says Peggy Hall, assistant professor and Ohio State University (OSU) Extension field specialist in agricultural and resource law. Hall said that while the technology is available for farmers and growers to utilize drones for their farm operations, the rules on who can use it and how aren’t as clear.

“In this case, the technology is clearly ahead of the law,” she said. “While there are unmanned aerial systems (UASs) available for purchase by consumers, the regulatory system on their usage is still developing. ... At this point it’s still a gray area in the law.”

The FAA is expected to propose rules by the end of the year for drones weighing less than 55 pounds, which would typically be what most farmers would use for their farm operations, she says, noting that regulations for larger UASs will come later.

“At this point, the FAA doesn’t allow UAS usage for personal commercial operations, even on private land, without an FAA-approved certificate or waiver,” Hall says. “Hobbyists can operate drones for recreation without a certificate, while universities and other governmental agencies can operate UASs for research and development with approved certificates from the FAA that include where they can be flown. But the FAA considers all other drone activities as ‘commercial’ activities that are regulated, or will be regulated once FAA develops the regulations.”

Some people are using drones anyway and are facing fines by the FAA, Hall says. An example is the \$10,000 fine levied against a man who was hired to fly a drone aircraft over the University of Virginia in 2011. The FAA levied the fine against the man for making the “commercial” flight without FAA approval.

An administrative law judge who said the FAA doesn’t have the authority to issue such fines reversed the decision, but the FAA has appealed the case to the National Transportation Safety Board. Despite the initial ruling, the FAA has stated it intends to continue fining those who use UASs for commercial purposes without FAA approval, Hall said.

Farmers who want to operate drones on their farms may face these fines from the FAA, she warns.

— by Tracy Turner, OSU College of Food, Agricultural and Environmental Sciences

The commercialization of AquAdvantage salmon and Enviropigs could create opportunities to extend this technology into bovines.

Suburban agriculture

Perhaps you've heard of the movement toward urban agriculture — growing gardens and raising honeybees on rooftops and apartment buildings. Now, a new trend is emerging for the future — farms smack dab in the middle of suburban dwellings. The appeal? Those living in the “agriburbs,” have local foods — from vegetables, orchards and even livestock — right outside their doors.

It's marketed as an attraction to draw in homebuyers, increase property values and foster a sense of community. This trend has been dubbed “development-supported agriculture” or DSA. An extension of the local-food movement, it's a close relative of the community-supported agriculture (CSA) movement.

While the goal of CSA is to connect consumers directly with farmers, the idea behind DSA is more about land use. These communities seek to create a different and sustainable model of land use, bringing

urban and rural populations together, offering the housing developments necessary for a growing population while preserving agricultural land and farming.

Another goal pursued by some of the DSA communities is encouraging and aiding a new generation of farmers. Some developments create a kind of incubator program, with a percentage of proceeds from the real-estate sales helping to establish small farms and support new farmers.

An early example of these developments in North Carolina was called Harvest. This 213-acre “farm community” offered 19 homes, each with 10 acres of land. Homeowners were given the option of leasing their land to the independent group that manages the 10-acre central community farm.

The Bucking Horse is a DSA community currently under construction in Fort Collins, Colo. The development is expected to support more than 1,000 households. The

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development's vegetables, goats and chickens, subsidized by residents, will be produced on a 3.6-acre farm, and the development will hire a farmer to run it. A central plaza will house a farmers' market, and at the educational center, homeowners can learn skills such as canning.

A couple hundred lots have already been sold for this agriburb development project. The Bucking Horse also has a vision for education, according to its website: “The community gardens and farm-to-fork restaurant will teach today's kids how a seed in the ground becomes the food on their plate. Not only will the project allow us to teach society where their food comes from, the children of today will learn how nature can provide endless opportunities for fun and learning. . . . The project will reflect how plants, animals and people can live and coexist.”

The interest in this project shows that the future of agriculture most certainly will look different. There are opportunities — and value — in what farmers and ranchers do. The question is how might your farm or ranch evolve to meet, adapt and capitalize on some of these and other emerging trends?

