Rethinking Agriculture for a More Resilient Future

Across Japan's food system, four companies are showing how precision, sustainability and smarter infrastructure can make agriculture more efficient, adaptable and resilient for the future. *By Daniel de Bomford*

Japan's agricultural sector is entering a new phase of innovation, shaped by companies that are finding smarter, more sustainable ways to grow, raise and deliver food. Across the industry, advances in materials, data, water management and logistics are helping build a food system that is more precise, efficient and resilient. Japanese companies are working across that system, and together they show how agricultural innovation is creating new opportunities from the field to the farm to the distribution network.

At the input stage, JCAM Agri focuses on delivering nutrients to crops with greater control and less waste. Its coated fertilizers are designed to release nutrients when plants need them, rather than after they have already washed away or volatilized. That precision is now being paired with a push to reduce the coating's environmental burden. As CEO Hiroyuki Omote put it, "Other companies haven't yet developed sigmoid-type biodegradable coatings; we may be the only ones who can." JCAM's work suggests that the future of farm inputs will depend not only on performance but on how intelligently that performance is delivered.

"True innovation arises at the margins, not the center."

Rui Tanaka, CEO, Kakuichi

Kakuichi is approaching resilience from another direction: water, soil and system design. The company argues that agriculture cannot remain dependent on brittle, centralized models if it is to withstand climate shocks and long-term degradation. Instead, it is investing in technologies that improve oxygen delivery in soil and support regenerative farming practices. "We deliberately position ourselves slightly outside the mainstream. At first, people may say it is unconventional or even strange," CEO Riu Tanaka said. For Kakuichi, resilience begins by rethinking the conditions that make growth possible in the first place.

Eco-Pork applies the same logic to livestock. Rather than digitizing paperwork, the company uses AI, imaging and automation to measure animal growth in real time, helping farmers raise output while cutting waste and emissions. "Our purpose is to increase productivity through data-driven production management while simultaneously reducing environmental impact," said founder and president Takashi Kambayashi. In that sense, Eco-Pork is turning livestock farming into a more measurable and responsive system.

Farmind shows that innovation does not stop at the farm gate. In fresh produce, timing, temperature and consistency can determine whether value is preserved or lost. The company has built its business around cold-chain infrastructure and processing capacity that keep perishables moving efficiently across Japan's difficult geography. "Our cold chain technology is one of our greatest strengths," Tatsuo Horiuchi, president and CEO, said.

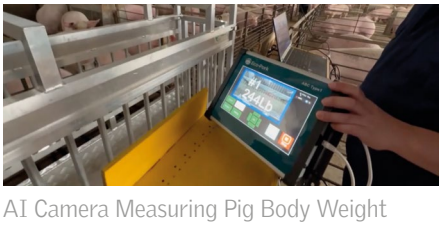
Together, these firms show that the future of agriculture will be shaped not by a single breakthrough, but by tighter control across the entire chain.

Data-Driven Technology Reshapes Global Pork

Eco-Pork is applying artificial intelligence and automation to pig farming, aiming to raise productivity while reducing environmental strain globally. *By Daniel de Bomford and Bernard Thompson*

In an industry often defined by thin margins and manual labor, Eco-Pork is betting that data can reshape how pork is produced worldwide.

Founded in 2017, the Tokyo-based company develops AI and automation systems for pig farming, an industry under growing pressure from labor shortages, rising feed costs and tighter environmental regulations. Rather than digitizing paperwork, Eco-Pork focuses on the production floor. Its AI cameras automatically count pigs and estimate weight using 3D imaging, eliminating the need for physical handling and giving farmers continuous, real-time data.



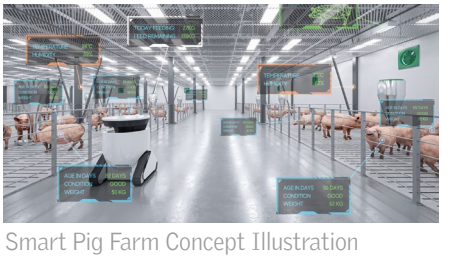
AI Camera Measuring Pig Body Weight

"Our purpose is to increase productivity through data-driven production management while simultaneously reducing environmental impact," founder and Representative Director Takashi Kambayashi said. "We're not just converting farmers' notebooks into digital formats." Farms using Eco-Pork's system average about 7 percent annual productivity growth, according to the company.

"Porker" Management Dashboard

That approach is gaining attention outside Japan. In 2025, Eco-Pork became the first Japanese company to exhibit at the World Pork Expo in Iowa, where its AI camera system drew interest from large U.S. producers focused on return on investment. The company is also working in Eastern Europe, having been selected for a UNIDO project to support the revival of Ukraine's pig farming sector through Japanese digital and green technologies.

At home, Eco-Pork is developing a fully automated "smart pig farm," where AI and IoT systems manage feeding, climate control and monitoring with minimal human presence. A demonstration farm is already operating in Aichi Prefecture, with commercialization targeted for 2028.



Smart Pig Farm Concept Illustration

For Eco-Pork, the goal is pragmatic rather than futuristic: produce more food with fewer inputs, while reducing emissions. As Kambayashi put it, the mission is "for pigs, for people, and for the planet."

"Our purpose is to increase productivity through data-driven management while reducing environmental impact."

Takashi Kambayashi, Founder and Representative Director, Eco-Pork.

Eco-Pork

www.eco-pork.com

JCAM Agri Advances Biodegradable Coated Fertilizer

JCAM Agri has moved its coated-fertilizer platform into a new phase: keeping the agronomic benefits of controlled release while reducing waste from the coating itself. *By Daniel de Bomford*

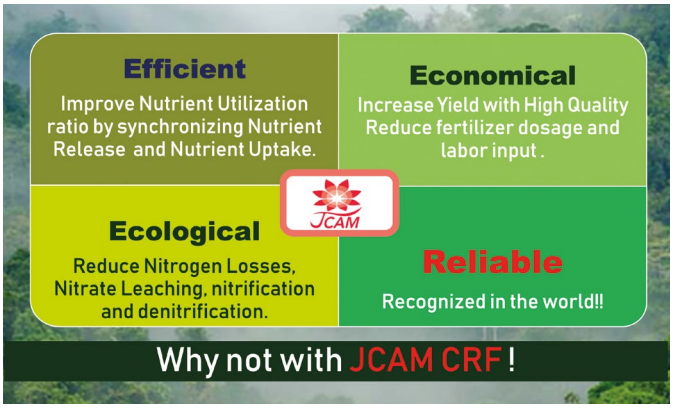
> "Other companies haven't yet developed sigmoid-type biodegradable coatings; we may be the only ones who can."
>
> **Hiroyuki Omote**, President and CEO, JCAM Agri

JCAM Agri works like a conductor for a silent orchestra in the soil, engineering fertilizer granules to release nutrients on cue, so crops get fed when they can use it. With J-Coat, the company is also dialing back the coating itself, cutting resin use while keeping controlled-release precision.

Fertilizer efficiency often comes down to one question: does the crop get nutrients when it needs them, or after they have already moved, volatilized or washed away? JCAM Agri's answer is controlled-release fertilizer, where the surface of each granule is coated so nutrients are delivered on a designed schedule. President and CEO Hiroyuki Omote explained it simply: "Our fertilizers are coated with resin-based membranes that precisely control nutrient release."

That control can be dialed in across seasons and crops. "These products can be engineered to release nutrients over anywhere from 20 to 700 days," Omote said. Instead of chasing growth stages with repeated applications, farmers can match nutrient availability to plant demand in fewer passes, which matters in regions facing labor constraints.

JCAM also points to a technical distinction that is increasingly important as growers look for precision, not just slow release. "We can design two release profiles: a linear release type ... and a sigmoid type," Omote said, describing a curve that "delays release for a set period before initiating a rapid release." Omote added that "We possess world-class coating technology and with particularly strong advantages in sigmoid-type release control performance. The sigmoid-type release pattern matches the nutrient demand characteristics of many crops, enabling optimal fertilization effects, which is one of the company's strongest differentiators."



Oil Palm

A New Coating With Less Plastic: J-Coat

Controlled-release fertilizers have traditionally relied on plastic resins, which have put coated fertilizers under growing scrutiny. In response, JCAM Agri developed J-Coat, a product designed to reduce resin use while keeping comparable release control. "J-Coat is a newly developed coated fertilizer that uses 40 percent less resin compared to our previous LP Coat and M Coat products," Omote said.

JCAM Agri said conventional coatings contain about 50 percent plastic, while J-Coat reduces it to about 30 percent. J-Coat is also designed with water environments in mind. The coating capsule is less likely to rise to the surface of the water, which can help suppress runoff from paddy fields to rivers, lakes and the sea. "J-Coat coatings are more fragile and break down more easily, meaning they don't remain intact and don't float into water systems," Omote said.

Moving From Reduction to Biodegradation

JCAM Agri is clear that plastic reduction is not the end point. "While J-Coat has reduced plastic, it still doesn't meet EU regulatory requirements," Omote said. "For European markets, we are now developing a fully biodegradable version."

The company has made lab-stage progress on biodegradable resin coatings with release control functions comparable to conventional products for some brands. Omote said that the work is moving toward scale: "We've made progress at the laboratory level and are now working toward industrial-scale production." The goal is ambitious but specific: "We aim to have it in widespread use by 2030."

Paddy rice

For growers, the promise is practical: fewer applications, more predictable feeding and coatings designed to align with both agronomic needs and environmental expectations. For JCAM Agri, J-Coat is the step on the market today, and biodegradable coatings are the next step already under development.

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Water, Soil and the Future of Farming

For 140 years, Kakuichi has worked alongside Japanese agriculture—starting with irrigation hoses and expanding into broader on-farm infrastructure, where water is central. *By Cian O'Neill*

Retrofit nozzle for nanobubble generation

Across the world, farmers are facing a quiet but profound crisis: soil is losing its ability to breathe.

Decades of intensive agriculture have compacted soils, reduced microbial life and increased reliance on chemical fertilizers. Crops may still grow, but the underlying system is becoming fragile—less resilient to drought, extreme weather and global supply shocks.

In this context, a Japanese company with more than 140 years of agricultural history is exploring a deceptively simple question: What if improving agriculture begins not with chemicals, but with water itself?

Kakuichi's roots: Founded 1886

From Irrigation Hoses to Regenerative Systems

Founded in 1886, Kakuichi Co., Ltd. has maintained close ties with farmers across Japan and has grown alongside them. Deeply rooted in the company's long history is a fundamental principle of mutual prosperity: the belief that true development is only achieved when farmers, society and the natural environment thrive together. As a manufacturer of irrigation hoses, the company's role has expanded beyond simply supplying equipment to include supporting the development of farm infrastructure where water plays a central role.

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> **Riu Tanaka**, CEO, Kakuichi

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For CEO Riu Tanaka, the company's long history offers a unique vantage point.

"Water touches every part of agriculture," Tanaka said. "Where it flows, life follows. If we change how water behaves in soil, we can change how farming works."

That perspective has led Kakuichi to focus on micro/nanobubble technologies—tiny gas bubbles suspended in water that can significantly alter how oxygen moves through soil.

What happens when water changes?

In conventional irrigation, water is supplied to the soil, but much of the dissolved oxygen escapes immediately. If the soil is compacted, this leaves the roots struggling in an oxygen-deprived environment. Micro/nanobubbles behave differently.

Due to their extremely small size and unique surface properties, micro/nanobubbles remain suspended in water for much longer than ordinary bubbles. This allows oxygen to penetrate deep into soil pores, improving aeration around plant roots and triggering biological benefits such as increased microbial activity.

In fact, field trials conducted with Japanese rice farmers have already demonstrated these precise effects. Most notably, the enhanced oxygen environment promoted robust root growth, increasing dry root weight by an average of 20 percent alongside significant fine root development. This improved root respiration directly translated to

Establishing KAKUICHI Ukraine, 2025

better nutrient absorption, with phosphorus and magnesium uptake in the soil increasing by approximately 37 percent and 63 percent, respectively.

As this technology continues to evolve through real-world applications, its impact is already undeniable. Altering the physical behavior of water holds the power to transform the entire soil ecosystem.

Soil Health: A New Frontier in Agriculture

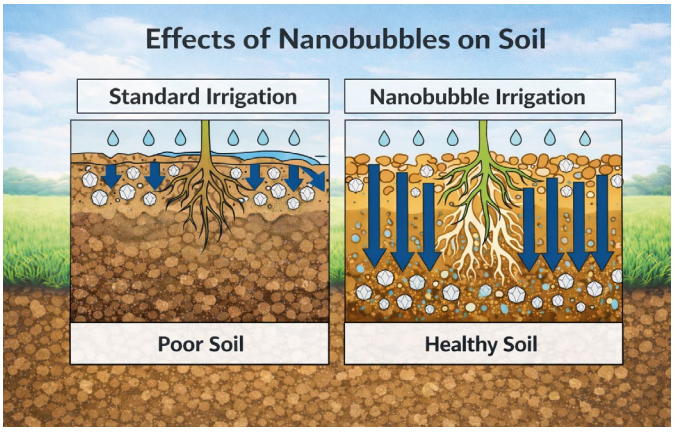
Globally, soil degradation has become one of the most serious threats to food production. According to international agricultural organizations, nearly one-third of the world's soil is suffering from moderate to severe degradation. Soil compaction, erosion and the overuse of chemicals are reducing the soil's biological vitality.

Tanaka believes the solution lies in restoring the physical and biological balance of the soil. "Plants need carbon dioxide, but roots need oxygen," he said. "If the soil cannot breathe, agriculture is forced to rely on chemicals to compensate for this deficiency."

By increasing the supply of oxygen in soil water, nanobubble irrigation has the potential to revitalize the microbial communities that play a crucial role in nutrient cycling. This aligns with a broader global movement toward regenerative agriculture, which prioritizes soil health, biodiversity and resilience.

A New Challenge: Regenerating the Soil in Ukraine

In recent years, these initiatives led by Kakuichi have begun to expand beyond Japan. In Ukraine, one of the world's leading grain-producing nations, years of conflict have damaged agricultural infrastructure and left vast tracts of farmland in ruins. Heavy metal contamination, soil compaction and dysfunctional irrigation systems pose significant challenges to restoring agricultural productivity.



Revitalizing soil with nanobubbles

When Tanaka visited the country, he saw an opportunity to explore new approaches to agricultural recovery. "Recovery isn't just about rebuilding infrastructure," he said. "It's also about regenerating the land itself." As part of a broad effort to revitalize soil ecosystems and improve water use efficiency on damaged farmland, research is underway on irrigation systems that utilize micro/nanobubbles.

Toward a Circular Food System

Kakuichi is exploring a holistic approach to make agricultural systems fully circular. In Japan, experiments are currently underway to integrate crop cultivation with livestock farming. This creates a regenerative, closed-loop model on the production side, in which animal waste from pig farming is processed into clean energy and compost, returning vital nutrients to the soil.

Crucially, Kakuichi is now taking this vision beyond Japan, having begun discussions with partners to deploy this model in Ukraine. Here, the system is not just about environmental sustainability; it reimagines the entire agricultural value chain.

As one of the world's leading grain producers, Ukraine typically exports raw crops as commodities. By channeling those locally grown grains into local livestock farming instead, the harvest is effectively "upcycled" into higher-value products like pork. This economically viable, circular model provides a highly resilient blueprint for the country's recovery—boosting profitability while simultaneously regenerating the soil.

"In the future, agriculture must combine both productivity and resilience," Tanaka said. "That means reconnecting the cycles between soil, crops, animals and energy."

A Paradigm Shift in Every Drop

For over a century, irrigation has focused simply on supplying moisture to crops. However, Kakuichi's approach suggests a much grander possibility. The true genius of this technology lies in its simplicity. Water and oxygen are fundamental elements already present in nature. Kakuichi is not adding anything artificial; rather, by introducing a microscopic physical shift—simply altering the size of a bubble—they are unlocking the maximum potential of these existing elements.

Sharing nanobubble technology expertise

Through this tiny shift, water itself becomes a dynamic catalyst for regeneration. If we can control the structure of water—its oxygen content, the dynamics of its bubbles and its interactions with soil microorganisms—irrigation becomes more than just replenishing moisture; it becomes a powerful tool for restoring entire soil ecosystems.

Tanaka views this shift as part of a larger transformation. "The most important innovations often begin on the fringes of the mainstream," he said. "True change rarely happens simply by doing the same thing just a little better. Sometimes, it starts with asking a different question."

In this case, that question might be a simple one.

What if the key to saving our soil lies not in the earth, but in the water?

Vision for Ukraine's soil recovery

Ultimately, there is a phrase that perfectly encapsulates Kakuichi's guiding philosophy of collective well-being. It is a passage from *An Outline of Peasant Art* by Kenji Miyazawa, one of Japan's most renowned poets and agricultural teachers: "Personal happiness cannot exist until the whole world is happy."

Their challenge to heal the soil and regenerate the earth's ecosystem is nothing less than an attempt to embody this very ideal in modern agriculture.