



# FOOD 4.0: LEVERAGING FOOD INNOVATION IN ASIA

Written by



## Foreword

### Harnessing innovation to strengthen our food system

Innovation in our food system comes in various forms.

On one end of the scale we have disruptive technologies and there are some fascinating innovations we are seeing across the supply chain. For example, one technology that always intrigues people is facial recognition for cows. Through careful analysis of individual cows coupled with AI, a dairy farmer is able to anticipate issues and adjust his operations to enhance animal health, improve efficiency, and increase his profitability. We are applying or exploring other incredible technologies for application to areas like cultured meat, insect proteins and more. One example is acoustic technology that tells aquaculture farmers when to feed their shrimps.

On the other end of the innovation spectrum, we find more basic technologies like irrigation systems, inter-cropping, mobile financing and such. In Asia, where a majority of farmers are smallholders, even these basic technologies applied en masse could tip the scale into making farming more attractive and subsequently strengthen our food system.

Technology, whether basic or cutting-edge, will be key to improving efficiency, which in turn will impact all the processes along the supply chain and beyond. Ultimately though, our ambitions are simple. Give the farmer and his family a decent living; give people affordable, safe and nutritious food; and make agriculture and food supply chains sustainable. We sincerely hope this research series with The EIU will help drive more conversations and collaboration in the industry to make these goals a reality.



Peter Van Deursen  
CEO, Asia Pacific  
Cargill

### About the research

Food 4.0 is part of *Fixing Asia's Food Systems*, a five-part research programme commissioned by Cargill. The research is based on two surveys conducted in November 2017 and March 2018 of a total of 820 industry leaders in the region, and expert interviews.

We would like to thank the following experts for contributing their time and insights:

- Yuki Hanyu, founder of Integriculture
- Matthew Morell, director general of IRRI

This report was written by Adam Green and edited by Rashmi Dalai. HuiQi Yow also provided editorial support.

## Food 4.0

As Asia's food producers aim to meet the demands of a growing population, they are also fighting against the "four horsemen" of climate change: increasing temperatures, decreasing rainfall, extreme adverse weather events and the environmental consequences of decades of intensive land use.

While these challenges pose a serious threat to the region's food supply, they also create opportunities for innovation—from gene editing and laboratory-grown meat to crop surveillance by drones and satellites. Food companies, scientists and farmers in Asia are adopting agricultural innovation to support their markets.

How regional players are innovating to overcome Asia's challenges holds lessons for global audiences. To examine their views and approaches, the EIU surveyed agriculture and food executives in China, India, Indonesia, Malaysia, the Philippines, Singapore and Thailand.

### Cultivating food in the lab

Food fortification has long been an innovative way to improve the nutritional value of food in Asia. The Golden Rice project was developed in the 1990s to fortify rice with beta carotene to address vitamin A deficiencies. Today, organisations like the Philippines-based International Rice Research Institute (IRRI) are developing rice varieties to further deliver important micro nutrients such as zinc and iron. Support for fortification is high in part because of food regulations in Asian markets; a majority (76%) of survey respondents state that regulatory policies mandating food fortifications exist in their countries.

Genetic science has also long been used to solve foundational growing problems where field-based interventions fall short. The IRRI has incorporated SUB1, the gene related to flood tolerance, into popular rice varieties. Studies show these have a yield advantage of one to three tonnes per hectare following ten to 15 days of flooding. Matthew Morell, director general of IRRI, says they are being planted across Asia.

These kinds of innovations need to continue, argues Mr Morell, especially as scientists cite rice's increasing vulnerability to climate change and rising methane emissions.<sup>1</sup> "Rice breeders urgently need to develop new and sustainable varieties with higher yield, healthier grains and reduced environmental footprints," he says.

However, genetically modified (GM) foods—in which foreign DNA has been introduced into a plant to modify particular attributes to improve yields—have drawn many critics and restrictive regulations.

The gene editing method, Clustered Regularly Interspaced Short Palindromic Repeats, otherwise known as CRISPR-Cas9 or CRISPR for short, could offer new hope. CRISPR introduces genetic mutations into a plant rather than foreign DNA. US companies have already leveraged this technique

<sup>1</sup> Rice agriculture accelerates global warming: more green-house gas per grain of rice <https://www.sciencedaily.com/releases/2012/10/121021154455.htm>

to create drought-resistant corn and wheat, and to lengthen the shelf-life of potatoes. South Korean researchers are investigating the editing of plant genes including lettuce and rice.

CRISPR can also be used to support Asia's rising demand for protein. As the population's tastes and budgets shift towards more protein-rich foods, producers must meet the demand while mitigating the environmental damage industrial-level livestock breeding can bring. In China, scientists have already used CRISPR to create a new breed of pigs with leaner body mass. These animals are more resilient to cold temperatures and less expensive to raise.<sup>2</sup>

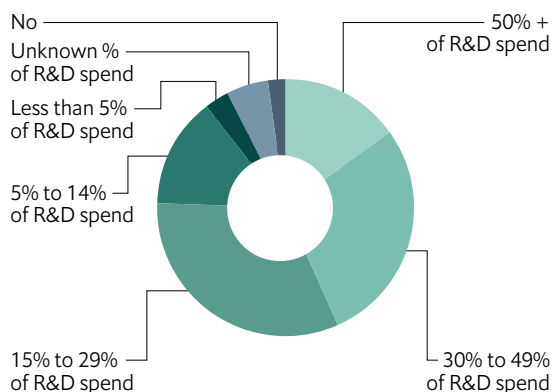
Some researchers in East Asia are seeking to create alternative protein sources separate from animals altogether—clean meat. This is an effort in which they are competing with companies in the US, Europe and Israel. The principle is simple, says Yuki Hanyu, founder of Japanese clean-meat company, Integriculture. “You take cells from living animals and grow the cells in a tank, in a cultured medium.” This process, known as cellular agriculture, allows for the growing of real animal meat in a lab without the costs of raising livestock.

While still in research and development (R&D), clean meat could become a mass market product as early as the 2020s, Mr Hanyu says. The market drivers are a combination of food security concerns and increasing sensitivity to animal rights. Consumers might not bite at first over fears of curious ‘Frankenmeat’, but it’s all down to taste and price, Mr Hanyu says. “Once the right price is reached, most consumers will probably go for clean meat”.

Further, he sees an important threshold ahead —when alternative proteins become one third of the protein market, giving consumers real power to choose other meat sources. At this point, he predicts, more robust criticisms can and will be made of the conventional market. “Slaughter meat [may] even being outlawed eventually” on the grounds of unnecessary cruelty, Mr Hanyu says.

**Figure 1: Investing in the future**

Does your organisation have dedicated budget allocated to food and agriculture-related innovation?



<sup>2</sup> DNA-free genome editing in plants with preassembled CRISPR-Cas9 ribonucleoproteins <https://www.nature.com/articles/nbt.3389>

## Seeding innovation

Government incentives, in the form of both carrots and sticks, have a large role in shaping food innovation decisions. Eighty-six per cent of survey respondents indicate that fiscal incentives to encourage food R&D exist in their core Asian markets. A further 78% confirm the presence of government-funded crop science research and 85% note government support for training and education programmes for farmers. Deterrents include penalties for environmentally harmful production methods, with a majority saying these also exist in their markets.

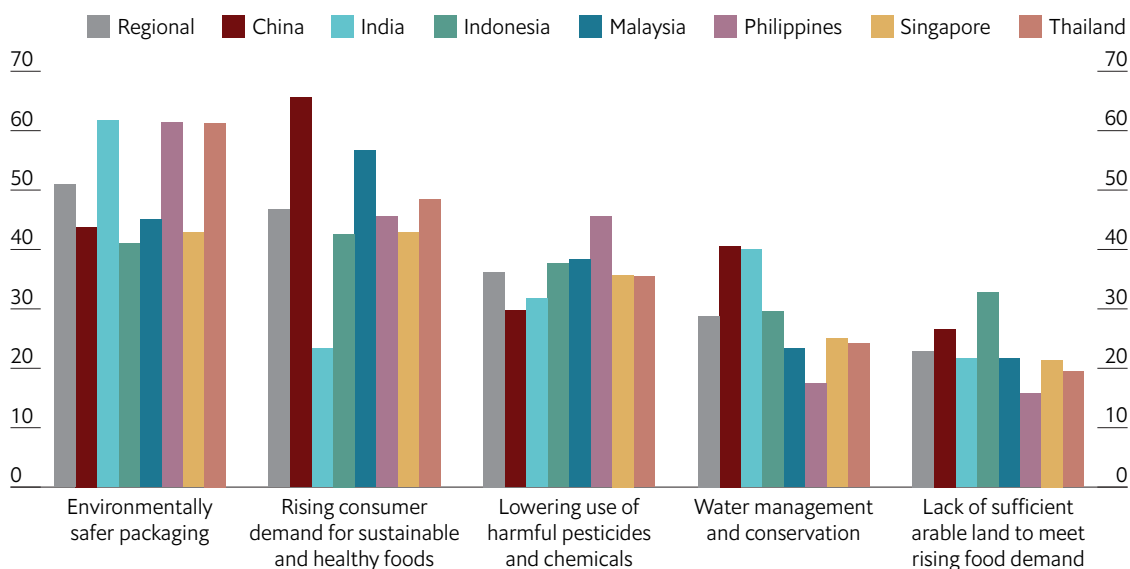
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Companies are important investors in food innovation as well and, according to survey data, most are financially engaged in the effort. Seventy-five per cent of companies surveyed say they spend more than 15% of their R&D budget on food and agriculture-specific innovations.

Tackling environmental and health issues rank at the top of companies' focus. The number one priority for R&D dollars is environmentally safer packaging, with 51% of respondents marking it as a top priority. How foods are produced also grabs significant attention as meeting consumer demand for sustainably sourced and "healthy foods" is a central issue for 48% of respondents. Lowering pesticide use is a third priority. The issue is most prominent in the Philippines where it ties as the second-biggest innovation objective for executives in the country. An outlier is China—where the need to meet rising consumer demand for sustainable and healthy foods is seen as most urgent.

**Figure 2: Seeding innovation**

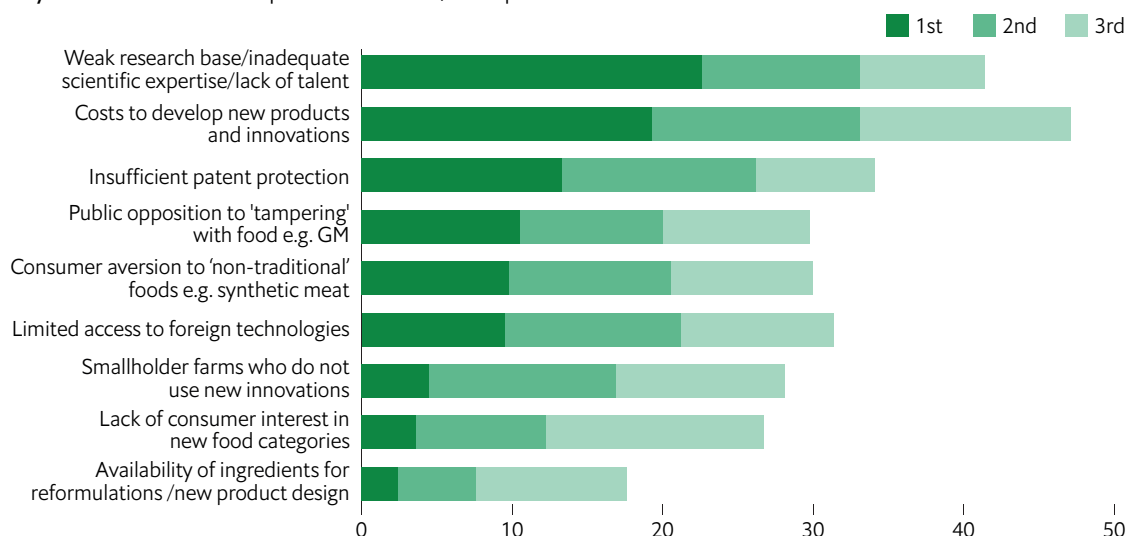
Which of the problems should food innovation focus on addressing? Top five responses; %



However, food producers face a wide range of obstacles to progress. In identifying their top three challenges, survey respondents cite innovation development costs, a weak research base, and insufficient patent protection as foremost.

**Figure 3: Impediments to growth**

What are the biggest obstacles to food innovation (agricultural production, or food product development) in your core market/s? Top three obstacles; % respondents



## Leveraging simplicity

High-tech innovation gets headlines, as well as the imagination of entrepreneurs. (Mr Hanyu says he initially wanted to work on space travel before ultimately going into the clean meat business).

Technological breakthroughs are not the only form of innovation that can benefit Asia though. Some solutions are simple, easy to roll out and immediately useful. The approach of climate-smart agriculture, for instance, deploys low-tech tactics like cover crops and shade management to deflect heat. Intermittent irrigation strategies lower water and energy use. Adaptive crop calendars can leverage the improved quality and accessibility of meteorological data.<sup>3</sup> Such approaches are especially important for smallholder farmers who lack the financial resources to deploy more advanced techniques.

Simple mobile-based innovations can also help the other end of the food cycle: waste. Much of the dialogue around food innovation suffers from a “productionist” bias where the most common solution to food insecurity is increased production,<sup>4</sup> but cutting food waste can go a long way to closing nourishment gaps. In cities across Asia, apps now connect large-scale food buyers (and wasters) such as hotels, supermarkets and restaurants with non-governmental organisations (NGOs) that can distribute food to the needy. One such app in Singapore, 11th Hour, shows users discounted menu items at restaurants and food stalls before closing. In India, No Food Waste allows entities with large quantities of waste to notify groups that collect and distribute food to slums, orphanages and the elderly<sup>5</sup>.

<sup>3</sup> Rice yields and water use under alternate wetting drying irrigation: A meta-analysis <https://www.sciencedirect.com/science/article/pii/S0378429016307791>

<sup>4</sup> “Feeding 9 billion people”: global food security debates and the productionist trap <https://www.tandfonline.com/doi/abs/10.1080/13501763.2017.1334084>

<sup>5</sup> <https://www.theguardian.com/sustainable-business/2017/feb/06/food-waste-apps-global-technologyleftovers-landfill>

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However, the success of these innovative efforts lies as much in new technologies as stakeholders' abilities to coordinate and work together. Given the complexity of the landscape ahead, it will take the combined efforts of scientists, entrepreneurial start-ups, food companies and governments to create the food 4.0 the world needs—human nutrition that is sustainable, less wasteful, and meets consumer demands.



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