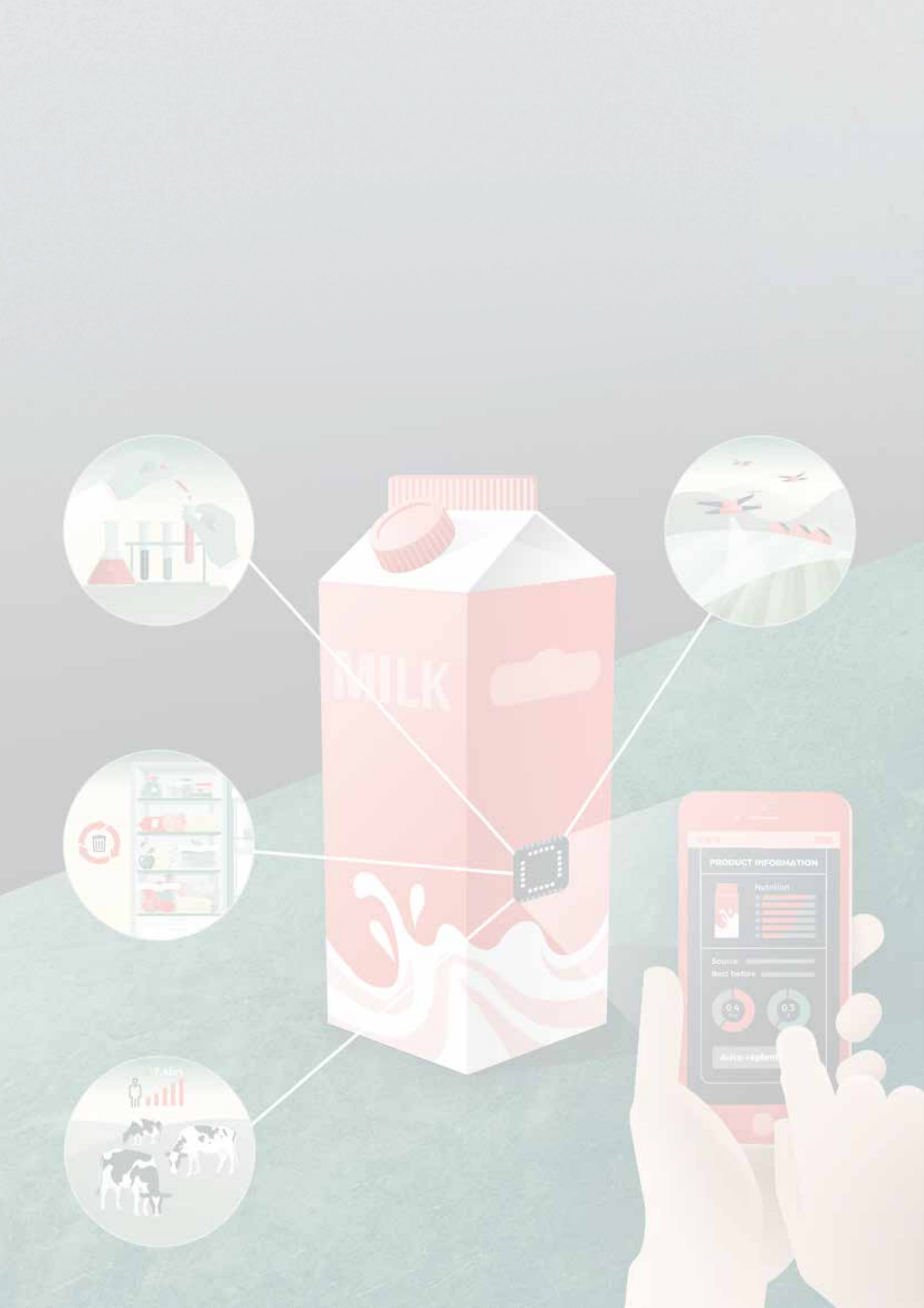
RACONTEUR

Future of Food & Beverage


MILK
PRODUCT INFORMATION
Nutrition
Source
Best before

From plantburgers to cutting food waste: how to feed the next billion

Innovation needed to nourish an extra 83 million people a year

LED lighting can power city farms close to where food is consumed

THE BIG PICTURE

Alison Coleman

As the world population grows and becomes more affluent, and as consumers become more fickle, the food and beverage industry is facing new challenges. The response is a slew of innovations, from fish protein grown in the lab to smartphone apps that can tackle the global scourge of food waste.

According to the United Nations, world population growth is currently running at 83 million people a year - meaning there will be more a billion more people to feed in just 13 years.

Steve Pinder, managing director at Kurt Salmon, part of Accenture Strategy, said: "Applying technology to production efficiency can help immensely."

"The use of digital solutions and advanced data analytics improves yields, cuts costs and increases crop resilience. Precision agriculture uses digital solutions to improve monitoring and optimise inputs, boosting profitability. Drones and robotics can further reduce labour and energy intensity with remote and automated crop monitoring."

A number of tech startups are expanding the food base by creating it in the lab, engineering artificially-created meat protein to taste like the real thing. California-based Impossible Foods, which is developing plant-based "meat" that it says has the "craveable depth of beef" but with needing just 5% of the land - raised $75 million over the summer from investors including Bill Gates and Singapore's Temasek.

However, Daniela Walker, insight editor at London-based futures consultancy The Future Laboratory, says growing cells of land animals is energy intensive because they need to be cultured at high temperatures. She

raconteur digital

In partnership with IFS

Head of publishing
Richard Hadler

Guest editor
Gren Manuel

Digital content manager
Elise Ngobi

Production editor
Ben Chiou

Design
Elisabetta Calabritto
Grant Chapman
Kellie Jerrard
Samuele Motta

Contributors

Adrian Bridgwater
Specialist author on software engineering and application development, he is a regular contributor to *Forbes* and *Computer Weekly*.

Alison Coleman
Writer and editor, she is a contributor to *Forbes, The Guardian, The Telegraph, Sunday Telegraph, Economia* and *Employee Benefits*.

Charles Orton-Jones
Award-winning journalist, he was editor-at-large of *LondonlovesBusiness.com* and editor of *EuroBusiness*.

Nick Easen
Award-winning journalist and broadcaster, he writes on science, technology, economics and business.

Green revolution: this perfect lettuce has never seen sunlight

believes a solution could lie in lab-cultured fish, currently being pioneered by US biotech company Finless Foods.

"Unlike meat, fish, being cold-blooded, can be cultured at room temperature," she says. "The structure of a fish fillet is also much simpler than beef. Finless Foods are aiming to be in market in two years. With 80 per cent of the fisheries in the world in peril, this could also be big news for the fish market."

Other innovators are developing more traditional plant-based proteins. Aylesbury-based Huel, for example, mixes protein from sources that include brown rice, oats, flaxseed and peas to produce a "nutritionally complete powdered food" that, it says, could replace all other foodstuffs in someone's diet.

The drive to reduce usage of conventional meat is because it uses so much space – beef production requires 20 times more land per unit of edible protein than common plant-based protein sources such as beans, peas and lentils. Rapidly growing urban populations, and shrinking availability of agricultural land have left farmers struggling to meet demand.

Nimble food tech start-ups can often respond to trends better than large firms

One innovative solution would be vertical urban farming. Here companies take over brownfield sites in cities and towns, and grow crops vertically, all indoors, without sunlight. The lighting division of Dutch industrial giant Philips, for example, has dedicated an entire portfolio of its business to making energy-efficient LED lights that can replicate sunlight and allow these indoor farms to produce a higher yield of crops than traditional farms – and do it all year round.

Producing more food is no good, however, if it's wasted. The United Nations Food and Agriculture Organisation currently estimates about a third of the food produced for humans is never eaten, with every step of the food journey from harvesting through transport, processing, retail and home storage creating waste.

Pinder of consultant Kurt Salmon says technology can help, but "truly moving the needle involves educating consumers on everything from eating 'ugly fruit' to better utilising 'use by' dates."

"As more food producers deploy circular, sustainable business models, such as food sharing platforms and

upcycling, innovation in food waste will continue to improve efficiency."

Local initiatives can play a part. At Brighton-based bakers Bagelman waste is being turned into profits. The growing bagel bakery business converts leftover bagels into a craft beer. They have started working with other local food waste charities to divert more would-be waste into brewing.

Another initiative that could reduce waste at the local level is Snaxchange, an app that connects those in need with those with food to spare that would otherwise be destined for the dustbin. It uses a simple exchange platform where people with a food surplus can list unwanted items and set a fair price. Users with small budgets, or who only need a small top up on food items can browse the site for nearby sellers to find what they need for a fraction of the cost of buying from a supermarket.

85m
people per year world population growth

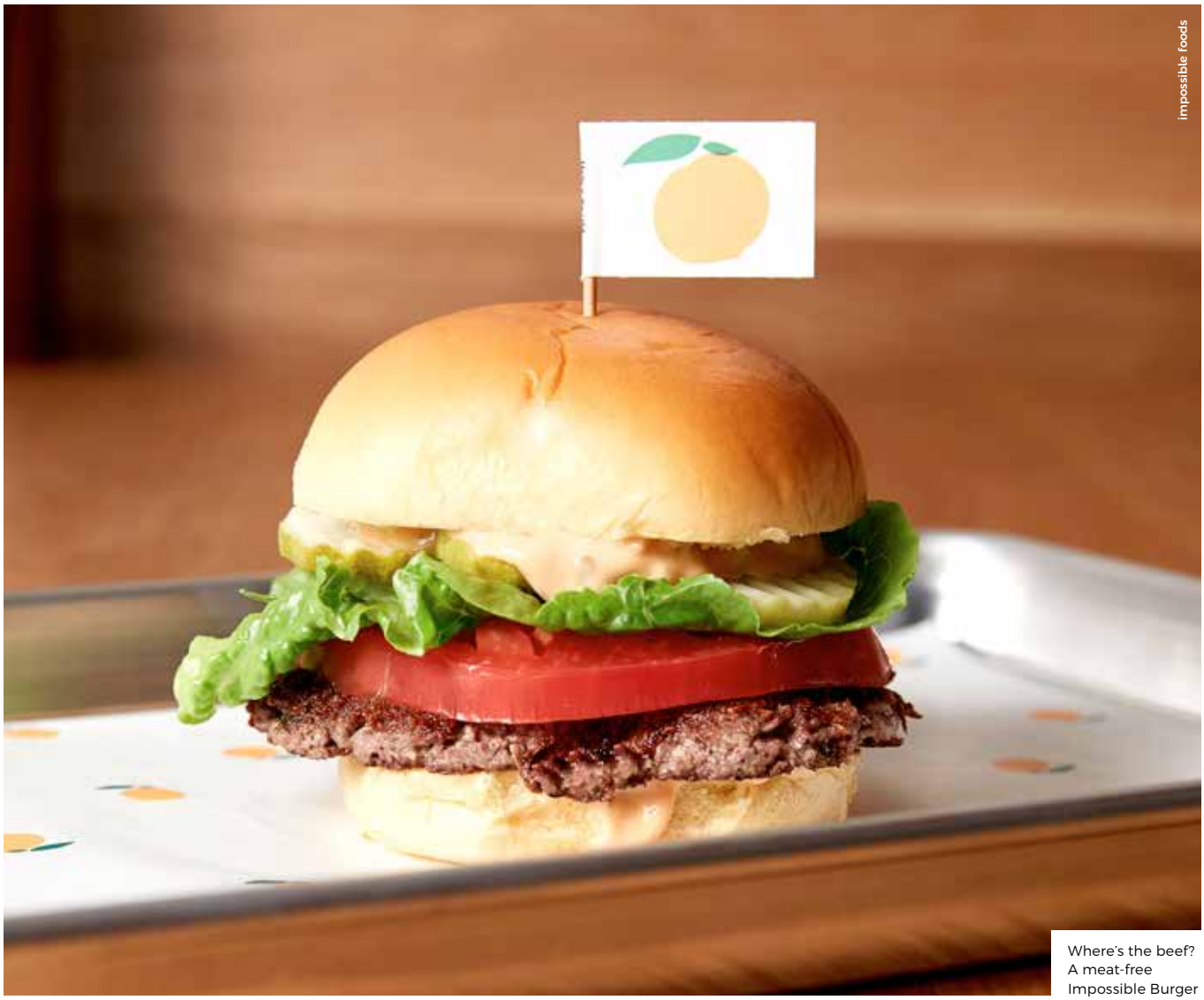
1bn
more people worldwide to feed in just 13 years

20x
more land per unit of edible protein required from beef production than common plant-based protein

As in many areas of business change, the small, nimble food tech start-up is better able to respond to burgeoning consumer trends than the larger companies with deeper pockets to invest in product development.

Trefor Griffith, head of food and beverage at Grant Thornton UK, says the UK has a long-established global reputation for innovation in the food and beverage sector, citing Nakd, Trek, Urban Fruit, and Sipsmith gin as innovators that have been snapped up by foreign firms wanting to add innovation to their portfolio.

He adds: "A growing number of food and beverage giants, such as Diageo, Unilever and Nestle, are also setting up their own investment arms or forming strategic alliances with other investment vehicles, specifically to invest in innovative start-up entities with a reduced risk methodology."



Where's the beef? A meat-free Impossible Burger

AI promises a food revolution, from farm to supermarket

From growing herbs to predicting fresh food demand, AI could yield big gains

ARTIFICIAL INTELLIGENCE
Charles Orton-Jones

What is the best way to grow basil? Pop a seed in compost, add water, and leave in the sun is the normal method. If you want to get serious then the Royal Horticultural Society lays down time-honoured tips like planting in February, and using 7.5cm of compost. Move your pots outside when the danger of frost is gone.

But if you want to get really serious? Then it's time to bring in artificial intelligence. Academics at the Massachusetts Institute of Technology are working with Silicon-Valley based Sentient Technologies to build an AI lab for growing the best basil in the world. Testing takes place over multiple generations of basil. Each is grown under strict conditions. Risto Miikkulainen, vice president of research at Sentient, explains: "Elements like UV light, salinity, heat, water stress, and more are controlled in these experiments and the crop yield is analysed."

Then comes the AI bit. "First, when the number of samples is small and only a few actuators are varied, Gaussian processes can be used to predict what the outcome would be given a new recipe, and Bayesian optimisation used to create suggestions for good recipes. Later on, as the dimensionality and number of samples grow, we use a neural network as the model, and evolutionary algorithms as the optimization method."

Slowly the links between growing conditions and the final plant become apparent. Miikkulainen says: "The AI has already rediscovered a known trade-off between weight and flavour, and a surprising new result that perpetual light may help some plants produce more flavour."

Using AI and robotics, smart farm equipment will help farmers produce 70 percent more food by 2050

Open Agriculture Initiative, MIT Media Lab

Budimir Jevtic / Shutterstock

Above Drones are already in use for crop monitoring

Left The Personal Food Computer v2.1: Open Agriculture Initiative, MIT Media Lab

This is just one of the countless ways AI is changing food and drink. Some data suggests the industry will be affected by AI more than many others. Accenture calculates that AI has the potential to raise productivity across the advanced world by 40 per cent by 2035, but agriculture will outperform with a 53 per cent increase.

Take farming methods. Drones are used to scan fields to monitor crops. Self-driving tractors and combine harvesters trundle round fields without human involvement. Trevor Wood, group algorithm leader at engineering and technology experts Cambridge Consultants, says "there are opportunities in using AI making more complex decisions around, for example, crop choice to give the optimal yield based on the data available for a particular field."

The University of Lincoln is creating a fleet of robots to pick fruit and veg. The University's Lincoln Institute of Agri-food Technology has created a fleet of transporters modelled on the Mars lander. A fully automatic broccoli-picking robot uses AI connected to a 3D camera to guide picking machinery with a soft, gentle touch to pluck each stem with minimal damage. At present almost all broccoli has to be picked manually; the machine may help farmers replace some of their 85,000 seasonal pickers, roles which may be hard to fill after Brexit.

In the food retail sector, AI is commonplace. Morrisons works with algorithm specialist Blue Yonder to automate product ordering for its supermarkets. Blue Yonder tracks sales data and then crunches hundreds of other variables, from weather to football fixtures, to gauge exactly how many courgettes and turnips to put on the shelves. The process automates the stocking of 26,000 ambient and long-life products in 491 stores. Morrisons reports shelf gaps are down 30 per cent and stock holding in store is down by two to three days. Staff are freed up from the arduous task of processing order numbers. It's a marvellous example of how AI can improve the performance and bottom line of a food and drink retailer.

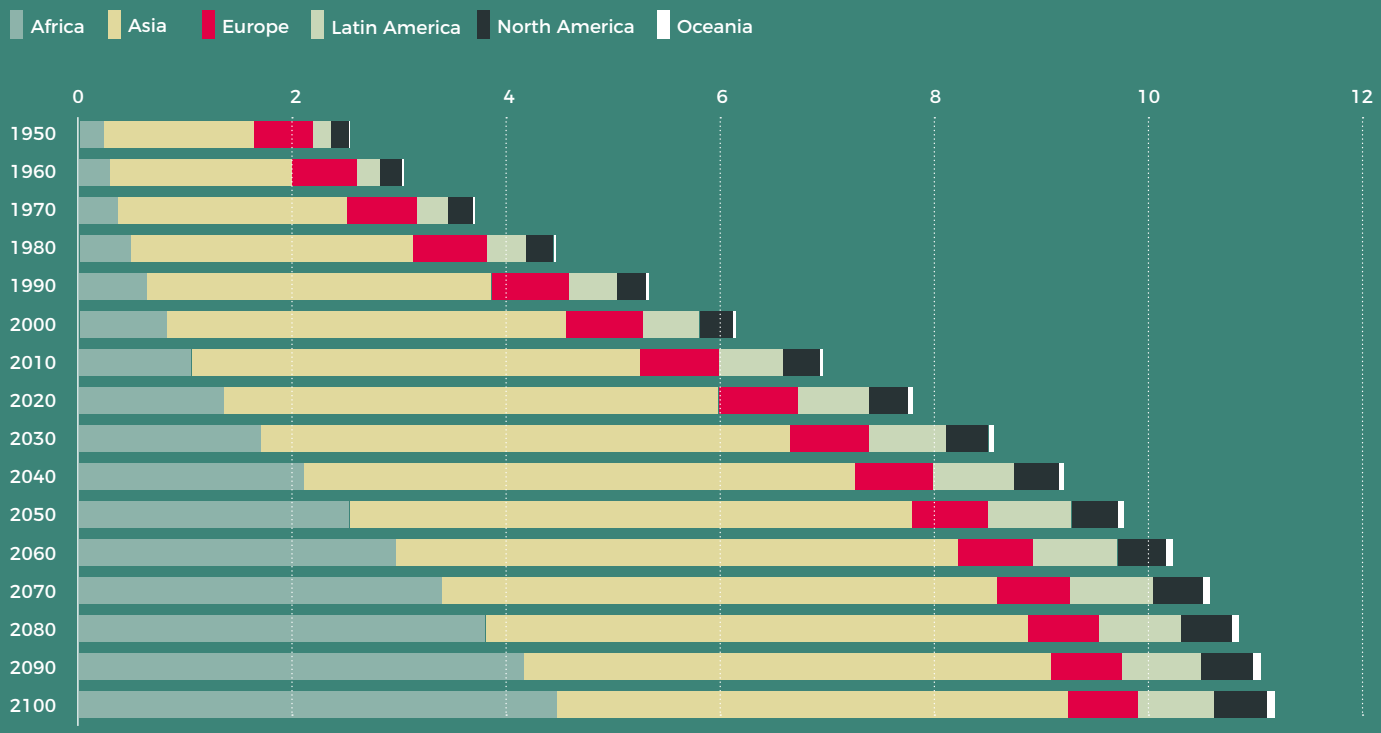
Complex handling is increasingly done by robot arms. Orkla, a consumer goods company mostly operating in the Nordic and Baltic regions is installing a range of Yumi robots, made by ABB. These dexterous robot arms are controlled by AI and can package and sort confectionery products many times faster than humans.

The impact of AI on food and drink will be immense. Chip-maker Intel says the combination of sensors, robotics, and AI will produce a leap in production: "Using AI and robotics, smart farm equipment will help farmers produce 70 percent more food by 2050 — to feed an ever-increasing world population."

Higher yields, less waste, cheaper harvesting, and of course, tastier basil: just a few of the outcomes of artificial intelligence in the food industry.

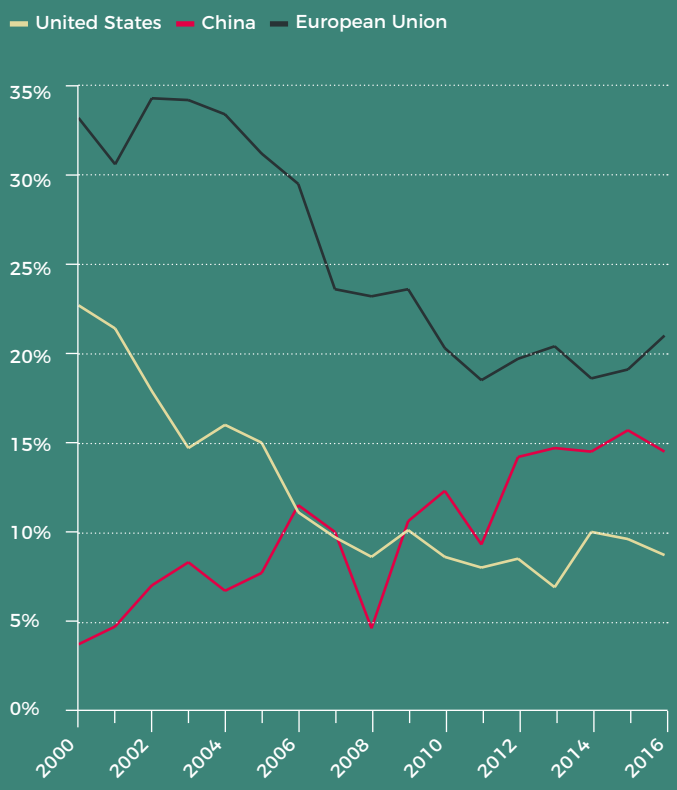
Feeding the world

GLOBAL POPULATION ESTIMATES (Bn)
Data for 2016 onwards under medium variant projections

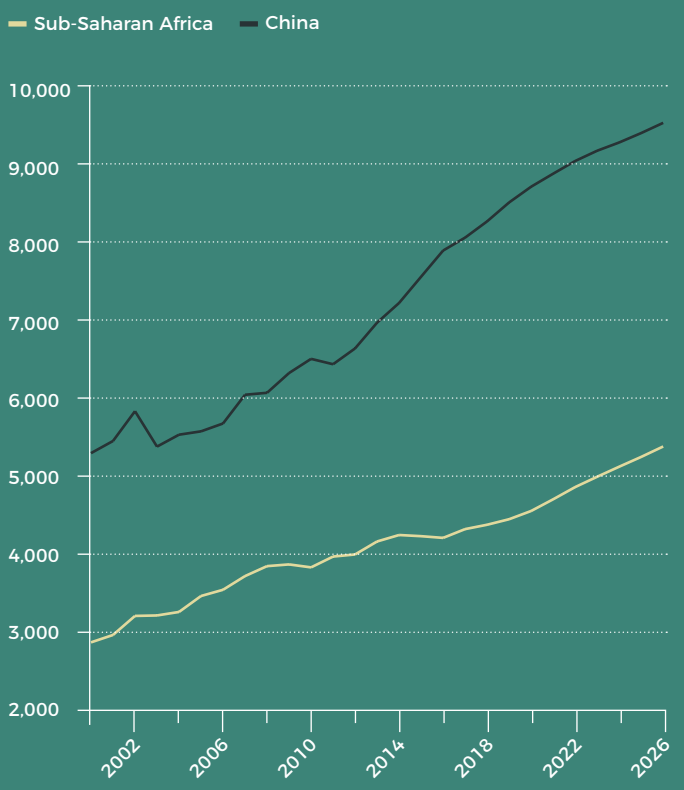


FAO 2016

FARMING SUPPORT FALLING IN US, EU; RISING IN CHINA
Percentage of farmers' income coming from government



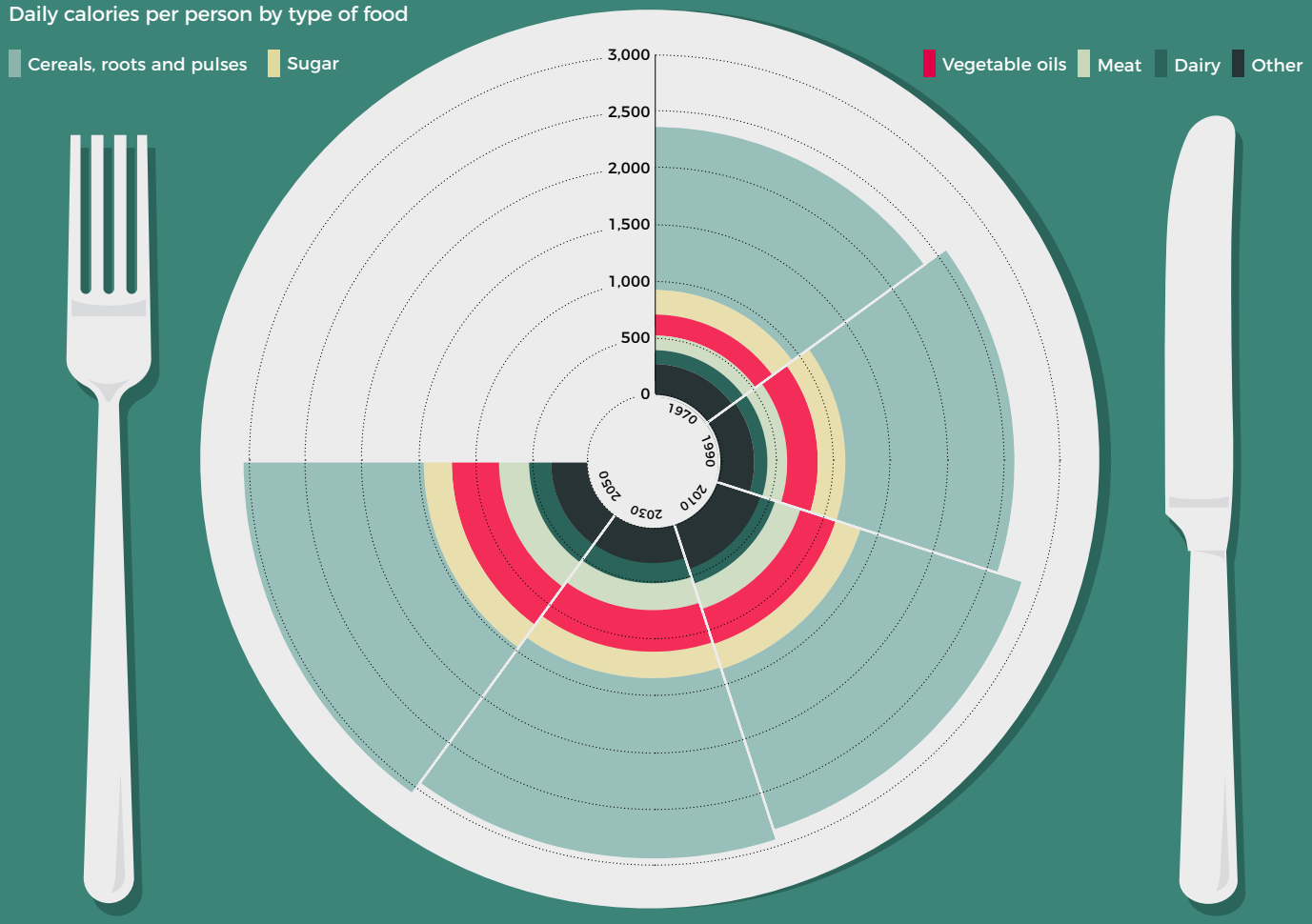
BEEF DEMAND RISING FAST IN CHINA, SUB-SAHARAN AFRICA
Beef consumption, in thousands of tonnes



OECD/FAO 2017

THE GLOBAL DIET

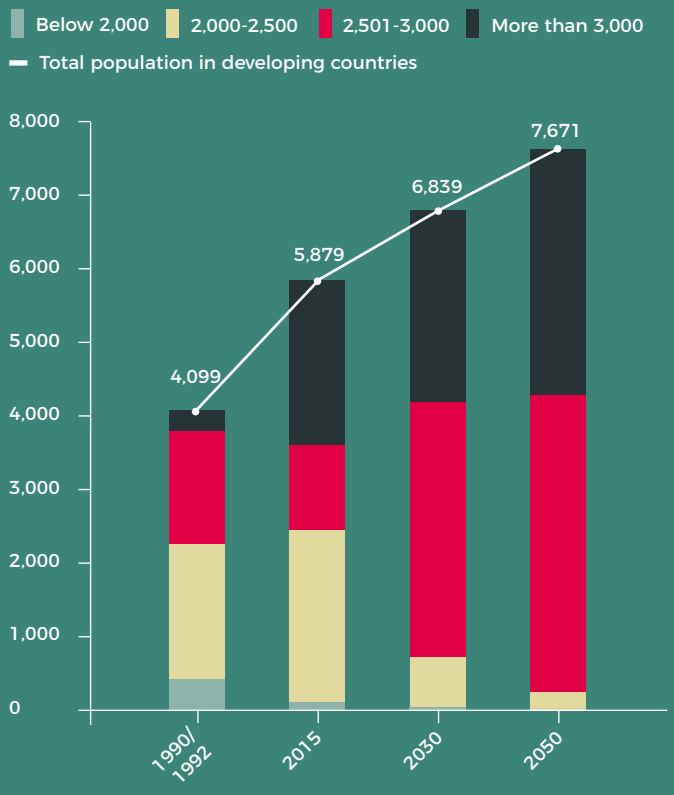
Daily calories per person by type of food



FAO 2016

CALORIE INTAKE RISING IN DEVELOPING COUNTRIES

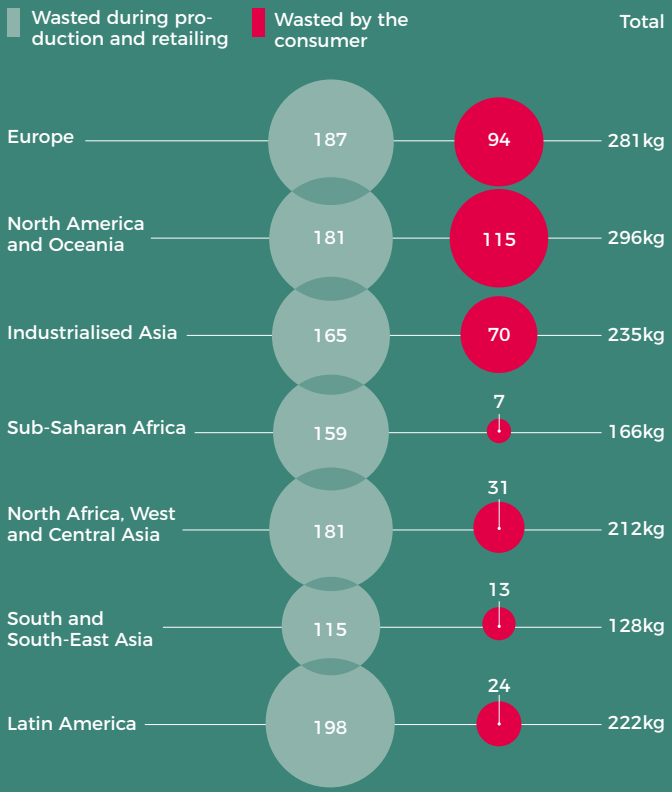
Population by daily calorie consumption in millions



FAO 2015

REGIONS WASTING THE MOST FOOD

Per capita food loss, and where the waste occurs (kg per year)



FAO 2017

Food companies face tough choices as 'meal kits' disrupt evening economy

Success in fast-growing market will come to firms that can adapt, according to Colin Elkins, IFS Global Industry Director for Process Manufacturing

The pressures of work coupled with the hectic pace of family and social life leave people with less time than ever to plan and prepare a healthy evening meal. This has fuelled strong growth in the meal kit sector, but now retailers are fighting back for their share of the so-called "feeding of the evening economy". All of this is shaking up the food production business, as Colin Elkins, global industry director of process manufacturing at IFS, explains:.

"It's all about the battle for our hard earned cash. Up until fairly recently the demand for something quick and easy to eat was met by processed food manufacturers, providing burgers and frozen pizzas, etc. Today, with a growing obesity crisis, people are more aware of the need to eat healthily within the constraints of the hour to prepare and cook a family meal each evening. This has been driving growth in the meal kit market; a model based on home delivery of a product that provides everything you need, in exact quantities, for five days of meals.

Now the retailers are fighting back. Food is a large part of their market and their sales are being hit. They are seizing on the weak spot in the meal kit model; meals planned five days in advance limits choice. Go in any supermarket today and you'll see a lot of freshly prepared produce; chickens ready rubbed with herbs and spices, and trays of par boiled roast potatoes ready for the oven. They have increased the level of choice, dedicating entire aisles to this burgeoning sector, but their challenge is the delivery. The meal kit companies have a distribution chain that retailers can't currently replicate on the same scale.

The meal kit market is one of the fastest growing food sectors, worth between $3 billion and $5 billion, and led by the likes of Hello Fresh and Gousto, with many new players entering the market. Amazon is also entering the meal kit space, and when you consider they have the supply chain already established they must be taken seriously.

Who will win this battle to feed the evening economy? I believe that the

Meal kit companies have a distribution chain that retailers can't currently replicate on the same scale

Cousto


Casey Lee /Unsplash

Above right
Colin Elkins, Industry director for process manufacturing, IFS Global

retailers will win back a proportion of market, although they face limitations of shelf space and delivery mechanisms. The simple meal kit market will shrink, as people take advantage of the retailer offering, and the meal kit brands may have to move to a more innovative space, using new recipes and different ingredients.

In addition, we can't rule out a significant push by frozen manufacturers into the fresh produce space. Frozen food processes have been significantly improved by new technologies, resulting in better quality, healthy foods that could have a place in that evening meal economy if those manufacturers get their marketing right. Amazon, with its network of small, very agile meal kitting companies and the potential for a whole new delivery capability could well be the one to watch.

This battle for the feeding of the evening economy has huge repercussions for food producers and manufacturers. A supplier of chicken, for example, must now decide whether to invest in producing a prepared product, i.e., a pre-stuffed or pre-flavoured raw chicken etc. Similarly decisions must be taken by , for suppliers of herbs and spices, really a very simple market in terms of packaging products of a

standard size and getting them to the retailer. Now the same suppliers are supplying to different outlets, including the meal kit companies, but in much smaller pack sizes.

These companies face a real investment dilemma around production. Do they invest in people and plant to meet new production demands, and if they do, can they handle this new level of competitiveness within the market?

Planning has also become hugely complex for fresh food manufacturers who now have to factor in the weather: products put out yesterday when it was warm and sunny may not sell, if it turns wet and chilly, and the media. TV food and cookery shows also do influence what people decide to eat. They are effectively planning in a vacuum, with no real insight into what will happen.

However, the biggest challenge facing the fresh food manufacturers and suppliers is day one for one planning. With frozen ambient, and chilled, you have reaction time to balance out your supply chain. With day one for one, the demands on the supply chain can increase exponentially.

Overcoming this challenge will require a change of mindset. The pressures of a shorter timescale and demand for greater choice make a move towards daily planning inevitable. Customers who I talk to are already taking advantage of the IFS Advanced planning capabilities, and benefiting from our experienced consultants who engage with them in order that they can deliver the solutions and the support that the food production industry needs to play its part in 'feeding the evening economy'."

For more information please visit ifsworld.com/times or call 01494 428900

The challenge to privacy when even the milk carton is smart

Smart packaging brings convenience and safety - but opens questions about data use

KITCHEN AUTOMATION
Adrian Bridgwater

In our science fiction-fuelled vision of the future we all enjoy video wristwatches, self-driving cars, and smart milk cartons that order another litre of semi-skimmed when their contents go out of date.

Well, the video wristwatch is here and the self-driving car will soon be literally around the corner. But our plastic milk bottles remain as dumb as ever. The implementation of smart packaging is still somewhat more marginal, for now at least.

However as the connected home and its web-powered smart devices come online, we must look to the refrigerator and the kitchen cupboards to see where the internet of things will soon be connected. Already, thanks to Amazon's 'Dash' devices, it's easy to stick a button on the dishwasher that with one click will see a big box of dishwasher tablets arrive the next day. The next phase of development removes the need for human interaction altogether: Welcome to the age of auto-replenish.

The 'how we do it?' part is not so tough. Sensors for packaged consumer goods are small and getting cheaper. What is perhaps less certain is how human beings will now accept - and engineer - this new automation into our lives.

The home used to be a place of refuge where we could seek sanctuary from the outside world. Now it's going to be an always-on service centre where our personal consumption preferences are reduced to data, to be consumed as raw material by the AI engines of Silicon Valley-based tech giants.

There are positives here as Colin Elkins, global industry director for process manufacturing at enterprise applications company IFS, points out. Smart packaging can aid authentication, to ensure food hasn't been tampered with. He also points to the potential to use packaging as interactive real estate for marketing which could be tailored, for instance, to the consumer's location or time of day.

London-based Zappar has collaborated with a number of packaging companies to create augmented reality products - a taste of what could happen as packaging becomes smarter. A consumer can view a product through a smartphone camera and see the real world with additional information 'augmented' on top, for instance the product could spring to life or be the central part of a game.

"We're moving towards a world where everything is smart, internet-connected, trackable and linked to everything else," says Zappar chief executive and co-founder Caspar Thykier. "In the packaging industry, smart tech will make products more engaging for customers and more valuable for manufacturing firms. It also gives packaging firms a new revenue stream, letting them provide extra value to their partners with additional insight into consumer behaviour."

We must remember, however, that every device has a digital identity and every time we interact with it, we create a piece of machine data, a digital fingerprint. Unless we manage it, this electronic trail may give an uncomfortable amount of information about our activities and preferences to firms who seek to apply "user behaviour analytics" to our private home life.

No longer a refuge, the home becomes an always-on service centre

"The problem is that we are not having conversations about consumer data collection and identity management," says Richard Slater, principal consultant at cloud software application development company Amido.

There are still some practical problems to be overcome before smart packaging becomes more widespread. Truly smart packaging requires products to be fitted with a chip that can be read remotely, similar to the one used in contactless bank cards, and the home to have devices that can read them. But even the latest £4,000 smart fridges from tech giant Samsung don't have readers.

Though the tech industry has aims get the cost of a chip down under a single penny, a penny per item is a lot for a food multinational that ships billions of items a year. Would dumb products be cheaper? Or would all consumer be forced to pay extra for smart ones? Do supermarkets need to extend shelf space for two types of packaging? The cost of intelligence appears to spiral upwards way before it comes down. Plus the presence of a chip may make a package hard to recycle.

Turn off the margarine

At this early stage there are positives and negatives in the auto-replenish revolution. If we do adopt smart packaging tomorrow it will be very important for us - the users - to be able to control how active these devices are inside our newly-smart homes. So far nobody has ever asked anyone to go and 'turn off the margarine', but that day is coming soon.

A meaty problem: solving the global protein crisis

The only way to meet spiralling demand is a shakeup of the $400bn animal feeds industry

THE CHANGING GLOBAL DIET

Nick Easen

As income grows in emerging economies, people change their diet to include more protein. Meeting this demand is a global challenge.

One innovative solution is a radical shakeup of what farm animals eat to raise productivity and reduce environmental impact. But it's no small matter changing the global animal feeds industry - which its trade association says is worth about $400 billion a year.

"From the feedlot to the food aisle there's a growing realisation that the current protein supply chain cannot cope with a growing global population and its demand for protein," says Jeremy Coller, founder of Farm Animal Investment Risk and Return, an investor initiative on sustainable farming.

Sure, more vegetarian and flexitarian diets will help. And there are innovative ideas around plant protein and using AI to increase yields. Even Tyson Foods Inc, the biggest U.S. meat company is investing in meatless meat, through a company developing pea-protein burgers. But these are unlikely to solve the protein crisis: The United Nations Food and Agriculture Organisation predicts our demand for food will rise by 70 per cent come 2050 - with demand for meat seen rising faster than this because of changes to the diet of the fast-growing middle class in Asia and Africa.

Yet of all the plant protein we produce, less than half is eaten by humans; the rest is used to feed cattle, pigs, sheep and poultry. Even farmed fish is heavily dependent on fish caught in the wild for feed.

Simon Billing, Protein 2040 Lead at sustainability non-profit Forum for the Future, says: "Feed is a big issue and we're feeding too high a value feed to animals"

There's a growing realisation that the current protein supply chain cannot cope

He adds: "We need a drive towards more sustainable animal feed."

Potential ingredients that could step-change the feed industry over night already exist. "In many cases they've now been tested in the labs and are with feed producers already, some are even reaching commercial scale," says Kate Wolfenden, co-founder of WWF's Project X, which aims to reduce the pressure on wildlife by changing the way farm animals and farmed fish are fed.

For instance, biotech firm Calysta in Silicon Valley, with help from the University of Nottingham, are developing a sustainable fish food based on synthetic bacteria fed on methane. The factory in Memphis, Tennessee in the U.S. will be the world's largest gas fermentation plant and will produce up to 200,000 tonnes of feed, called FeedKind. Operational by 2019, Calysta believes scale is important if it's to have any effect on global feed production.

Alan Shaw, Calysta chief executive, explains: "Approximately 1 billion tonnes of animal feed was produced last year. Feed ingredients that are available in

Top Fish being fed an insect-based diet produced by Protix of the Netherlands

Above Kees Aarts, Founder, Protix

anything less than thousands of tonnes per year will struggle to get any attention from the industry."

In Europe two prominent companies, Ynsect and Protix, are involved with ratcheting up insect production for animal feed; our six-legged friends are very efficient at upscaling food waste and plant biomass into animal feed.

Netherlands-based Protix in June raised €45 million and are planning to expand their insect farming business. They already sell feeds to 12 countries in Europe. Ynsect has raised a similar amount over the last few years and now has a fully robotic demonstration plant in France.

Both have been boosted by recent changes to EU rules allowing the use of insect-based feedstocks. Fish can now be fed with seven species of insect. Work still needs to be done to ensure the insect protein can enter poultry and pig markets.

Kees Aarts, Protix founder, says: "The system will change, but it's going to take time."

However these innovative measures have to compete with established supply chains with huge scale. Antoine Hubert, CEO Ynsect, says: "Without a sustainability premium coming from the retailer to the farmer, innovative feed companies need to be competitive with existing products."

Ingredients that could step-change the global animal feed industry already exist

"This means proposing similar or better efficiency on animal growth, conversion and survival than current solutions."

Mr Hubert says the solution to the scale of the protein crisis demands a range of solutions. He says: "This will involve a mix of insects, algae, single-cell proteins, fungi, new crops used in feed and eventually in the long term also in human food. Diversity will certainly be key for our society and resilience in our food supply."

RACONTEUR

6th Floor, 38-40 Commercial Rd, London E1 1LN