AGRI BUSINESS

SUMMER 2018

AN IRISH FARMERS JOURNAL REPORT IN ASSOCIATION WITH KPMG

AGRICULTURAL DISRUPTION

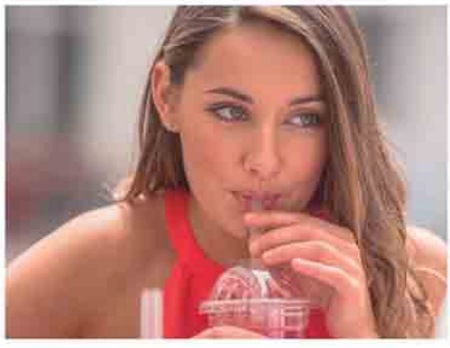
Traditional agriculture is increasingly being disrupted by new technology

KPMG

IRISH FARMERS JOURNAL

We're passionate

about taste and nutrition



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Kerry Innovation

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AGRI BUSINESS

FOREWORD

EOIN LOWRY

Agribusiness editor, Irish Farmers Journal

In the last 50 years, agricultural production has tripled thanks to advances in technology which have helped farmers become much more productive. If yields had stayed the same since 1960s, we'd need to cultivate more than double the amount of land to feed the population today.

Population growth, the impact of climate change and the need to reduce greenhouse gas emissions in agriculture are some of the challenges faced by agriculture today.

The urban population is exploding around the globe, and yesterday's food systems will soon be sub-optimal for many of the megacities swelling with tens of millions of people.

In our sixth year of the Irish Farmers Journal/KPMG *Agribusiness* report, we look at the innovations that are happening in our food system and ask how will we grow, produce, buy and eat our food in the future.

We ask what defines food in the modern world. Do you define meat by what it is – amino acids, fats, carbohydrates, minerals, and water or where it is from (ie cows, chickens, pigs)? In blurring categories such as these, questions about labelling and marketing abound.

We are delighted to partner with KPMG again this year, combining its expertise and global network with the insights and analysis from the agribusiness team at the *Irish Farmers Journal*.

The overall aim of this publication is to educate and challenge industry leaders to drive change for the improvement of the agri-food sector including farmer's productivity and their long-term sustainability while providing consumers with safe, healthy and nutritious food.

DAVID MEAGHER

Partner-in-charge for agribusiness, KPMG

This report, the sixth in our series of *Agribusiness* reports published by the *Irish Farmers Journal* in association with KPMG, focuses on the future of food production.

Technology is changing our world, in how we live, how we work, how we communicate and how we eat in ways that would not have been thought possible a generation ago.

It is not surprising, therefore, that 95% of the respondents to our global survey say that research and development is important to their business. It is interesting to note that this percentage is up from 78% last year. This provides clear evidence that we can expect to see profound changes in our industry over the coming years and that this change will occur quickly and relentlessly.

In this report, we have tried to signpost some of the areas of change and give a sense as to the impact of those changes. As you will see, there are exciting – and challenging – times ahead.

From the perspective of Irish agribusiness, it will be critical to embrace these changes, and, indeed, be at their forefront. It would be a pity if we do not take full advantage of the many natural attributes that we have carefully nurtured over the years and that have formed the basis for a world-class industry in Ireland.

So we encourage all participants in the industry to read this report, reflect on its findings and take action. As a small country, one of our key advantages should be the ability to respond to changes quickly. A world of opportunity awaits – let's seize it.

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KPMG

At the heart of business in Ireland

Time to talk up agricultural innovation

In 1798, the economist Thomas Malthus predicted that the world would exceed its food supply by the late 20th century. Two hundred and twenty years later, on the same amount of land, the world's farmers have continued to feed the world's people. **Eoin Lowry** reports

On the face of it modern agriculture has been an unqualified success. Farmers today produce more food on less land and feed more people more cost-effectively than before. This has been thanks to continuous innovation over time.

But instead of celebrating the advances that made this possible, many consumers are fearful of them. A typical example is genetic modification. So why do consumers embrace technological advances in virtually all other fields, and yet expect farmers to revert to agrarian practices used more than a century ago?

Some of the reasons for this can be explained by the fact that in the developed world only a fraction of the population have a connection to a farm. These same people can appreciate the technological advances in other parts of their lives, but there is little understanding or appreciation of the innovations that make agriculture and the food production system successful. The EU's view on how food should be produced has not helped and also stifled innovation and the perception of it. While farmers work in a global field, that field is not level. For example, US farmers have access to technological advancements such as genetically modified crops and Brazilian farmers have access to growth enhancing hormones.

At the moment it seems like a one-way conversation is taking place in Europe that favours small cohorts of people with non-scientific arguments. While their concerns should be listened to, a common ground that is based on science must be found.

At the moment it seems like a one-way conversation is taking place in Europe that favours small cohorts of people with non-scientific arguments

We know they care deeply about human safety, biodiversity, water quality, soil health, and environmental sustainability—the same considerations that drive farmers to take care of the land as it passes on to the next generation.

Through better communication of those involved in agriculture, we need to better explain why innovation is not the cause of their concerns, but instead the solution to them.

As consumers ultimately define what foods or farm practices are acceptable, the industry should be attentive to their concerns and responsive to their needs.

That doesn't mean we abandon our principles, but rather that we improve the quality of our conversations, and engage now.

When consumers walk into the fresh produce aisle of the modern supermarket, many don't realise they are seeing the fruits of modern agriculture's innovation. These same consumers want yet more choice and variety without technological advancements in agriculture. That is a false expectation.

With the world's population increasing, we must find new ways to safely and sustainably increase food production by 50% by 2050. We know this cannot happen by adopting the farming practices of yesterday.

SPROUTING INNOVATION

Innovation is seen as the most important driver of growth in this year's Irish Farmers Journal/KPMG Agribusiness survey

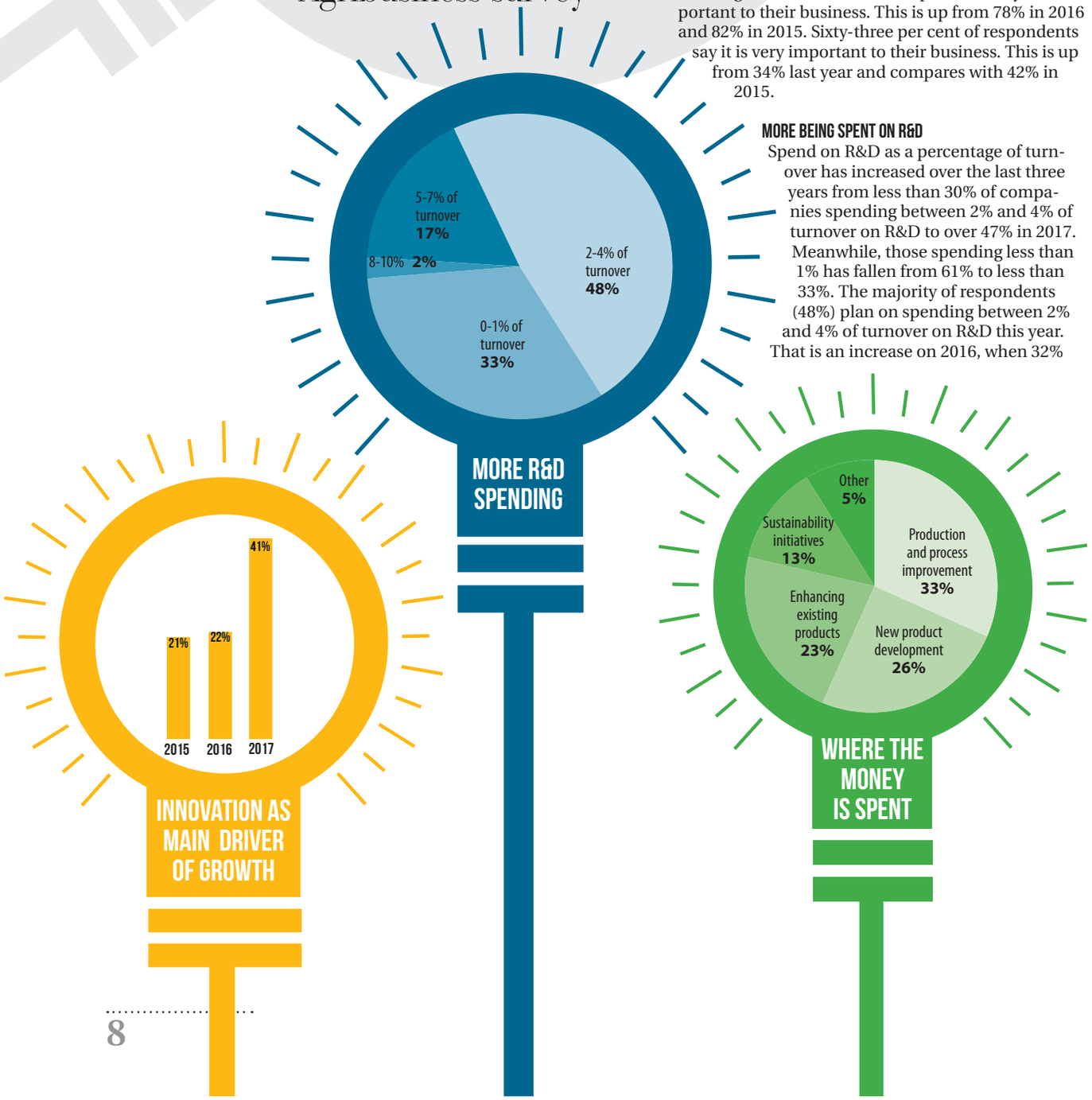
The 2018 *Irish Farmers Journal*/KPMG *Agribusiness* global survey focuses on innovation and compares the results to the last three years. Globally, innovation was seen as the most important factor in driving future business growth. Forty-one per cent of respondents say innovation is the most important factor driving the future growth of their business. This is up from 22% in 2016 and 21% in 2015. However, 40% of respondents cite innovation as the most significant challenge facing their businesses in the coming years – up from 24% in 2016 and 20% in 2015.

R&D SEEN AS KEY TO THE BUSINESS

With regards to R&D, 95% of respondents say it is important to their business. This is up from 78% in 2016 and 82% in 2015. Sixty-three per cent of respondents say it is very important to their business. This is up from 34% last year and compares with 42% in 2015.

MORE BEING SPENT ON R&D

Spend on R&D as a percentage of turnover has increased over the last three years from less than 30% of companies spending between 2% and 4% of turnover on R&D to over 47% in 2017. Meanwhile, those spending less than 1% has fallen from 61% to less than 33%. The majority of respondents (48%) plan on spending between 2% and 4% of turnover on R&D this year. That is an increase on 2016, when 32%



said they would spend this percentage. It is also up on 2015, when 29% said they would spend this amount.

MOST R&D SPENDING IS IN PROCESS IMPROVEMENT

The majority of spending on R&D has been on production and process improvement for the last three years. Approximately one-third of all R&D is in this area and is pretty stable over the last number of years at around 33%. New product development accounts for around one-quarter of all spend on R&D. Spend on sustainability is also stable at around 13%, with the balance being spent on enhancing existing products.

PEOPLE ARE THE GREATEST CHALLENGE TO DRIVING INNOVATION

Forty per cent of respondents identified people as the biggest challenge in driving innovation.

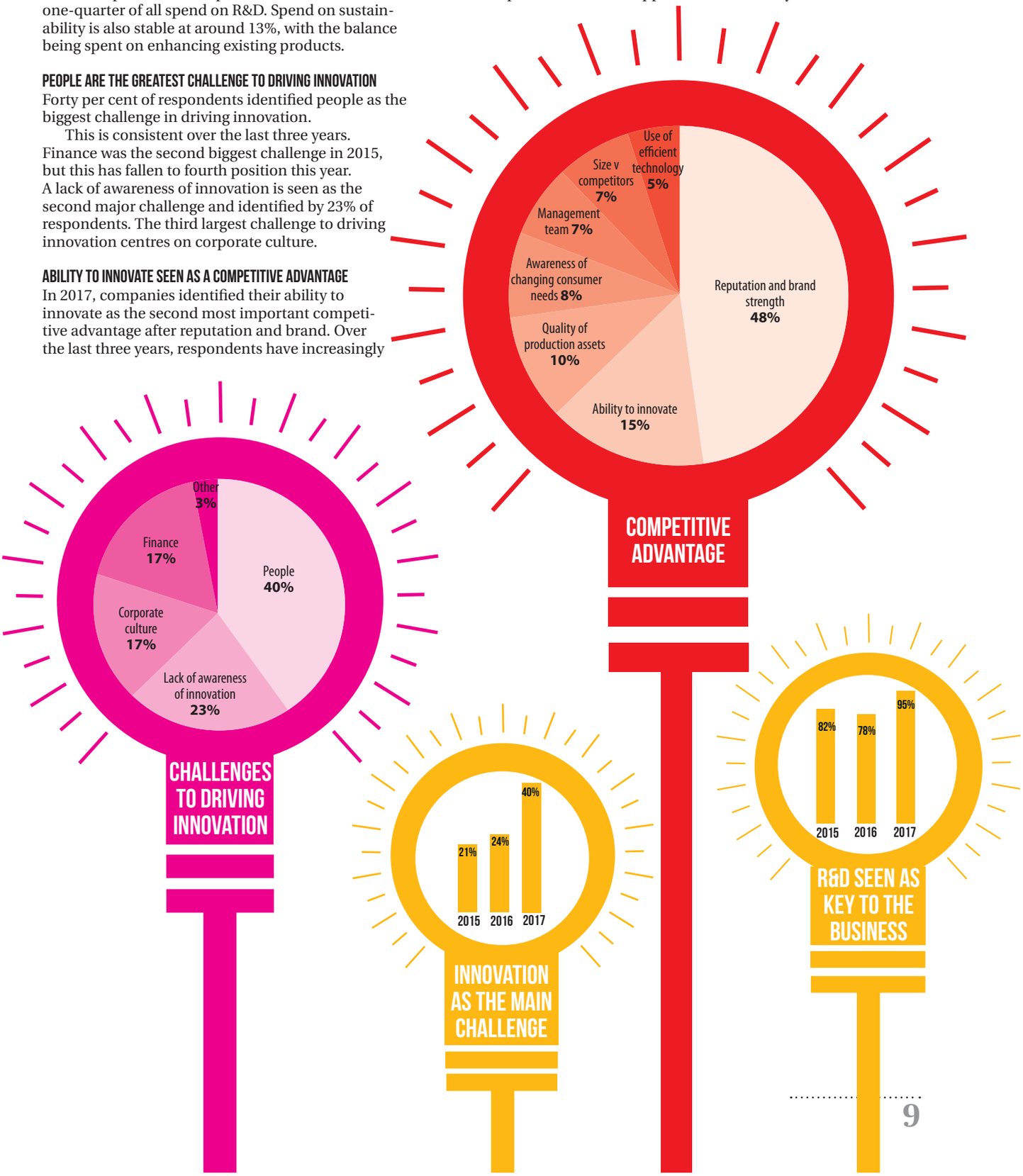
This is consistent over the last three years. Finance was the second biggest challenge in 2015, but this has fallen to fourth position this year. A lack of awareness of innovation is seen as the second major challenge and identified by 23% of respondents. The third largest challenge to driving innovation centres on corporate culture.

ABILITY TO INNOVATE SEEN AS A COMPETITIVE ADVANTAGE

In 2017, companies identified their ability to innovate as the second most important competitive advantage after reputation and brand. Over the last three years, respondents have increasingly identified the ability to innovate as a key competitive advantage. It has moved from fourth position to second, overtaking scale and integration, which have fallen to sixth and seventh position, respectively.

GOVERNMENTS COULD DO MORE TO SUPPORT INNOVATION

Overall, 36% of respondents feel that government could do more to support R&D innovation. As few as 28% of respondents felt the support was satisfactory.



AGRI
BUSINESS SURVEY

CHALLENGES

WHAT ARE THE BIGGEST CHALLENGES FACING AGRIBUSINESS TODAY?

CONFIDENCE

HOW CONFIDENT ARE COMPANIES IN THE SECTOR?

of companies expect growth above 3% in the global economy.

of companies expect growth above 3% in the agribusiness sector.

of companies expect growth above 3% in their overall business.

METHODOLOGY

The research for the survey was conducted by KPMG and was based on a representative sample of agribusinesses in the main agri-producing regions of the world.

The survey, which consisted of 33 questions across a range of agribusiness-related topics was sent to the senior management of a wide cross-section of businesses with the sector. All quotes used throughout the survey were submitted by respondents.

The survey was made available to respondents in hard copy and was also available electronically.

We would like to thank all the respondents for taking the time to complete the agribusiness survey and we hope you find our results informative and insightful. We welcome any feedback and suggestions that you feel could improve our 2019 *Agribusiness* survey.

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FARMERS JOURNAL An Irish Farmers Journal company

AGRI BUSINESS SURVEY

INVESTMENT

83%

of respondents plan to invest in the next 12 months.

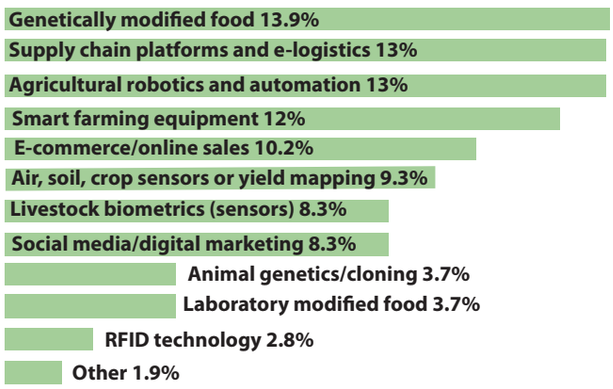
WHERE COMPANIES ARE GOING TO INVEST

DISRUPTION

65%

of respondents believe that the sector is exposed to technological disruption with 10% anticipating significant technological advances.

WHERE THE SECTOR IS EXPOSED TO DISRUPTION



WHAT RESPONDENTS SAID

- "Government should allow competition on the railway in terms of private locomotives (and trains in general). Monopoly in railway transport increases costs and slows down the supply chain from field to port."
- "Due to our geographic location we are unable to receive or be considered for capital grants. The most serious challenges are emerging in the form of Brexit. In light of this, the state aid rules constraints need to be reviewed."
- "More grants to support capital investment."
- "Prioritise market access."
- "Lowering port import costs. Ports are effectively Government monopolies that charge whatever they need to recover costs. This does not encourage efficiency and therefore adds cost to the production chain."
- "Continuous development and promotion of training and education programmes at third level, ensuring a strong talent pool with world-class skills remains available to the sector."

EMPLOYMENT

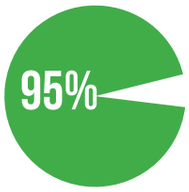
of respondents expect to grow workforce in next 12 months.

of respondents said a key constraint to employment growth is lack of skilled people.

of respondents said they were significantly reliant on immigration.

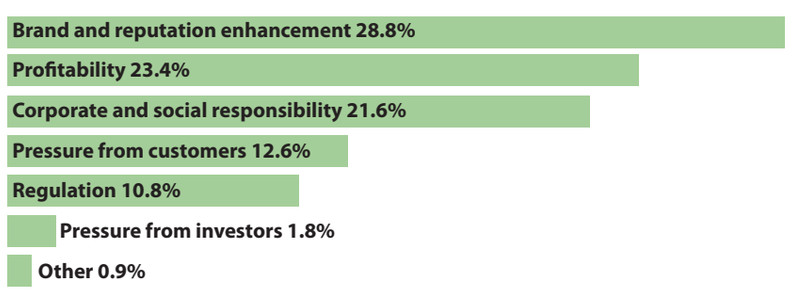
Comment: It is encouraging that almost half of the companies surveyed expect to grow their workforce in the next 12 months. What is more concerning is that a major constraint to growth is the lack of skilled people. Given the changing geo-political environment, it is also of note that 30% of respondents are significantly reliant on immigrant labour.

SUSTAINABILITY



of companies feel sustainability is important

WHY IS SUSTAINABILITY IMPORTANT TO YOUR BUSINESS?



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IRISH FARMERS JOURNAL

TOMORROW'S FOOD, TODAY

The pace of disruption in traditional agriculture is rapidly gaining pace. For established players, the ability to adapt to new technology will be key to future success

AGRI BUSINESS OVERVIEW

In this year's *Irish Farmers Journal Agribusiness* report, brought to you in partnership with KPMG, we examine the global agriculture sector in terms of innovation, technological disruption and how this results in changing consumer trends.

Agriculture has been one of the last sectors to experience significant disruption from new technologies. However, the agtech movement is now maturing rapidly with investors funneling more and more cash into new startups looking to disrupt traditional agriculture.

In countries such as New Zealand, we see how a specialist startup accelerator programme is helping to foster new ideas in agriculture and develop groundbreaking technologies for on-farm applications.

We also examine the vibrant agtech ecosystem that has emerged in Israel, where farmers collaborate directly with researchers to overcome the natural challenges of producing food in a country that is two-thirds desert.

A similar approach is being taken to food production in Singapore where, due to a shortage of land availability, farmers are building vertical farms to grow more food per acre than ever before. In an increasingly urbanising world, we look at how new applications such as hydroponic farming are enabling farmers to grow food closer to cities at much less of a cost.

At farm level, we visit a farmer in the Netherlands who has created a novel idea to engage directly with his consumers, receive a higher market price and improve the animal welfare image of his business at the same time.

We also see how today's dairy farmer is becoming increasingly data-driven in their business. New technology is helping farmers to make more informed decisions when it comes to animal health, heat detection and breeding genetics.

We also look to the past to learn how the Irish mushroom industry successfully innovated and adapted its production system during the 1980s to become highly efficient and win premium shelf space in UK supermarkets.

FUNDAMENTALS

The market fundamentals of low food prices and squeezing producer margins demands new innovation in the eyes of investors. As such, it is no surprise to see venture capital investment in agritech startup companies more than double to $700m (€590m) in the US last year.

This surge in interest in agtech startups is likely to continue in 2018 as established agricultural giants such as Monsanto, Bayer and John Deere plough more cash into new technology for fear of being disrupted themselves.

We examine how some of the largest meat and dairy companies in the world are buying up stakes in new companies that specialise in alternative proteins.

These companies are protecting themselves from long-term disruption by transitioning away from their core business of meat or dairy to rebrand themselves as protein companies – a catch-all term that allows them to play for new, fast-growth consumer trends.

At the end of the food supply chain remains the supermarket. In the early 2000s, the grocery retail sector underwent significant market concentration as the dominant three or four supermarkets in most developed countries expanded store numbers to choke out competition from smaller, independent stores.

THREAT

Today, these established supermarkets face their own threat of being choked out of business due to the advent of online retail, or ecommerce. While online grocery retail is yet to fully take off, traditional supermarkets are bracing themselves for a significant period of disruption over the next decade.

Companies such as Ocado in the UK are developing new technologies for dark supermarkets that will change how consumers buy their food. Traditional retailers are now scrambling to adapt to this changing sales model before it is too late.

€590M capital investment in agritech startup companies in 2017

THE SURGE IN INTEREST IN AGRITECH STARTUPS IS LIKELY TO CONTINUE IN 2018 AS ESTABLISHED AGRICULTURAL GIANTS PLOUGH MORE CASH INTO NEW TECHNOLOGY FOR FEAR OF BEING DISRUPTED THEMSELVES

We also meet two very different agribusiness companies who are both using technology and science to differentiate their business models. Zespri, a kiwifruit exporter, and Ethanol Europe, a corn ethanol producer, both established themselves playing in the commodity space.

Using new technology, Ethanol Europe has ambitious plans to move its business model up the value chain into manufacturing much higher margin pharma and nutraceutical producing from the by-products of corn.

Zespri has been innovating away from the commodity space for a number of years but the company is not resting on its laurels.

We visit the home of the world's largest kiwifruit exporter to see the latest technological developments taking place to keep Zespri playing in high-margin, premium markets.

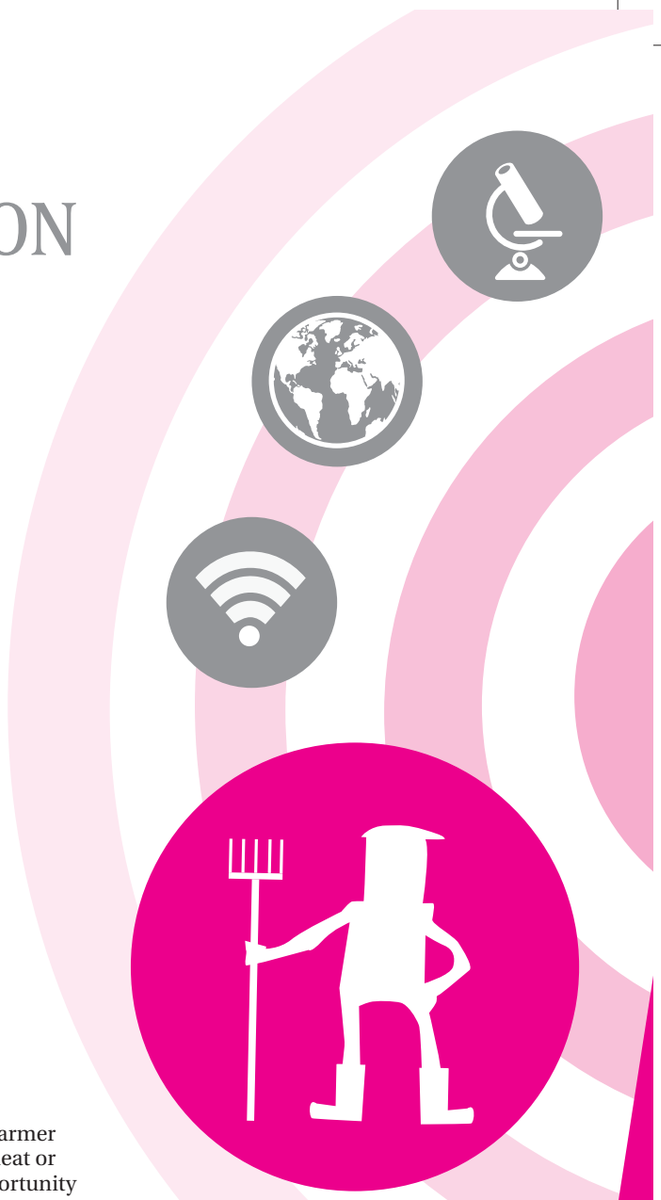
After years of lagging behind, new technology is rapidly gaining a toehold in agriculture and is increasingly disrupting traditional models from farm to processer to supermarket.

KPMG IRISH FARMERS JOURNAL

1 TRADITIONAL DISRUPTION

Perhaps the most glaring example of technological disruption was the dramatic fall in the fortunes of mobile phone giant Nokia. In 2007, *Forbes* magazine carried a front-page story on the Finnish company posing the question, "can anyone catch the cellphone king?" At the time, Nokia had one billion customers the world over but its dominance blinded the company to the industry shift towards smartphones. The emergence of the Apple iPhone and other smartphones ultimately led to Nokia's downfall, which culminated in selling its mobile phone business to Microsoft in 2016. The lesson from Nokia is that no company, no matter how dominant, is too big to fail or be disrupted by new technology.

DIGITAL DISRUPTION



Ian Proudfoot, global head of agribusiness with KPMG, believes that digital disruption is rewriting the rules for a consumer-centric agri-food supply chain

When I arrived in New Zealand 22 years ago, it cost me NZ$20 or more to make a telephone call home. I was one of the first staff in the office to have email access (although you could go a week without receiving a message) and when you logged off on a Friday that was it for the weekend, as there was no smart device to accompany you everywhere. The internet was a quirky collection of amateur pages rather than a channel for global commerce.

Digital innovation has dramatically changed social and professional interaction over the last 20 years. Skype now enables me to video-call home for free, and an hour without an email (day or night) is a luxury. Most people are rarely disconnected from their digital ecosystem and annually shift more of their routine purchasing online. We expect information to be available instantly, we can follow, contribute and shape global discussions and curate our own streamed entertainment. Most companies have recognised digitally connected people are potential consumers of their products and, as a result, digital marketing has evolved from spam emails into a data-driven science.

Acknowledging that every digitally connected citizen on the planet is a potential consumer of the product you grow is a game-changer for the agri-food sector as it challenges traditional thinking around the supply chain. However, the industry globally has been slow to respond to the technology-led disruption reshaping many aspects of our day-to-day lives.

Historically, a farmer producing milk, meat or fruit had little opportunity to build a direct connection with the ultimate consumer of the products they grew. The consumer relationship was owned by the retailer who provided the bricks-and-mortar assets in which consumer and product were connected. The product was pressed down a chain from grower to processor to distributor to retailer and ultimately to the consumer. The return to the farm gate was whatever was left after the retailer and other supply chain participants had covered their costs and collected their margin.

RISK

The risk and volatility in the traditional lineal supply chain has largely sat with the farmer. Our analysis indicates that farmers usually receive between 10% and 30% of the ultimate retail value of the products that they grow at the farm gate.

We attribute these low returns to the lack of connection between farmer, product and its ultimate consumer. Retailers have intentionally kept products ''naked'', providing them with the flexibility to source from the supplier offering the lowest price. The consumer has been comfortable to benefit by way of lower food prices.

The last 10 years have presented challenges to the agri-food sector. The sector has been held to account on the environmental and social sustainability of many of its products, on the nutritional quality of the food being supplied, on the ethics of using animals to provide humans with food and on the safety of some products.

On food safety, the industry has not helped itself. The financial incentives to mislabel or tamper with

PRODUCERS CAN BUILD A DIRECT CONNECTION WITH THE CONSUMERS OF THEIR PRODUCTS

products have increased, while the authorities have been slow to respond to consumer calls to strengthen rules intended to protect them. Melamine-laced milk in China, European horsemeat and numerous campylobacter outbreaks have dramatically eroded the trust that consumers have in the ''naked'' products that retailers offer them. As a result, consumers have taken the quest for complete and accurate information into their own hands and turned to digital sources to seek products they can trust to be exactly as they are described on packaging.

Consumer behaviour indicates a preparedness to pay premiums for products with verifiable provenance and the attributes that they consider important.

The challenge for producers is actually understanding what needs and expectations customers have of them in different markets around the world, creating the products aligned to these needs before telling the story in a compelling way.

KPMG IRISH FARMERS JOURNAL

THE KEY SKILLS

The skills needed to collect deep consumer insight, analyse the findings, innovate responsively and then articulate the story through the consumer's eyes are skillsets that have historically been absent from many agri-food organisations because their place on the supply chain made such capabilities unnecessary.

To my mind, digital disruption is rewriting the rules for an agri-food supply chain. It can no longer be viewed as a lineal chain as the consumer is no longer prepared to confine themselves to the choices a retailer puts in front of them. Every participant in an industry now has the ability to build relationships directly with the consumer and with every other participant in the industry in a web of connections, collaborations and competition that is centred around fulfilling the needs of particular groups of consumers.

If a farmer wants to grow the right product in the right way to meet a consumer need, they need to have a connection with the consumer to fully understand their requirements. However, they also need their seed or genetics supplier to understand the consumer so they supply the right inputs, as well as their processing partner (so the product is processed in the right way), their logistics chain partners (to deliver the product on time in the right condition) and their regulators (so the product can be sold).

In some cases, these relationships need to be physical, but in many cases the relationships can be virtual through a range of digital channels, be that social media, a blockchain or a virtual reality experience.

As the speed of innovation accelerates, the opportunities for farmers, processors, distributors and retailers to disrupt traditional business models multiply. A virtual reality headset can put a potential consumer in the middle of a farm anywhere in the world, giving any producer the ability to tell their story in an immersive and compelling manner, creating the opportunity for them to become a "local food" supplier to the world.

New technology presents every organisation with the potential to unlock step changes in their business if they are open to thinking about their supply chain as a value web. I don't expect every farmer will change; too many are complacent in their view that there will always be a market for their products. While this may be the case, I believe when innovation makes your traditional product one of 10 choices available to the consumer rather than the only choice (with the new options having been designed to meet specific consumer needs) a complacent farmer will be very lucky to secure the prices that they have traditionally received for their products.

Innovation is never mandatory but being open to change is the most effective way to remain relevant; preserving, and hopefully increasing, the value generated for the products a farming business grows.

AGRI
BUSINESS

TRADITIONAL DISRUPTION

KPMG | IRISH FARMERS JOURNAL

SMARTPHONE SHOPPING THE RETAIL REALITY

More and more, consumers are switching to cashless or mobile payments, writes **Lorcan Allen**. But what does this trend mean for Ireland's food industry?

In January of this year, Irish native Paul O'Brien, a Chinese market access specialist and trade policy expert, posted an interesting video on his LinkedIn channel where he filmed himself over the course of a day going about his usual routine in the Chinese city of Hangzhou.

The point of the video was to illustrate how China is becoming an increasingly cashless society, particularly in the tier 1 cities such as Hangzhou, Beijing and Shanghai. In place of cash, Chinese consumers are increasingly adopting online or mobile phone payments and disrupting traditional forms of commerce.

In the video, O'Brien visits a local supermarket come restaurant chain that he says perfectly encapsulates the rapidly changing consumer preferences in China. The supermarket is entirely self-service but is also entirely cashless.

To make a purchase in the store, consumers must have a mobile payment app such as Apple Pay or WePay, the mobile payment service offered by WeChat, a Chinese messaging app with more than one billion monthly users.

Over the remainder of the video, O'Brien further illustrates the market penetration of mobile payments in Hangzhou as he uses his smartphone to ride the subway, rent a city bicycle and even make a contactless payment to a stranger on the street for a lift downtown on their motorbike.

The move to cashless payments is sweeping through China. In 2012, about 50m Chinese consumers used mobile payment systems. By 2016, this figure had soared close to half a billion users, or one-third of the Chinese population.

The adoption of cashless technology in China and other Asian countries has been much more rapid than in developed countries, where cash payments remain stubbornly high.

TRADITIONAL DISRUPTION

In the US, where the smartphone revolution emanated from, mobile payments stood at $112bn in 2016. By contrast, Chinese consumers are using mobile payments to pay for just about everything today with mobile transactions reaching $9 trillion in 2016 – that's 80 times higher than in the US. Chinese consumers also order 10 times more food online than US consumers.

RAPID SHIFT

Behind the rapid shift to this new form of commerce is Alibaba, the Chinese online retail giant led by executive chair Jack Ma. Alibaba offers customers a mobile payments service known as Alipay, which accounts for 54% of all mobile payments made in China today. For Alibaba, the real payoff of the move to mobile payments is the valuable consumer data it collects, allowing it to better target emerging trends. It also makes the company more relevant to consumers in their day-to-day offline lives and not just in the online world.

In 2014, Alibaba shattered all records when it claimed the title for the largest initial public offering (IPO) in history at $25bn.

The company has built its success on the back of online sales events such as Singles Day, a Chinese shopping day similar to Black Friday in the US and Europe, which generated $25bn in sales in one day for Alibaba last year.

WATCH the video on farmersjournal.tv

However, Alibaba clearly views mobile payments as the next frontier in the e-commerce market as smartphones double seamlessly as wallets for today's consumer. While initially slow to take off in Europe and the US, it is likely that mobile payments will rapidly take off in the developed world over the next decade. But what does the move towards a cashless society actually mean? A transaction completed electronically or via cash ultimately makes little difference to the buyer or the seller but what is significant is the technology that enables the change in payment method – the smartphone.

REACH CUSTOMERS DIRECTLY

For companies selling to mass markets such as China, the smartphone offers a new opportunity to differentiate and reach consumers directly.

Smartphone penetration in the global market is forecast to reach 66% this year, with market penetration of 80% to 90% already in most developed countries.

China is the world's largest smartphone market with almost half the country's 1.4bn citizens owning a smartphone today. With Chinese consumers increasingly using their mobile phones to buy their day-to-day groceries, it presents a new opening for food companies and farmers to communicate directly with the consumer. Consumers today are more discerning in how they shop for their food.

Yes, price point remains critical for the majority of shoppers but health concerns, animal welfare, environmental impact and food provenance are playing an increasingly important role in how people purchase their food.

SMART LABEL TECHNOLOGY

Ultimately, the smartphone offers the chance to bring the farmer and the end consumer closer together after decades of drifting further apart in a globalised economy.

Smart label technology, which is a simple QR code printed on the packaging, will allow consumers instant access in store to identify where their food was produced, how it was produced, as well as who is the primary producer of the meat, milk or grain in the product they are buying.

For Ireland's food industry, this technology offers the chance to add value to our meat and dairy exports by marketing the tractability of our food supply chain directly to consumers in the US, Asia or the Middle East with a smartphone in their hands.

Already, large multinational food companies such as Unilever, Nestlé, PepsiCo and Coca Cola are investing in smart labelling as a means of reaching their consumers directly. By 2020, it is forecast that 80% of all food sold in the US will have smart labelling, particularly to inform consumers if their food has been made using GMOs or hormones.

Today's consumer is living their life more and more via their smartphone. What started as a mobile telephone has morphed into a device that people use as a camera, newsfeed, audio and video player, and now as their wallet.

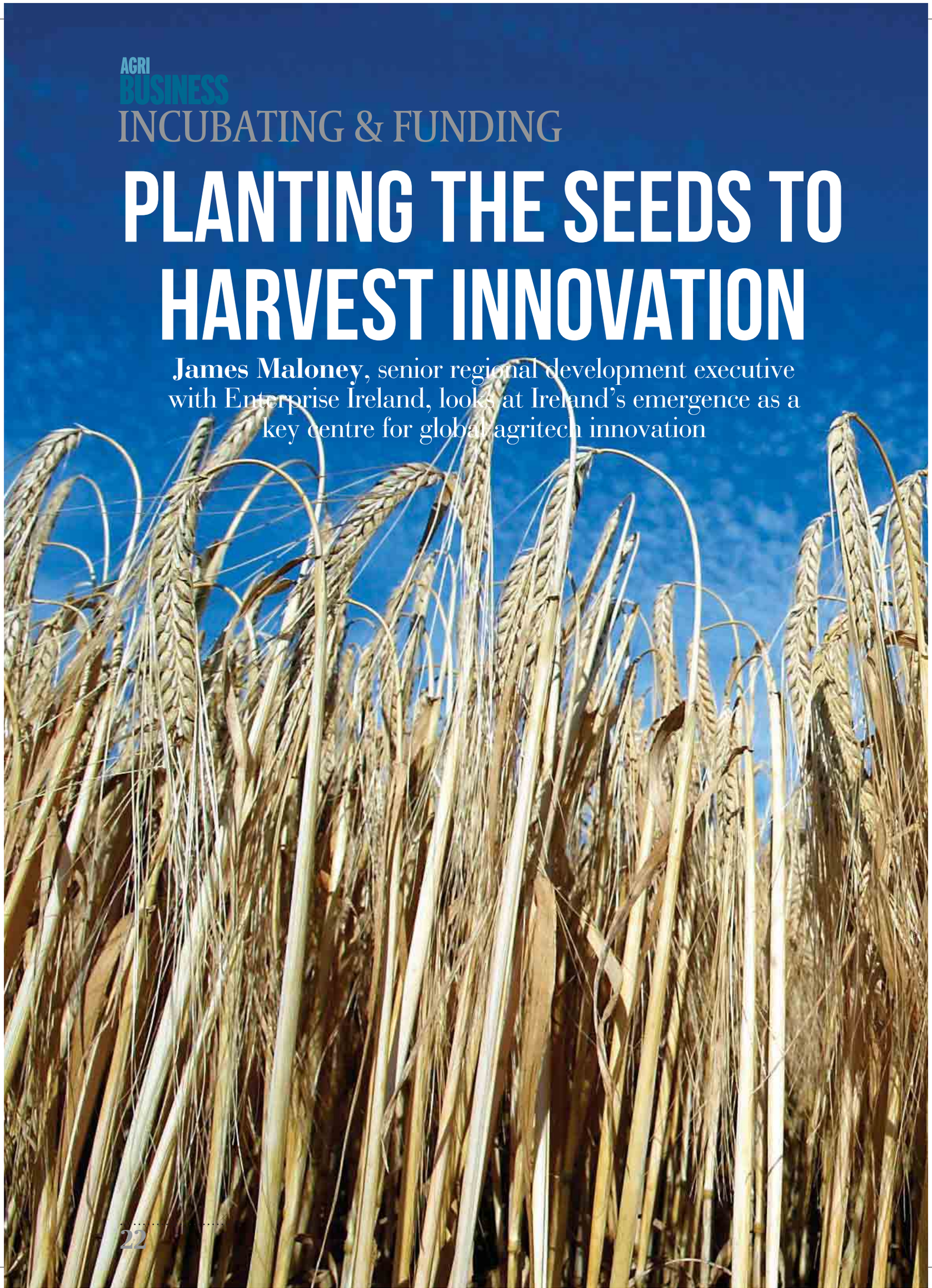
To reach these consumers directly, companies need to rethink traditional marketing strategies to a mobile world. For companies that never had a direct marketing relationships with consumers up to now, the smartphone era allows for the first time a cheap, cost-effective means to communicate their product.

2 INCUBATING & FUNDING INNOVATION

As the agtech movement grows with more capital than ever flowing in to fund new startups, countries are rightly asking themselves how they can take advantage of this new frontier. For decades, California has long been the destination where fledging technology companies have moved to secure new capital. Agtech has proved somewhat different as new companies need to stay close to the farmers they hope to develop next generation technology for. As a result, countries such as Ireland, the Netherlands, Israel and New Zealand have emerged as hotspot pipelines for agtech startup companies, alongside California.

PLANTING THE SEEDS TO HARVEST INNOVATION

James Maloney, senior regional development executive with Enterprise Ireland, looks at Ireland's emergence as a key centre for global agritech innovation



The dominant mega-trend in global agriculture for the foreseeable future will be sustainability; the need to produce enough food for a rapidly growing world population over the next half century and beyond, at the same time as reducing environmental impacts from pesticide use and protecting water quality.

That is possibly the greatest single challenge facing the world at present: how to feed a population set to grow from 7.6bn today to 8.6bn by 2030, 10bn by 2050, and 11bn by 2100.

Agritech will play a key role in meeting that challenge. The word "agritech" tends to conjure up images of drones patrolling farms, autonomous tractors and harvesters, robotic milkers and other pieces of futuristic technology. While these images are accurate, the most important developments in agricultural science and technology will be those that allow us to do more with less as we continue to produce high-quality food.

INCUBATING & FUNDING

Ireland is enormously efficient when it comes to food production. Our population currently stands at 4.7m people but enough beef and dairy produce for roughly 35m people is produced.

None of these developments have occurred by accident. Getting the balance right between increased production and high standards of animal welfare and sustainability requires a combination of best farming practice and innovative agricultural technologies.

World-leading research carried out by Teagasc, along with ongoing investments in R&D by Irish firms, has helped to create a thriving agritech sector.

The need for change in traditional agricultural systems is being driven by a range of powerful forces, including pesticide reduction initiatives, the need to reduce antibiotic use, increased scarcity of water and the challenge to provide sustainable food production systems for the growing world population. As Irish companies develop innovative solutions to meet these challenges, the world is beginning to take notice. For example, Irish agri-engineering exports are now worth €250m annually to the Irish economy.

Today, machinery produced by Irish manufacturers is harvesting grass throughout the world and is responsible for feeding cattle in every continent. Ireland might be a relatively small agricultural producer globally but what we do in the sector, we do extremely well. Ireland has the highest standard of agricultural education in Europe. The country has established a deserved reputation for innovation across the entire agricultural value chain.

Ireland has won €475m in competitive funding from the EU programme for research and innovation called Horizon 2020 to date. This has a budget of €80bn running over seven years up to 2020. More than 1,100 applications have been successful for 536 higher-education researchers and 430 companies, placing Ireland's success rate above the EU average by 7%.

436
projects approved by Enterprise Ireland in 2017

€250M
value of agri-engineering exports from Ireland

€475M
worth of EU competitive funding received by Ireland

Enterprise Ireland approved the delivery of 436 projects for industry development last year. This is an increase of 17% on 2016. These projects are delivered through the Technology Gateway Centres, located in the Institutes of Technology across Ireland. These collaborations help Irish companies to find solutions to technical challenges and implement innovations that make their solutions more competitive.

OUR POPULATION STANDS AT 4.7M PEOPLE BUT ENOUGH BEEF AND DAIRY PRODUCE FOR 35M PEOPLE IS PRODUCED

This year, Enterprise Ireland launched the Agile Innovation Fund to support companies to respond faster to market opportunities and challenges, including those posed by Brexit. Offering fast-track approval and a streamlined online application process, companies can access up to 50% to support product, process or service development projects with a total cost of up to €300,000. This fund is also available to companies who deal with the local enterprise office.

A new €20m investment fund established by the Ireland Strategic Investment Fund (ISIF) and Finistere Ventures also aims to support Ireland's development as an "agritech island". The Ireland AgTech Fund will invest in startup and early-stage companies that can generate significant economic impact in the Irish agriculture and food sectors.

INNOVATION ARENA 2018

The hugely successful Innovation Arena organised by Enterprise Ireland, the *Irish Farmers Journal* and the National Ploughing Association is fast becoming a focal point for the agritech sector in Ireland.

Last year, Enterprise Ireland hosted 109 international buyers from across the globe to look at Irish innovation in ag engineering. This benefited the established companies, creating new market opportunities, which is important in light of Brexit. The Innovation Arena will be used as a conference venue this year, where new products can be launched, and presentations made to international buyers. To help develop business, private meeting rooms will also be available to discuss potential with international buyers. The Innovation Arena will provide the perfect launchpad for new innovations from established leaders in agritech.

On an annual basis, Enterprise Ireland is working with around 5,000 companies through a network of market and sector advisers based across 10 national offices and 33 international offices. This illustrates how Enterprise Ireland can help to take an innovative company, and create the opportunity to deliver global success. Agritech will play an important role in Enterprise Ireland's strategy to deliver 60,000 new jobs across all sectors by 2020, and create €5bn in extra exports.

At the launch of the National Ploughing Championships Innovation Arena, in association with Enterprise Ireland and the Irish Farmers Journal, were: Eoin Lowry, Irish Farmers Journal; Anna May McHugh, NPA; Julie Sinnamon, Enterprise Ireland; and James Maloney, Enterprise Ireland. \ Karl Hussey / Fennell Photography

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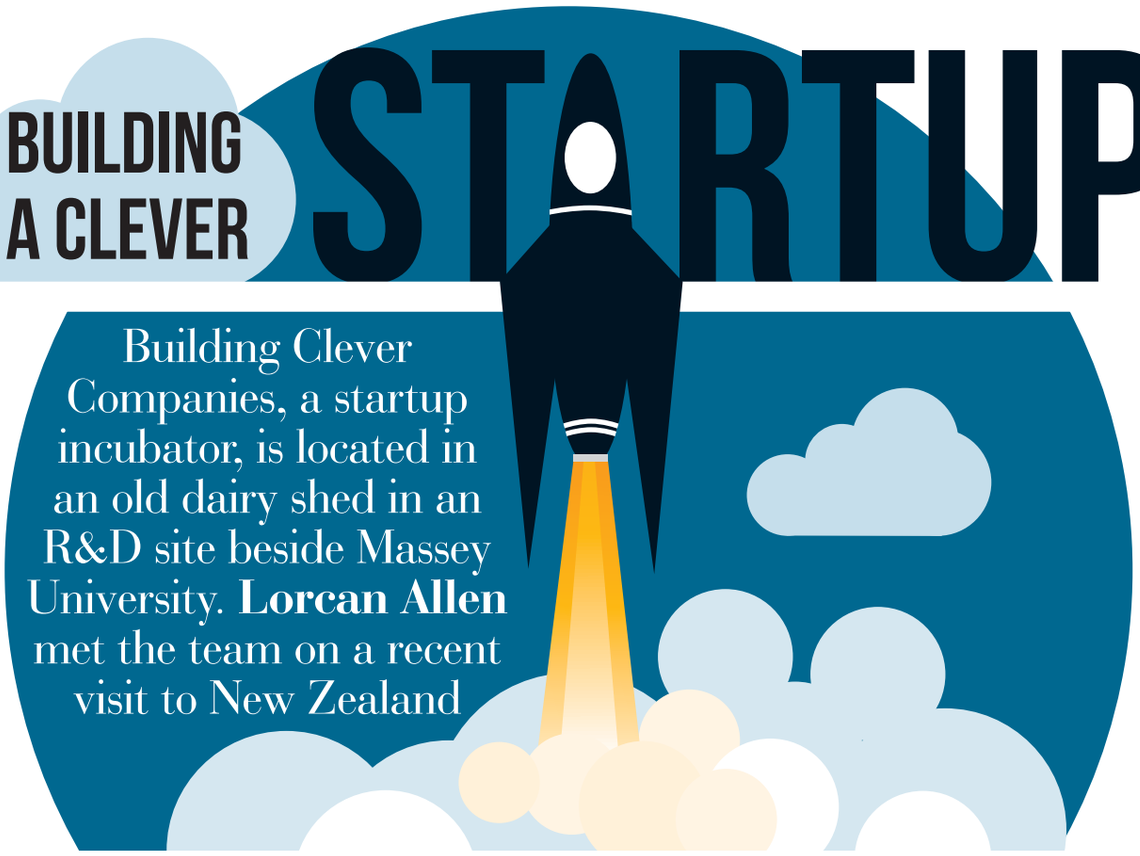
BUILDING A CLEVER STARTUP



Building Clever Companies, a startup incubator, is located in an old dairy shed in an R&D site beside Massey University. **Lorcan Allen** met the team on a recent visit to New Zealand

On New Zealand's North Island, sitting on the banks of the winding Manawatu river, is Palmerston North, a small city where Ireland rugby coach Joe Schmidt began his coaching career at the local high school.

Palmerston is also home to Massey University, one of the world's leading third-level institutions when it comes to agricultural science and research. The expertise and talent developed out of Massey made Palmerston the natural location for New Zealand's agriculture industry when it came to research and development.

Just across from Massey's tree-lined campus, located on the appropriately named dairy farm road, is a small cluster of research centres. AgResearch, the New Zealand grassland research body is based here, as is New Zealand's research centre for agricultural greenhouse gases.

Fonterra, the New Zealand dairy co-op, also operates its world-class R&D centre at this site, where a number of world firsts have been developed such as spreadable butter and milk protein concentrates, which are used in cheese, yoghurt, sports nutrition and pharma products.

One of the newer entities located along the dairy farm road is a startup business incubator called Building Clever Companies, or BCC as its better known.

BCC traces its roots back to the late 1990s when entrepreneurs and businesses were looking for a way to develop the economy of the Manawatu district, which is the name for the wider geographical region around Palmerston.

To fund this incubator, the business community of the region established the Manawatu Investment Group (MIG) – an angel investment group for new startup companies. At the same time, a technology transfer partnership was also signed with Massey University to help bridge the gap between business and science.

It was 2005 before BCC became fully operational and started to launch the first startup companies from its incubator. The new incubator grew over the years and began to expand its investment activities following the global financial crisis.

BCC has since evolved to focus on high-potential startup companies that can one day deliver employment, exports for New Zealand and a return on investment for the MIG angel investors. The BCC incubator has had particular success when it comes to startup companies involved in food, animal health, agritech and environmental technologies.

Dean Tilyard is chief executive of BCC and has been with the company since its inception.

"For me, agritech is the application of new technologies along the food supply chain," says Tilyard. "BCC is focused on the startup pipeline and there are about 120 new technologies looking to come to market every year in New Zealand."

Surprisingly few dairy applications are coming through the startup pipeline in New Zealand, says Tilyard. Most of the pipeline to date is from companies looking to innovate in more niche sectors such as honey and horticulture.

Angel investors are plentiful in New Zealand, according to Tilyard, with most companies able to attract seed investment. However, venture capital

> BCC is focused on the startup pipeline and there are about 120 new technologies looking to come to market every year in New Zealand

required for the next phase growth is absent from New Zealand, which is forcing rapidly expanding companies to look abroad in places like California for next level finance.

New Zealand agritech companies such as CropX and BioLumic have attracted $17m and $12m, respectively, in series A rounds of funding from investors in California. Series A funding is typically the first significant round of venture capital financing for a new company.

Tilyard says there are 20 venture capital funds operating in California that specialise in agritech investment.

"The big venture capital money was not previously going into on-farm applications. It first went to new innovations around food delivery and forms of indoor planting," says Tilyard.

"But now people are getting more confident around on-farm applications and solutions. The seasonality of farming makes agritech development slower but that shouldn't mean we use seasonality as an excuse," he adds.

WEAKNESS

The absence of serious venture capital funding needed by growing startups has been a major weakness for the agritech movement in New Zealand. BCC has poured huge energy into developing clever ideas and innovations from its startup pipeline but has lost the fruits of this work when companies were forced to move abroad in search of next level funding.

CropX, an analytics company that develops software for saving water and boosting crop yields, has moved its headquarters to Israel, with an additional office also located in San Francisco. Likewise, BioLumic, a New Zealand company that has developed a unique UV light treatment technology to boost crop yields and disease resistance, has recently opened an office in California. While BioLumic maintains its headquarters in Palmerston North, it is building its staff in the US and Mexico, which are seen as key markets.

For any country, the ultimate goal of fostering innovation and the development of new companies is to add to the domestic economy, particularly via job creation and future investment. However, the flight of New Zealand's agritech startups to other parts of the world is eroding the future economic potential of New Zealand and losing it to agri-tech hotspots such as Israel, California and even Ireland.

Creating an environment of innovation and building a startup pipeline like BCC has done is admirable. However, the absence of capital investment to fund the next level growth of these companies only robs New Zealand of the future benefit they could deliver.

CropX is an analytics company that develops software for saving water and boosting crop yields.

$17M

attracted by CropX in funding from investors in California.

$12M

attracted by BioLumic in funding from investors in California.

20

venture capital funds operate in California that specialise in agri-tech investment.

BioLumic, one of the startup companies that came through the Sprout accelerator.

While BioLumic maintains its headquarters in Palmerston North, it is building its staff in the US and Mexico, which are seen as key markets.

INCUBATING & FUNDING

Companies in the 2017 Sprout accelerator programme pitching to judges.

SPROUT ACCELERATOR

Given the rapid growth in agritech startups coming through its pipeline over recent years, BCC has developed a specialised accelerator programme for agritech companies called Sprout. Every year, the best eight to 10 agritech startups are identified in New Zealand and added to the Sprout accelerator programme.

Companies selected for the five-month Sprout accelerator are provided with expert mentorship and training from leaders in technology, research and business growth, on top of extra seed funding. Over the last three years, some of the largest agribusinesses and food companies in New Zealand, including the dairy giant Fonterra, have taken a hands-on approach to the Sprout accelerator.

According to Tilyard, New Zealand's large agribusinesses are involved because they want to know what new innovations are coming that might potentially disrupt their business models.

"These large corporate agribusinesses are involved with Sprout because they want a line of sight into the startup pipeline. They want to see what's going on so they can avoid being disrupted," says Tilyard.

To avoid disruption, established agribusiness companies in New Zealand are asking how they can collaborate with the new innovations coming through the startup pipeline at Sprout.

Sprout is an agritech accelerator programme in New Zealand.

COMPANIES SELECTED FOR THE FIVE-MONTH SPROUT ACCELERATOR ARE PROVIDED WITH EXPERT MENTORSHIP AND TRAINING FROM LEADERS IN TECHNOLOGY, RESEARCH AND BUSINESS GROWTH

ISRAEL THE GLOBAL LEADER IN AGRITECH

Israel's population and land size is small relative to the US, China, and India, yet the country has produced an agritech sector that ranks among the top five countries in innovation. **Eoin Lowry** reports

In terms of agricultural innovation, Israel could be a role model for the world. Beginning half a century before its independence in 1948, the country has had to feed an ever-growing population which now reaches almost 9m.

Approximately one-quarter the size of Ireland in area, it is more difficult given that its geographical landscape comprises semi-arid land, combined with declining natural freshwater resources.

Thanks to a culture of agricultural research and development promoted by the government, along with innovative farmers, Israel has cultivated an ecosystem of agricultural innovation.

Over the last decade, Israel has produced a high number of new, technologically innovative companies which address global agricultural issues, such as food insecurity and safety, labour shortages and environmental strains.

Scientists closely collaborate with farmers to invent cutting-edge collaborations, such as heat-tolerant tomatoes, drought-resistant cucumber seeds, and ultra-efficient drip irrigation.

Israel has also achieved water self-sufficiency through a combination of education, policies, pricing and technologies.

Israel has always answered its own agricultural challenges, and in the process has created a large produce export industry.

But the real comparative advantage of this small country with its proven agricultural know-how lies in exporting technology, often tested first by Israel's own farmers. Thanks to the combination of long-term experience and the expertise of the broader high-tech ecosystem, Israel is becoming a global leader in agritech.

According to Start-Up Nation Central, an NGO dedicated to the Israel innovation ecosystem, there are over 460 Israeli agritech companies, with more than 25% of them founded in the last five years, and 50% founded in the last 10 years. It is no surprise that investors want in. Over the past four years, more than $400m has been invested in agritech with the majority of investment rounds in seed-stage. The entire sector raised $97m in 2016, 3% of global funding in agritech. Investments for the first nine months of 2017 totalled $131m, 35% more than the full year 2016.

By comparison, investments in American agritech amounted to 58% ($1.87bn).

INCUBATING & FUNDING

While the American sector's share of global venture captial overshadows that of Israel, when we consider population sizes, on a per-capita basis, Israel is miles ahead. In 2016, American agritech raised $5.80 per capita; its Israeli counterpart raised almost double. Israel's agritech sector, though small in absolute figures, consistently attracts investor activity in higher intensity per capita than the US. It therefore appears that not only does Israeli agritech innovation command investor confidence, but it does so at a greater level. Israeli agritech has proven particularly strong in on-farm technologies, solutions that interact with the farmer. Since about two-thirds of the country is desert, Israel's agriculture sector has had to cope with a limited amount of natural resources, growing more with less. More and more countries around the world are reaching their limits and face threats similar to those Israel has overcome. This is where smart farming technologies (data-driven solutions and high-performance hardware for increased resource efficiency and crop yield) are important.

MACHINERY AND ROBOTICS

Israeli innovators have developed artificial intelligence (AI)-based ground robots that pollinate tomatoes in greenhouses—keeping a record of treated plants—while self-sterilising and cleaning to prevent crop disease.

The sector also makes use of machine vision in robotic harvesters, which can identify crop ripeness, and be used for pruning, pollination, and monitoring. Israeli robotics are also enhancing post-harvest handling through automation of sorting, picking, packing, and quality control. One Israeli company specialises in hardware-independent robotic vision and automation for high-versatility production lines.

Its robotic system learns and mimics human or robot performance, removing the need to reprogram robots for different tasks. A small percentage of the companies in the sector focus on livestock, such as one company that offers robotic milking systems.

AGRI-BIOTECHNOLOGY

More than half of these companies innovate in plant breeding or genetics, modifying traditional breeding methods and deriving new genetic analysis. Some of these companies offer platforms for gene discovery, analytics, selection, and editing, while others focus on biological inputs and treatments.

Among the Israeli agritech industry's non-GMO solutions, one innovative company encourages selective breeding by focusing on plant roots, promoting only the high-performing, abiotic stress-tolerant plants in a group. Other bio-solutions include nanoparticle-based methods of transporting and delivering agrochemicals through plants, and mycorrhizal inoculants for improving 90% of all plant species' uptake of soil nutrients, thereby reducing fertiliser amounts and increasing crop yield, among others.

ALTERNATIVE PROTEIN

Companies are also seeking to reduce the dependence of an ever-growing population on traditional meat sources by developing sustainable alternative sources of protein. There are nine Israeli alternative protein companies, six of which were founded in the last three years. These companies innovate in one of three protein sources: plants, insects or cultured meats.

ISRAELI AGRITECH COMPANIES OFFER TECHNOLOGIES TO BOOST AND ENHANCE FOOD SAFETY. THERE ARE 20 COMPANIES THAT INNOVATE IN FOOD-PRODUCTION TRACKING, QUALITY MONITORING, CONTAMINANT DETECTION AND STERILISATION

The Israeli companies developing plant-based protein – eg from seaweed, chickpeas – are the best funded in Israeli alternative protein. Among the insect-based protein offerings in Israel, one company has developed a technology for establishing commercial grasshopper farms that leave a minimal water footprint and create almost no waste.

Another alternative protein group of companies, crossing into foodtech, grows meat in cell cultures. It is currently developing poultry and bovine meat using regenerative technology.

Israeli agritech offers technologies to boost and enhance food safety. There are 20 Israeli companies that innovate in food-production tracking, quality monitoring, contaminant detection and sterilisation, as well as post-harvest technologies that ensure produce quality in packaging and storage.

One company has devised a pocket-sized microspectrometer that instantly reads produce quality, ripeness, spoilage and contamination, and reports nutrient analysis for animal feed. Another company has developed a low-power radio-transmission technology for breast-cancer screening, which it now applies also to monitoring for food safety, including dairy-contaminant detection at farms.

460
Israeli agritech companies.

25%
of them founded in the last five years.

50%
founded in the last 10 years.

$131M
raised by agritech in 2017.

SUMMARY

Israel's population and land size is small relative to the US, China, and India, yet the country has produced an agritech sector that ranks among the top five countries in number of deals. It also receives a disproportionately large share of global agritech funding, especially in on-farm technologies and smart farming. With a significant pool of highly skilled yet affordable labour, and an influx of expertise and technological innovation from academia and the high-tech ecosystem, there is still plenty of room to grow. As global agriculture challenges become ever pressing, farmers and agribusinesses around the world are turning to Israeli agritech for collaboration. Investors, too, are realising the promise of deal flow, and the field is not yet crowded.

Further details about Israel's agricultural sector can be obtained from the commercial office at the Embassy of Israel in Dublin. Tel: 01-230 9415 or email trade@dublin.mfa.gov.il

The information used in this article was supplied by Start-Up Nation Central, an Israeli NGO that promotes technology and innovation.

KPMG IRISH FARMERS JOURNAL

3 FARMING WITH TECHNOLOGY

In less than 30 years, US grain farmers have increased the yield per acre of growing maize corn from 118 to 172 bushels. This incredible rise in productivity per acre demonstrates that farmers will always innovate to become more efficient and productive once the right technology is made available to them. The hyper competitive nature of grocery retail in most developed economies today has led supermarkets to consistently push down food prices in a bid to gain, or defend, market share. To offset this squeeze on prices, farmers will continue to adopt the latest technology available to them to remain competitive.

FARMING WITH TECHNOLOGY

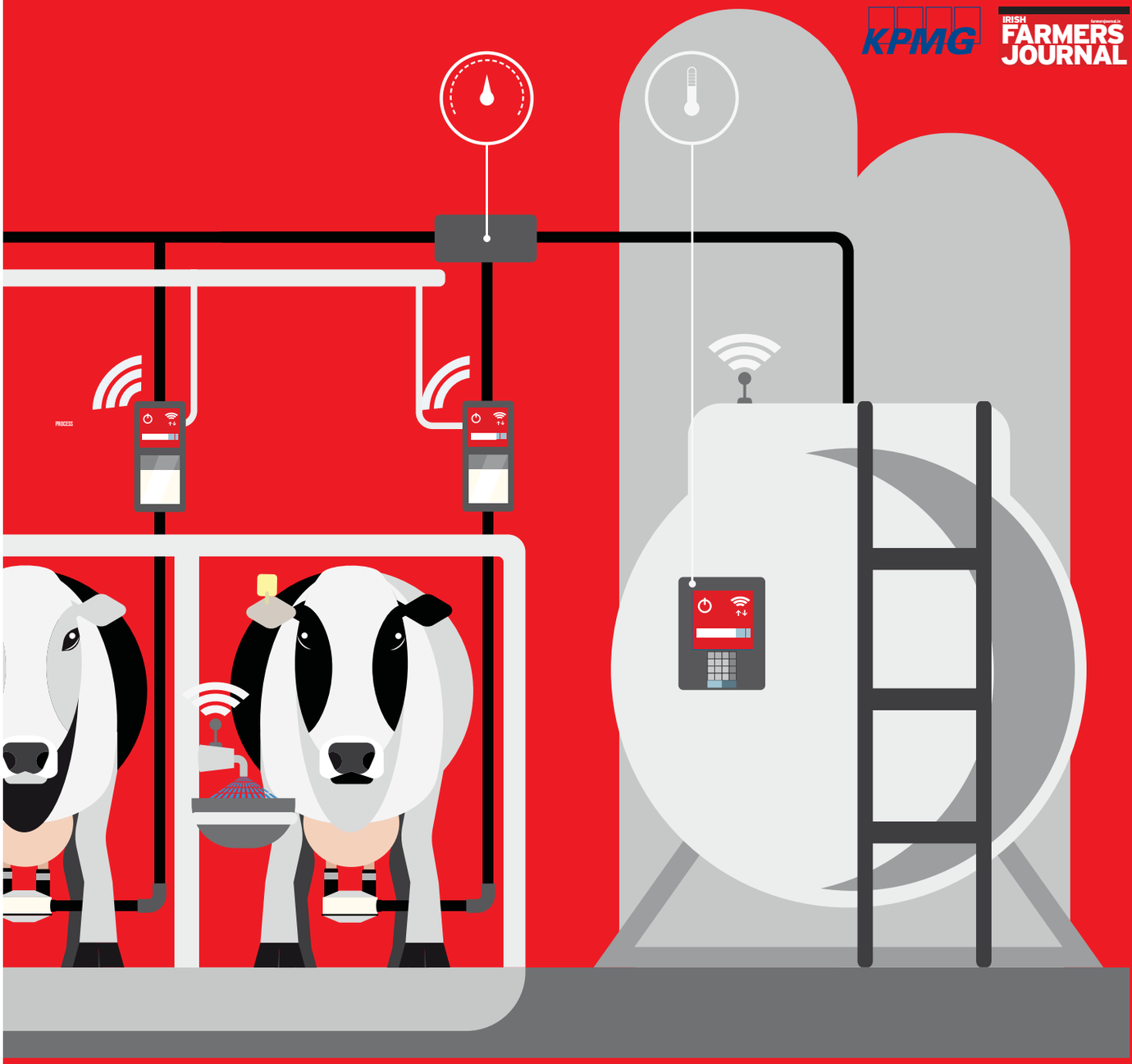
WELL-CONNECTED DAIRY COWS

Aidan Brennan looks at the evolution of the smart cow, and why sensors will change farming forever

Over the last decade, consumers in the developed world have become accustomed to the next generation of smart devices. These are everyday objects such as televisions, watches, phones and houses that are interactive and connected through the internet. We now have the "internet of things". Smart technology enhances the user experience and allows manufacturers to add value to what are essentially everyday devices.

In the same time, we have seen an increase in the technology being used on farms. Indeed, the smart cow can now be added to the list of smart devices alongside smartphones, smart watches and smart TVs.

It could be said that the smart cow's conception began 20 years ago with the introduction of feed-to-yield feeding systems. These use computer pro-



grammes to give more feed to cows that give more milk. More recently, automated heat and health detection aids have combined to grow the repertoire of decision support tools available to farmers.

BEHAVIOUR

These devices monitor cow behaviour and use computer-generated algorithms to predict the onset of heat, or if a cow is sick. The farmer can check, through his or her smartphone, the time each cow has spent eating, walking and chewing the cud. Sick cows and cows close to calving are identified and cows that are on-heat can be automatically drafted after milking for artificial insemination. In fact, a whole herd could be inseminated without the farmer looking at one cow for signs of heat or pressing a button on a drafting gate.

This removes the necessity of human decision-making in what is a critical part of the dairy farming calendar. But not only is the decision-making removed, so too is the physical labour – no tail painting, no time spent watching cows for signs of heat. These devices are also safer, as the period of artificial insemination can go on for longer removing the need for bulls on dairy farms.

Combine this technology with robotic milking and computerised calf feeding and the physical input required for dairy farming reduces even further. Research has shown that the actual time spent managing farms with high levels of automation does not change dramatically, but the type of work being done does, with much less physical work and much more data and information management type of work being done. This suits some people more.

Of course, the evolution of the smart cow hasn't just been to do with removing the physical workload with dairy farming. Since 2009, there has been a quiet revolution in the way cows are bred. In the same way, geneticists can detect gene and health defects in humans using genomics, they can use genomics to fast-forward genetic gain in dairy cows by identifying bulls that have superior traits, from the DNA in a hair follicle. Over 70% of all dairy calves born in Ireland now have at least one parent that was genomically selected.

FARMING WITH TECHNOLOGY

FUTURE

Where to from here? If new technology in the last decade was about decision support tools and reducing physical labour input, then the next decade will be about artificial intelligence (AI). AI is essentially machine learning. In its simplest form, AI is giving a computer information (data) and making it come up with expected outcomes (results). By then feeding in the actual outcomes, the computer will get better at making predictions over time.

From a farming point of view, the possibilities with AI are endless. Let's say every parish in Ireland had 10 fields with weather stations in them. These weather stations are just sensors monitoring rainfall and soil temperatures. This data, along with weather forecasts and grass growth information can all be fed into an AI computer. Grass growth doesn't even need to be manually measured as the technology now exists to measure grass from space with the technology being used currently in New Zealand.

Using all of these parameters, the computer should be able to predict what grass growth will be like up to the next month. The amount of fertiliser being spread can also be fed in to the computer. GPS-enabled machines can tell the computer where it was spread and how much went out. Over time, the computer will learn from the outcomes and the accuracy of the predictions on grass growth will increase.

At the macro level, the implications of this are huge.

If growth is going to be slow, then feed manufacturers will know that extra feed will be required on farms so they can increase production in advance. Milk processors will know that if grass growth and ground conditions are going to be good, that extra milk deliveries will be coming. Not only will the volume of milk be able to be predicted, but also the fat and protein composition, as this is largely based on the diet of the cows.

From a supply chain management point of view, the implications of this are huge. Milk processing and the logistics around collection and end product deliveries will become much smarter. From the farmer's point of view, feed and financial budgeting will become a lot easier and a lot more accurate.

That's just one example. There are many more examples of where AI can have a huge effect such as predicting animal health problems, soil fertility, profitability, input requirements, environmental footprint and global supply and demand of dairy products. The key to all of this is sensors.

NEXT DECADE

Over the next decade, we will see the widespread rollout of sensors to farms. These will become cheap and almost disposable. They will be in fields, on tractors, in milking parlours and in cow's rumens. Each sensor might only gather a very small amount of data, but they are connected through the internet to the AI computer that will use the data to compute outcomes.

Science Foundation Ireland last year announced a Teagasc-led project called Future Milk. The project is a collaboration between research and industry to develop future technologies for precision agriculture.

Over 50 research officers will be employed working on different projects across grass production, animal health, milk processing and genetics.

EFFECT

The question farmers will have is whether this new technology will improve profitability and for whom.

It is very easy to see the cost savings for milk processors and feed merchants as they will have visibility of what is coming down the line. This means they can plan for logistics, staff numbers, production levels and set targets for sales teams.

From the farmer's point of view, the effect on the bottom line will be less visible. For sure, knowing grass growth and knowing future production has certain benefits but effectively this is going to happen anyway, whether the computer predicted it or not.

What the farmer needs to know is what to do and when to do it to get the best outcome – when to start grazing cows, how much meal to feed and when to plough the field and sow the crop. This will have real benefits for the farmer.

There are still a large number of unknowns. Who will pay for the sensors?

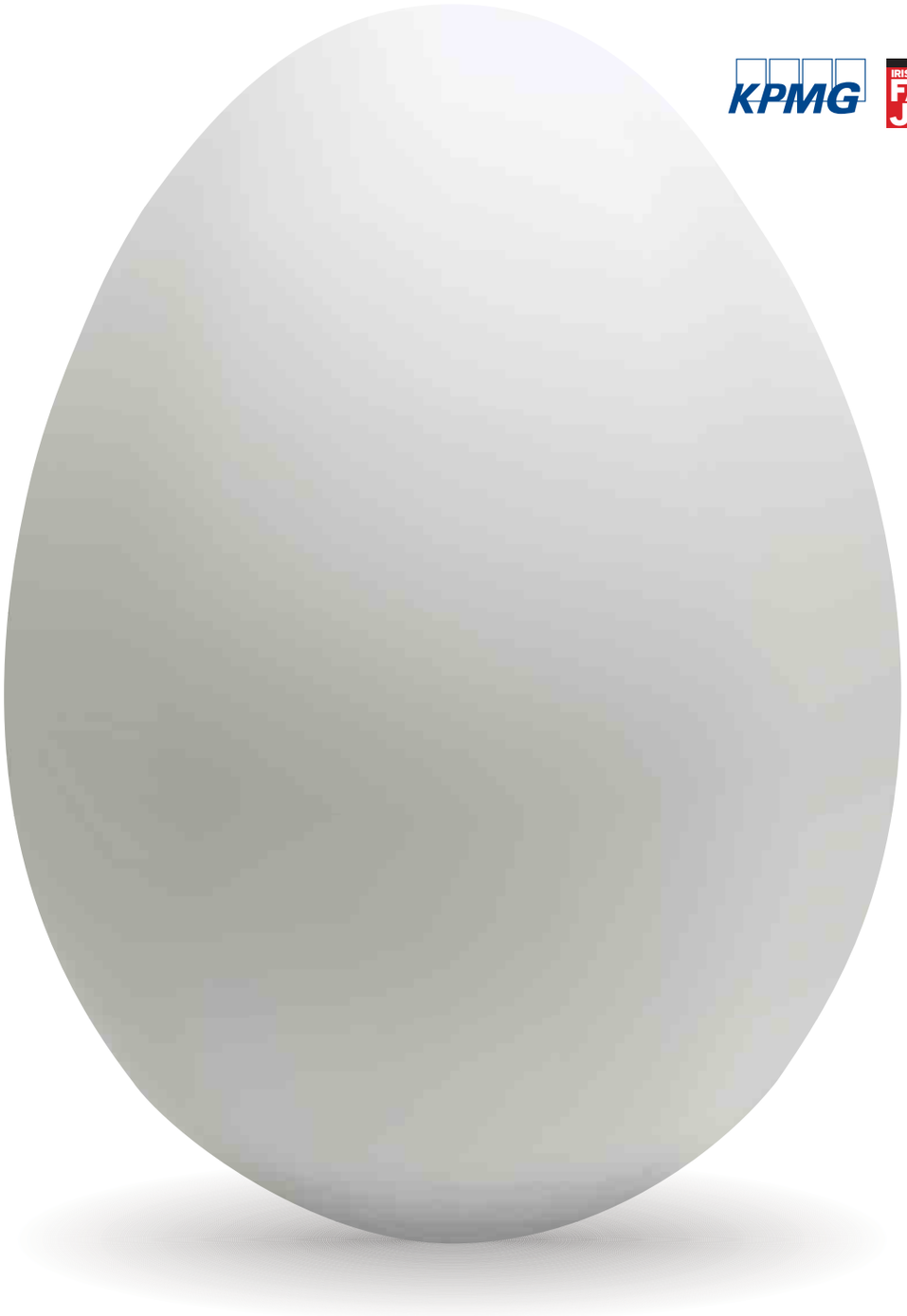
Who will pay for the AI and who owns the data? Is it the farmer generating the data, the tech company, or the milk processor?

The other concern farmers will have is about where the world's food will be produced. Many developing and third-world countries have excellent resources in terms of soil type and weather, but lack the skills and human capital element.

Smart technology has the capacity to fast-forward human learning. Will technology enable a shift in food production away from the western world with its labour problems to the developing world in South America and southeast Asia where the cost of production is cheaper?

A cow with a heat and health detection sensor on.

WHERE TO FROM HERE? IF NEW TECHNOLOGY IN THE LAST DECADE WAS ABOUT DECISION SUPPORT TOOLS AND REDUCING PHYSICAL LABOUR INPUT, THEN THE NEXT DECADE WILL BE ABOUT ARTIFICIAL INTELLIGENCE



CRACKING THE EGG MARKET

Dutch farming is intensive and production focussed. But some farmers have found ways to innovate, almost literally, at the farmgate, writes **Lorcan Allen**

FARMING WITH TECHNOLOGY

In the east of the Netherlands, not far from the border with Germany, is the city of Doetinchem. Like most Dutch cities, you don't have to travel too far from the city centre until you start to see green paddocks with grazing cows or fields of planted forage crops.

On the southwestern edge of Doetinchem lives Roy Tomesen, a Dutch egg farmer and 2016 Nuffield scholar with about 120,000 layers. Like poultry and pig production, egg farming is heavily commoditised and scaled – intensive production is an absolute necessity to survive.

"In a typical week we produce 150,000 eggs, selling anywhere between 60,000 to 70,000 of those," says Tomesen, whose family have been producing eggs for more than 50 years. "Large egg-packing stations are the only buyer of eggs in the Netherlands. They take the eggs direct from farmers like me, grade them and package the eggs for supermarkets. I typically get a price of 6.5c/egg from the company I sell to," he adds.

Depending on the price of feed, the costs of production on the farm generally average about 6c/egg, meaning margins are tight in the egg business. Faced with this reality, Tomesen has devised a clever idea to take advantage of his farm's proximity to the city of Doetinchem, which has a population of 50,000.

At the entrance to his farm, Tomesen has installed a number of self-service egg vending machines that he also stocks with seasonal produce such as honey, strawberries and jams.

"We now have almost 2,000 customers a week who just stop in and take as many eggs as they need. We're selling about 25,000 eggs per week from the vending machines," says Tomesen.

This simple innovation has proven a real added value investment for Tomesen. Although he is selling less than 10% of his egg production via these machines, the profit margin is much higher.

The direct relationship with the customer allows him to achieve a market price of 10c/egg, while also saving on the transport costs to the egg packing company.

"Facebook works really well for promoting the egg vending machines," says Tomesen. "We now have up to 20,000 followers on our social media. I sometimes get people calling me saying they have a big order of 90 eggs and would I have that many eggs. I just tell them 'sure just come along to the vending machines'."

With most Dutch consumers almost 20 generations removed from the farmgate, Tomesen has found a unique and positive way to communicate with his customers.

The egg-shaped Venco Campus and, right, Roy Tomesen, egg farmer.

RETAIL PRESSURE

Similar to most developed countries, a handful of powerful supermarket chains control the retail sector in the Netherlands and increasingly dictate the pricing of eggs to Dutch farmers. However, supermarkets in the Netherlands have come under intense pressure from animal welfare organisations, who are strongly against intensive pig, poultry and egg production.

Prior to the EU-wide ban on battery caged egg production in 2012, animal welfare groups in the Netherlands would pay for radio and television adverts naming and shaming retailers that were stocking caged eggs.

Although the caged egg production system has since disappeared from the Netherlands, animal rights groups are now targeting the barn egg production system, which is the most widespread system now used by Dutch egg farmers.

Pressure from animal rights groups has forced Dutch supermarkets to label eggs using a star system to indi-

Roy Tomesen has installed egg vending machines at his farm to sell product directly to local consumers.

> In a few years the only place I will be able to buy my own eggs will be to drive to Germany and get them

cate to consumers what system has been used by the farmer to produce the eggs.

Barn-produced eggs have zero stars, while eggs coming from laying hens housed in a wintergarden attracts one star. A wintergarden is a normal poultry house with a veranda extension that allows for extra movement for hens.

Free-range eggs get two stars under the ratings system, while organic produced eggs attract the highest rating of three stars. Tomesen believes the wintergarden system, which he houses his layers in, will soon be heading for a zero star rating because of mounting pressure from animal rights groups.

"In a year I don't think my eggs will be sold in Dutch supermarkets anymore because of the star system," says Tomesen. "The wintergarden system of production is heading for zero stars. In a few years the only place I will be able to buy my own eggs will be to drive to Germany and get them."

Like everything in the agri sector in the Netherlands, the Dutch produce more eggs than their domestic need. Less than a third (30%) of Dutch eggs are consumed in the Netherlands, with the remaining 70% exported. Germany is by far the largest export market, taking 85% of exports.

Rondeel branded eggs.

RONDEEL

Sensing the rising opposition to barn egg production, the Dutch poultry housing and egg handling manufacturer Vencomatic has developed a novel new form of layer housing for egg farmers called the Rondeel.

Vencomatic is not an old company by Dutch standards, having been established in 1983 by Cor Van de Ven, who developed the first automatic solution for egg collection in a hen house. Today, the company has sales in 76 markets around the world and operates from its state-of-the-art Venco Campus, which is shaped like an enormous egg.

The Rondeel system is a complete egg farm that can house up to 40,000 layer hens. However, the system is primarily designed to address the animal welfare and environmental challenges facing the modern Dutch egg farmer today, as well as leverage a marketing opportunity from its unique design.

Shaped in a circle, the Rondeel is composed of five houses for layer hens, which offer extra space and a more natural environment to birds than conventional housing. All eggs are collected to the central core of the Rondeel to the egg packing station.

To further promote this high welfare system, Vencomatic invented a unique packaging system that reflects the unique design of the laying house. Breaking away from the traditional format of selling eggs in sixes or 12s, the new Rondeel branded packaging carries eggs in odd numbers such as three, five and seven in circular-shaped cartons.

Further playing into the environmental field, the packaging is all made from wood and potato shavings, making it completely biodegradable.

While Vencomatic has installed just eight of these Rondeel systems to date (seven in the Netherlands and one in China), the company is betting that continued animal welfare pressure in the Netherlands and Europe will force traditional egg farmers to think very differently about their production systems.

MAGIC MUSHROOMS

Brendan Dunleavy looks at how Irish mushroom growers converted fungus to fresh food and horse manure into hard cash

For a country synonymous with grass-based livestock production, selecting the mushroom industry as a model for Innovation is a big call. From a value of approximately €600,000 50 years ago, last year Irish mushroom exports were over €91m.

The dairy and beef processors always had an unlimited and captive supply of raw material. They started supplying basic standard food staples with long shelf lives to British markets. Traditionally, these markets were chronically short of meat and dairy products. So getting into them was no big deal. But the mushroom industry had only horse manure and poultry litter as its raw material – agricultural waste byproducts effectively worth nothing. In fact, it costs a lot to store and dispose of them. But when the mushroom innovators transformed these agri-waste byproducts into mushroom compost, they acquired real value.

Mushrooms are the highest value-added food product. That's because when composted, 1t of horse manure or poultry litter will produce 1.56t of mushrooms. These are the alchemies which the Irish mushroom industry used. Simultaneously, they opened new markets in the UK. The farmgate value of mushroom production north and south is €130m, according to Bord Bia.

Before UK and Dutch mushroom growers knew

> Almost overnight, innovation propelled Irish mushroom growers from shovels, wheel-barrows and compost bags to computers, combi-lifts and supermarket shelves

FARMING WITH TECHNOLOGY

what was happening, the Irish had gone a long way to push their mushrooms out of the UK market. The Irish achieved this remarkable feat on the basis of excellence, quality, technical efficiency, productivity and constant innovation.

The UK mushroom market is one of the most competitive in the world. Domestic UK, Dutch, Polish, and Irish growers are continually vying for space on supermarket shelves. To even survive in this market is a major achievement; to take and to hold a large share of this market is nothing short of a miracle.

UK consumers always had a big appetite for fresh mushrooms. Forty years ago, UK consumers spent less than €1m a year and consumed less than 1kg per head per year. Today, every year UK consumers spend £400m on fresh mushrooms and eat 3.25kg per head.

FACTORS FOR SUCCESS

In the early 1980s, UK consumers were still depending on their mushrooms from outdated UK growers and obsolete growing systems. Specifically, the systems had never been mechanised and the costs were always too high. Accordingly, compost and mushroom production could neither be ramped up to an industrial scale for corporate investors; nor scaled down to a cottage industry for family farmers.

After a century of stagnation, the technology of compost production and mushroom growing was about to skip several generations. This new technological leap was accompanied by a fortunate confluence of some new social, demographic and economic developments. Specifically, Dutch mushroom companies had much earlier built up a big market for processed mushrooms in Germany. These processed mushrooms were preserved in a brine solution and packed in cans, jars, and even big plastic bags.

Traditionally, these Dutch-processed mushrooms were mechanically harvested. However, the mechanical harvesters caused a lot of damage, bruising and compost/peat contamination to the mushrooms. As German consumers got more affluent, they also got more discerning and more selective. Specifically, German consumers didn't like their mushrooms to be bruised, broken or contaminated in any way. Accordingly, Dutch-processed mushrooms would have to be handpicked. However, given the high costs of labour in Holland, this was impossible.

The three new critical technology breakthroughs which would change the face of the Irish and UK mushroom industries forever were: bulk pasteurisation and spawning of compost; growing mushrooms in 20kg plastic bags and construction of low-cost, insulated polytunnels.

Unprofitable beef enterprises, a looming milk quota, a superlevy regime, and the scourge of bovine TB and brucellosis pandemics, were the norm in Ireland 1980. Worse still, Irish farmers were just in the middle of receiving a Government-funded agricultural credit rescue package to repay bad loans; bank interest rates were 20%: inflation was 20%; and unemployment was 20%.

Almost overnight, innovation propelled Irish mushroom growers from shovels, wheel-barrows and compost bags to computers, combi-lifts and supermarket shelves.

400KG

mushroom yield per tonne of phase 3 compost, double that of 30 years ago.

€2M

construction cost of a typical mushroom farm.

Thirty years ago, everything on an Irish mushroom farm had to be done by hand. At the time, a three-tunnel mushroom farm was a viable family mushroom farm. The growing houses plus a small cold-store and a store for packaging, etc, could be constructed for €15 000 after grants.

Over a 12-week growing cycle, mushroom yields were 200kg per tonne of phase 2 compost. Mushroom picking rates were 13kg per hour. Today, mushroom yields have doubled to 400kg per tonne of phase 3 compost and mushroom picking has doubled to 27kg per hour.

Today's typical mushroom farm puts in 200t of phase 3 compost per week and produces 68t of mushrooms per week in three flushes over a six-week growing cycle. It costs €2m to construct and employs 80 pickers.

But both compost and mushroom production at that time required a lot of fixed capital to get started. Furthermore, the variable production costs of both compost and mushrooms, were extraordinary high and non-viable.

Mushrooms for fresh UK markets must always have the best quality standards, the best appearance, and the longest shelf-lives.

It was imperative that when mushroom pickers plucked a mushroom they placed it carefully in the punnet with the cap turned up. This was very important. It created an image of uniformity and quality. With the mushroom caps turned up, the mushrooms held their freshness that bit longer. Therefore, the shelf lives of Irish mushrooms was also that bit longer too.

In these ways the Irish mushroom industry fast-tracked its way on to the premium value fresh produce shelves of the best and the biggest UK supermarkets.

Within 10 years of their startup, Irish mushroom growers had performed three phenomenal feats. They had copied and replicated Dutch compost and mushroom production technology systems. They had surpassed the production efficiency and quality standards of Dutch mushroom growers. And finally Irish mushrooms had pushed Dutch mushrooms off the premium shelves of the fastest-growing, highest value, UK supermarkets.

4 INNOVATE OR DIE

In any commodity market, efficiency and scale are important to survive. By their very nature, commodities are interchangeable and extremely sensitive to the economics of supply and demand, which can lead to a race to the bottom scenario. Faced with these realities, many companies have found innovative ways of differentiating themselves, particularly in times of falling prices. In agriculture, successful innovation away from commodities has allowed farmers and processors in some sectors to differentiate and add new value to a commoditised product.

ARE WE GETTING A RAW DEAL?

Beef cattle are graded and valued on an EU scale, but **Phelim O'Neill** asks if there is a better way that includes eating quality

Much time and energy is spent debating Irish beef prices, but it is usually on how high or low the top line price is. We never ask the question, are we valuing cattle in the best way that reflects the true value of the carcase.

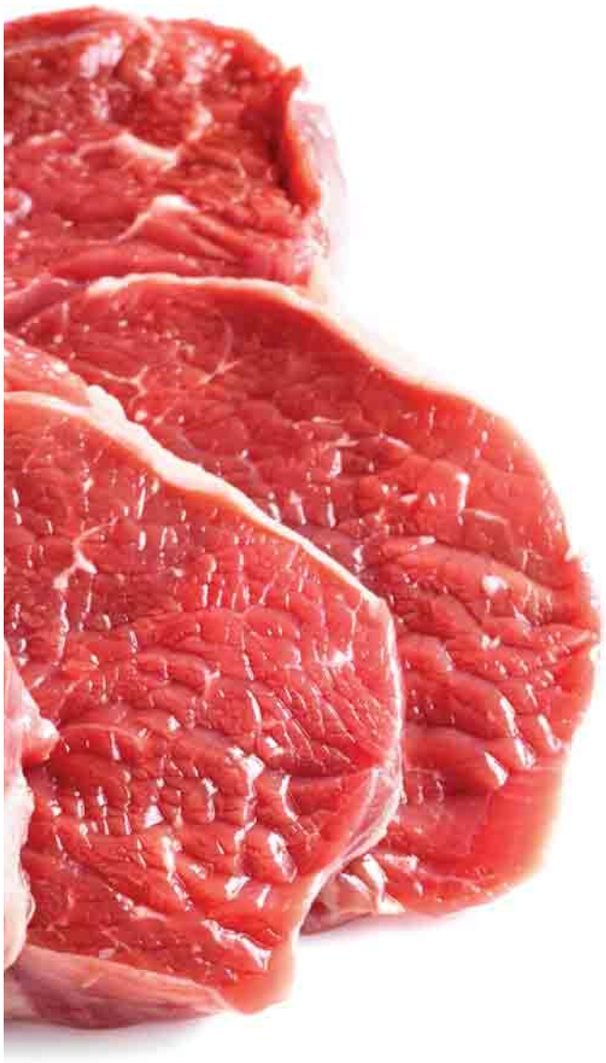
Factories currently value carcases on the standard EUROP scale for conformation where E grade has the most muscle down to the P grade which has the least muscle. Alongside this, the carcase is similarly graded for fat cover on a scale between one and five, where one is little or no fat cover and five has a heavy level of fat cover. This is a standard EU scale that is operated in each member country so that farmgate prices can be monitored across the EU on a weekly basis.

This system has been in place for decades and was fine when factories bought cattle more or less on a flat-rate basis. However, with the introduction of the QPS-based payment system, which was introduced to reflect the value of cattle coming from a Quality Assurance Scheme, came other specification requirements driven by the growing retail and burger chain market. Each individual conformation and fat grade is subdivided into three categories: minus, equals and plus.

USE OF TECHNOLOGY

Cattle grading in Ireland was carried out by state employed licensed graders until 2004 when a camera-based machine took over the role and licensed graders were withdrawn. The same type of grading machine is used in every factory in Ireland, though only in the north, since 2011. The system works on the principle of a camera capturing the image of the carcase and applying a computer programme to the image, calculating what grade it merits on the EUROP, one-to-five scale. This system has performed satisfactorily for over a decade in Irish factories.

The current system of grading cattle in Irish factories is based on technology that was in place 20 years ago. Just like the mobile phone, car or tractor from that era, it works perfectly satisfactorily and consistently, doing the job that is was installed to do. However, there have been technological improvements over the past two decades that would mean the existing system could be upgraded. Since the beginning of this century we have moved from analogue images to digital, to high definition and now ultra-high defini-



tion. The television picture we receive today is much sharper than what we watched 20 years ago. It follows that the factory camera system could similarly be upgraded.

ARE WE MEASURING THE RIGHT THING TO CALCULATE VALUE?

As explained previously, the reason for the present grading system is to enable a standard price comparison be made for cattle across the EU. The introduction of a QPS bonus in Ireland is intended to reflect market value but it could go much further.

With up to 60% of the beef carcase going to mince or grinding beef used in burger manufacture or retail mince sales, the extra value in a carcase is found in the hind quarter cuts, particularly the steak meat. The larger the muscles that provide the steak meat, the greater the value of the carcase. The current EUROP scale broadly reflects this but the technology exists to give a more precise measurement of the muscles. The company E+V, which is German-based and supplies the grading machines currently in use in Irish factories, also has the capability to scientifically measure the:

- Yield grade.
- Total area.
- Fat/meat rate and absolute areas.
- Hypodermic fat thickness (PYG).
- Rib eye area.
- Rib eye height and width.

By going to this level, which is over and above legislative requirements, it would be possible to determine a precise calculation of the amount and types of meat in each carcase presented.

48,000

farmers in the MSA scheme, producing:

40%

of the total Australian cattle kill.

666,000

samples of beef assessed by consumers.

AUSTRALIAN METHOD

Measuring meat yield enables the value of a carcase to be calculated precisely based on the volume of meat it produces for the most valuable parts of the carcase.

However, for consumers of the product, the value of the beef they eat will be based on its quality as opposed to quantity.

This has led to Meat Standards Australia (MSA) developing a system that measures the expected eating quality of a beef carcase, based on the production system and the key eating quality indicators such as marbling for flavour, tenderness and juiciness. Eating standards were established originally by 94,000 consumers assessing 660,000 samples of beef, and the characteristics given an eating quality score.

Each animal is assessed by an inspector at the point of slaughter where the production system and percentage of marbling in the carcase is assessed. From this assessment, a score is given that will determine its eating quality.

DOES IT WORK?

Critics of the Australian system for assessing eating quality in addition to carcase meat yield, as a means of valuing the carcase, would say that the eating quality test is too vague and subjective. MSA, on the other hand, would point out that there is now 20 years of work in this project and it continues to show year-on-year growth.

In its report on 2017, MSA had 48,000 farmers in the scheme producing 2.7m cattle which was 40% of the total Australian cattle kill. They have 54 processors in the scheme and 3,668 end users. What is most interesting is that the estimated farmgate value of being part of the MSA production system, farmers have added an extra AUS$130m (€81.25m). On individual cuts of beef, MSA reported that striploins were worth AUS$1.19/kg (€0.74/kg) more, cube roll AUS$ 2.85/kg (€1.78/kg) more and fillet AUS$ 2.97/kg (€1.86/kg) more.

Whatever the accuracy of the assessment process, it is clear that there is a value in the marketplace for MSA-graded product. Additionally, the company, E+V which supplies the grading machines currently used in Ireland have been working in Australia on an automated system for conducting the MSA measurements. MSA beef is already a successful brand of beef in Australia.

If the assessment process can be automated and deliver a consistent eating quality experience, then the scoring of eating quality will be as important as amount of beef yielded from the carcase.

FUELLING INNOVATION

Lorcan Allen speaks to Mark Turley, chief executive of Ethanol Europe, about his push to transform his company from a commodity business into a bioeconomy leader grounded in science.

In 2009, the EU adopted the Renewable Energy Directive (RED), which mandated for the first time that 10% of the transport fuel used by member states must come from biofuels by 2020. While oil companies were believed to be against it, the Renewable Energy Directive was just the opening Dublin businessman Mark Turley had been waiting for.

"I'd been looking at investing in renewables since 2007," says Turley. "Most renewable energies need to be subsidised in order to make them work but ethanol was the exception."

With the EU's renewables directive in place, Turley and his team started a new business called Ethanol Europe and began construction in 2010 of a new biofuels plant. Located on the edge of the river Danube in Hungary, the plant required a capital investment of €150m, with construction completed in 2012, and had an initial capacity of 200m litres of ethanol per year.

Today, the plant in Hungary is pushing out 500m litres of ethanol a year, making Turley chief executive of Europe's largest ethanol biorefinery with a 10% share of the 5bn litre market. Ethanol Europe takes in about 1.1m tonnes of maize corn every year, with about 60% sourced of this sourced directly from local farmers.

Turley says he chose Hungary as the location to build his ethanol plant because farmers grew abundant supplies of maize corn in the country but had little market for it. In the mid-2000s, Hungary accounted for 80% of all maize stocks offered into intervention at just €100/t.

Despite the electrical revolution taking hold in the car industry, Turley remains bullish on the long-term fundamentals of ethanol. Most large countries in Europe such as Germany and France already have 10% ethanol blended into their petrol fuels. However, Ireland and the UK still have just 5% ethanol in fuels.

By next year, both governments are expected to increase the ethanol mandate to 10% to meet targets under the EU's renewables directive. Turley believes ethanol blends in Europe need to go as high as 25% to 30%, particularly as demand for liquid fuels in Europe is growing at 3% to 4% per annum.

BYPRODUCTS

Ethanol Europe also produces 350,000t of dried distiller's grain per year and 15,000t of corn oil, which are both byproducts of the ethanol distilling process. The distiller's grain is sold for animal feed, typically at €150/t to €200/t, while the self-emulsifying corn oil can be used to feed heat-stressed animals through their water supply.

For a man with no previous experience in the renewables sector, the scale of the business that Turley has built in Ethanol Europe over such a short space is impressive. However, he is not happy to stand still.

Over the next 12 months, Turley plans to transform his business from playing solely in the commodity ethanol sector and associated byproducts to a much more added-value and science-led business by focusing on what is known as the bioeconomy.

"Ethanol is just ethanol. But the really exciting stuff we're working on is the bioeconomy," says Turley. "Over the last three years we've spent €5m to €6m on novel bioeconomy projects. In 2018, we will spend €30m on new facilities at the ethanol plant in Hungary that will allow us to start extracting fibre from the maize corn."

In the current process, what's left from the ethanol process is used in animal feed. However, by extracting fibre from the maize corn, the company will have a new raw material that is extremely versatile in its applications.

Fibre can be used to make products such as cellulose and chitin. Cellulose is a natural polymer substance that can be used to make plastics and paper. Cellulose can also be used as a coating on paper cups or plates, which Turley believes will be in higher demand in the years ahead with countries in Europe like the UK and France moving to ban plastic straws and cups for environmental reasons.

Chitin is also a natural polymer and can be further processed into chitosan, which has a variety of uses, including in water treatment, biological plant protection, cosmetics or biomedical applications.

Because these products are found naturally in the environment they are biodegradable, unlike synthetic polymers.

Ethanol Europe's biorefinery in Hungary is the largest in Europe, processing 1.1m tonnes of maize each year.

350,000T

of distillers grain produced by Ethanol Europe each year.

15,000T

of corn oil

> Ethanol is just ethanol. But the really exciting stuff we're working on is the bioeconomy

INNOVATE OR DIE

Turley says his company aims to manufacture 3,000t of chitin by 2020. Another positive effect removing fibre from the maize corn is that it raises the percentage protein in the byproduct distiller's grains.

In the normal process, the leftover distiller's grains from making ethanol has a typical protein level of 30%. However, when the fibre is removed, the protein rate in the distiller's grains will increase to over 40%, which Turley says could be a game-changer for Europe's animal feed industry.

SOYA REPLACER

"From next January, when we start taking the fibre out of the corn, our animal feed is going to go to over 40% protein. This immediately makes it a replacement protein source to the soya Europe is currently importing from the US and South America, which is genetically modified (GMO) and has antibiotics," says Turley.

"I think this will be very interesting for the Irish dairy companies, particularly for making Kerrygold butter because GMO-free is becoming increasingly important for German consumers."

However, the real point of differentiation for Turley's company moving forward could be based much further up the value chain. The fibre extracted from the maize corn can be purified into a prebiotic, which are increasingly seen as good for maintaining gut and microbiome health.

"We have acquired the intellectual property rights (IP) for extracting a prebiotic from fibre from a Swedish company called Carbiotix," says Turley. "We hope to supply Carbiotix with their fibre needs to make probiotics, which they sell to human consumers."

Turley adds that the company plans to manufacture 5,000t of purified prebiotics from fibre in 2019 and has set up a company based in Dublin called PureFiber to commercialise prebiotic products made from fibre material for the animal feed, human health and nutraceutical sectors.

James Cogan is general manager with PureFiber and says the company is becoming more and more science focused as it explores new applications for the fibre raw material.

"We're heavily involved with University College Cork (UCC) at the moment. One of the world's leading microbiome research facilities is in UCC and they are acting as scientific advisers for PureFiber," says Cogan. "The research team in UCC will help carry out the clinical trials for the prebiotics we make for infants, elderly people and also animals."

Cogan says the company will also benefit from the development of the national bioeconomy campus at Lisheen, Co Tipperary, on the site of the former Lisheen zinc mines.

The anchor project of this bioeconomy campus is the recently announced AgriChemWhey project, which will be led by Glanbia. The project was awarded €22m in EU funding and will take low-value dairy byproducts such as whey permeate and delactosed whey permeate and convert them into bio-based products such as biodegradable plastics and fertilisers."We're pushing the Government to bring the European bioeconomy summit to Ireland next year," says Cogan. "We want to bring all the players in this sector together in one place."

For Turley, the shift in focus towards the bioeconomy will become a greater part of the business in the coming years. Today, almost 80% of Ethanol Europe's €24.1m in operating profits are generated from ethanol, with the remaining 20% derived from selling corn oil and distiller's grains as animal feed. However, Turley believes the transitioning of the business towards the bioeconomy will transform his company and move it out of the commodity space. He forecasts that less than half of profits will come from ethanol by 2020 with new products such as prebiotics and chitin delivering new higher-margin profit streams for the business.

Ethanol Europe produces 350,000t of distiller's grains.

> From next January, when we start taking the fibre out of the corn, our animal feed is going to go to over 40% protein. This immediately makes it replacement protein source to the soya Europe is importing from the US and South America

GOLD RUSH

Innovation is delivering phenomenal returns for producers, writes **Lorcan Allen**

If you've ever eaten a kiwifruit, chances are you've had one grown in the sleepy town of Te Puke, located on the North Island of New Zealand. Te Puke is the heart and soul of kiwifruit production, not just in New Zealand but the world over. A giant welcome sign moulded in the shape of a sliced kiwifruit welcomes visitors to Te Puke, which is appropriate for a place that markets itself to visitors as the "kiwifruit capital of the world".

But behind the tourism benefits and the thousands of seasonal workers that arrive for the annual harvest starting in March, the story of New Zealand's kiwifruit industry in one of remarkable innovation, especially given the commodity nature of producing fruit.

Since 2010, New Zealand's kiwifruit industry has seen annual exports grow at a compound rate of 13% to reach NZ$1.7bn (€1bn) in 2017. Last year was the first time kiwifruit exports overtook New Zealand wine exports, marking a significant milestone for the sector. A target of more than NZ$3bn (€1.8bn) has been set for kiwifruit exports from New Zealand by 2025. Zespri, the grower-owned exporter of New Zealand kiwifruit, has driven much of this export growth with a particular focus on innovating its product offering for the global market. To differentiate in a commodity fruit market, Zespri invests heavily in the breeding and development of new varieties.

GOLD VARIETY

The company first tasted success in breeding new varieties in the 1990s when it developed a new kiwifruit variety that was gold in colour. This differentiated variety immediately separated the company's product offering from the standard commodity green kiwifruit. On the back of this new coloured variety, Zespri established the Zespri Gold brand in the late 1990s, which has allowed it to further position itself in a premium segment of the commodity kiwifruit market. The brand typically allows Zespri to charge prices that are 60% to 100% above the commodity sales price of green kiwifruit.

The company is also able to sell the licensing of the gold variety to growers outside New Zealand, particularly those in the northern hemisphere where their counter-seasonal production will not affect Zespri sales.

$1.7BN

the value of NZ kiwifruit exports in 2017.

$3BN

target set for kiwifruit export value by 2025.

$1.3BN

paid to 2,500 growers in 2017.

INNOVATE OR DIE

Zespri received more than NZ$67m (€40m) in income from the sale of variety licences last year, with growers in Europe the main buyers. Zespri estimates the gold variety will return NZ$40bn (€24bn) to the New Zealand economy over its lifetime. The plant variety rights (PVR) on the gold variety will expire in 2035. The commercial success of the gold variety has encouraged Zespri to continuously invest in its plant breeding pipeline to develop further innovations.

Each year, the company typically invests NZ$20m (€12m) in new plant breeding with 100,000 new varieties being developed at any one time at Zespri's 50ha research and development orchard on the outskirts of Te Puke.

Zespri's plant breeding programme is the biggest and longest running of its type in the world, with the aim of keeping ahead of competitors.

RETURNS

The company understands it takes just one successful new variety to be developed from this pipeline to deliver a significant return on investment. Without the returns delivered by the gold variety since the 1990s, the University of Waikato estimates New Zealand's kiwifruit industry would be less than half of what it is today.

The next big innovation coming to the market from Zespri's plant breeding programme will be a red variety of kiwifruit. The company says it currently has three red kiwifruit varieties that are in the pre-commercial phase of development and likely to become available to commercial growers within the next two years.

If any of these new red varieties can deliver a percentage of the NZ$40bn returned by the gold variety, Zespri will consider the investment a success. For New Zealand's kiwifruit growers, the continuous research carried out by Zespri into new varieties has allowed their businesses to flourish. The focus on R&D has risen all boats in what was traditionally a commodity sector.

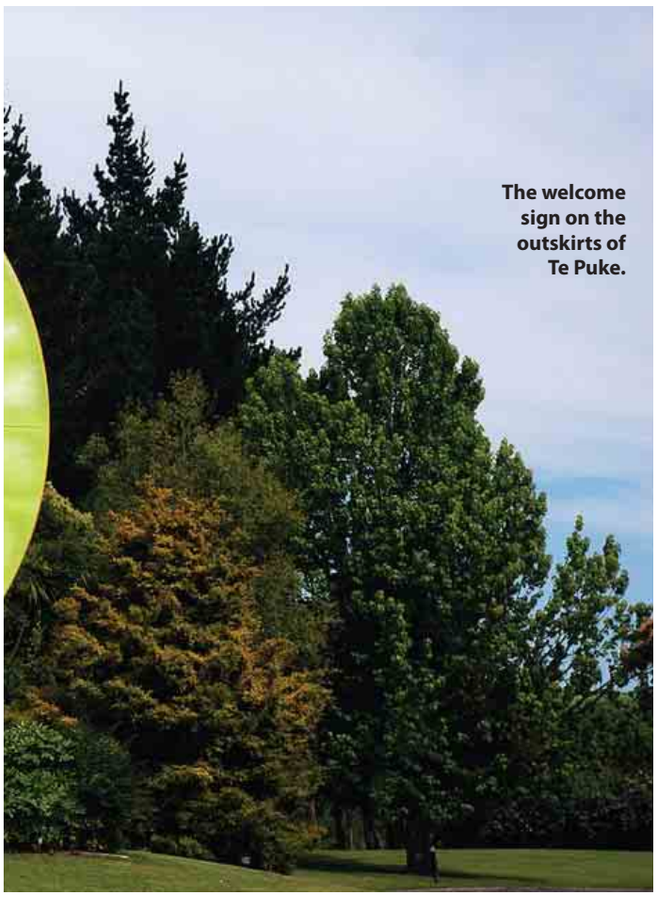
In 2017, Zespri paid out NZ$1.3bn (€800m) to its 2,500 growers in New Zealand in return for the 138m trays of kiwifruit supplied during the year. Almost half of this, or NZ$600m (€355m), was paid out to growers for gold kiwifruit, even though gold varieties account for just a third of Zespri's supply.

The average per hectare return from supplying gold varieties was almost NZ$100,000 (€60,000) last year, according to Zespri. This is up from €42,000/ha the previous year, mainly driven by record yields for gold varieties.

The majority of kiwifruit supplied to Zespri (60%) is still the standard green variety. However, the added value created by the gold variety allows Zespri to deliver superior returns to its green variety growers.

In 2017, over €400m was paid out to green kiwifruit growers in New Zealand, which equates to an average per hectare return of almost NZ$54,000 (€32,000). This is the third consecutive year that returns for supplying standard green kiwifruit have been above NZ$50,000/ha. With about 90% of Zespri's supply of green and 75% of its supply of gold kiwifruit produced in the Bay of Plenty, these strong returns to growers are a huge financial injection into the rural economy of New Zealand every year.

Zespri purchased 138m trays of kiwifruit from its growers in 2017.



The welcome sign on the outskirts of Te Puke.

CHALLENGES

However, the success of the Zespri model has created its own unique challenges for kiwifruit growers. With the farmer co-op delivering such attractive returns to growers, many new entrants are eager to join the sector and start growing kiwifruit, particularly if they can get a licence to grow the gold variety.

But with kiwifruit production centred in the Bay of Plenty region, this new wave of interest has caused the local land market to balloon. Land prices in the Bay of Plenty have risen to an average of NZ$80,000/ha (€50,000/ha), while around Te Puke deals have recently been done for gold orchards for as much as NZ$1m/ha (€600,000/ha).

While a rising asset value is a positive for existing growers, it has created significant barriers to entry for younger growers seeking to enter the sector. With New Zealand dairying having lost its shine due to environmental concerns and low milk prices, the kiwifruit sector has become increasingly attractive for investment funds.

MyFarm Investments, a rural-focused investment fund with €300m under management, has moved its focus away from its dairy farming origins over the last year and is increasingly putting its investors' money into horticulture, particularly kiwifruit.

Cash returns from horticulture can be as high as 15%, which is significantly better than the 4% returns available in dairying at the moment.

The average kiwifruit orchard in the Bay of Plenty is between 3ha and 3.5ha. However, commercial orchards up to 100ha in size have sprung up in the Bay of Plenty region over recent years as the investment money flows in.

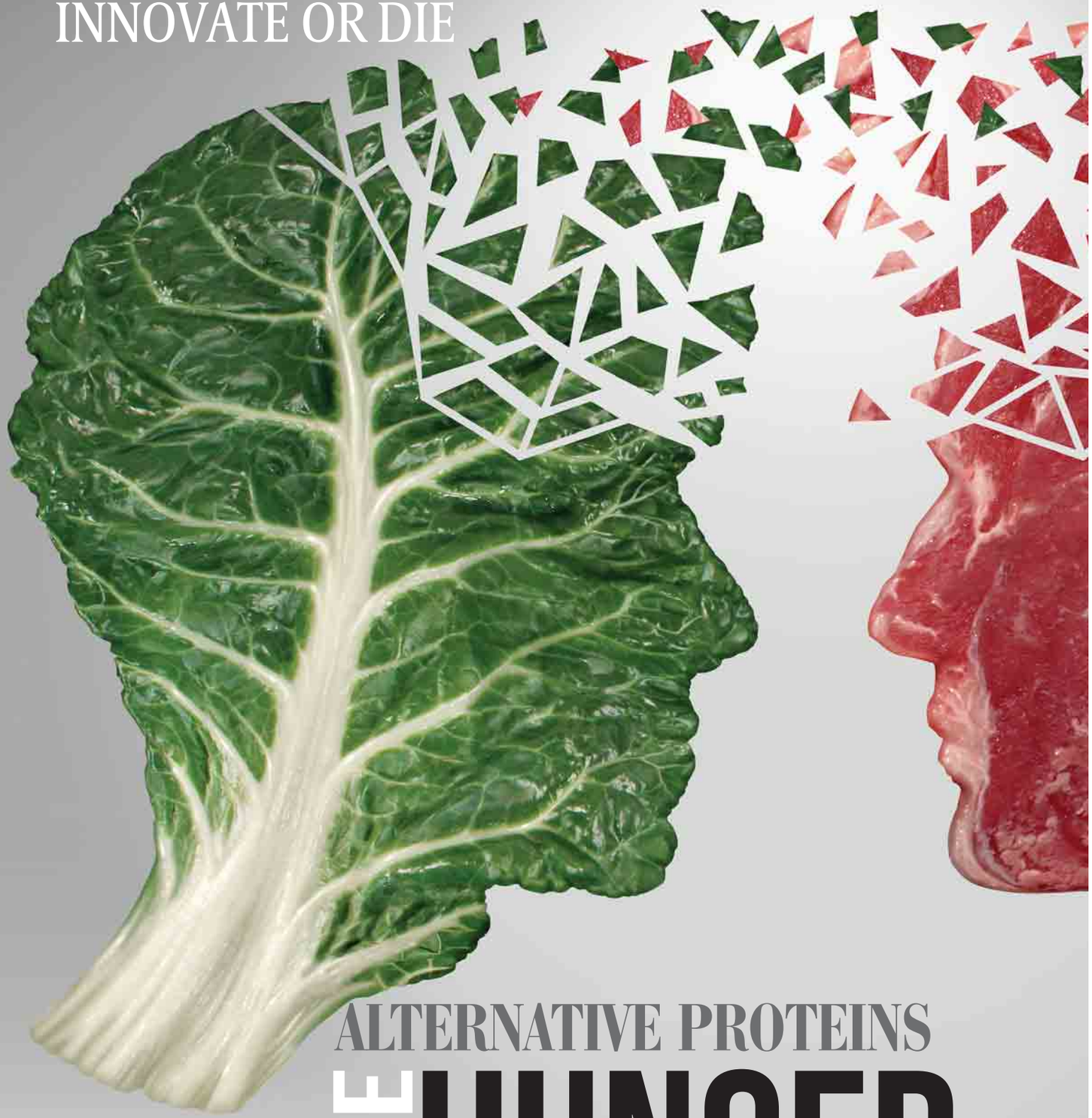
The business model and innovation pipeline created by Zespri makes sense for investors and looks set to deliver in the years ahead. The kiwifruit gold rush is well under way.

Zespri exports New Zealand kiwifruit to markets around the world, where Zespri products sell for 60% to 10% above the commodity kiwifruit price.

An orchard of green kiwifruit in Te Puke, New Zealand.

AGRI
BUSINESS

INNOVATE OR DIE



ALTERNATIVE PROTEINS

THE HUNGER PERSISTS

KPMG | IRISH FARMERS JOURNAL

Traditional protein companies are being increasingly disrupted by new and innovative science-led businesses, writes **Lorcan Allen**. What does this mean for Ireland's protein sector?

When is a meat company not a meat company? The answer, of course, is when it becomes a protein company. In the US, Tyson Foods is the country's largest meat processor, selling more than $30bn worth of beef, pork and chicken in 2017. However, management at Tyson are increasingly trying to position the business away from its traditional image of a meat processor, describing itself to investors as a "leader in protein".

In December last year, Tyson's chief sustainability officer Justin Whitmore told financial markets the company was reinforcing its focus on protein with its latest investment. It just so happened this latest investment was to increase its stake above 5% in Beyond Meat, a company that makes imitation burgers from plant proteins and whose other investors include Bill Gates and Leonardo DiCaprio.

To make these investments, Tyson has a specialised $150m investment arm known as Tyson Ventures. As well as Beyond Meat, Tyson Ventures has also invested in Memphis Meats, a startup company based in San Francisco that grows cultured meat such as beef, chicken, pork and duck from petri dishes in a lab.

Tyson is not the only established food giant to make such a move into the alternative protein sector. In July 2016, French dairy giant Danone announced to financial markets it had agreed a $12.5bn (€10bn) deal to acquire WhiteWave Foods, a Colorado-based manufacturer of branded health foods.

The company is best known for its Alpro brand, under which it sells protein products such as almond, soya or coconut dairy alternatives. Danone described the deal as a perfect match that created a global company "aligned" with consumer trends.

The WhiteWave acquisition was the largest deal in over a decade for Danone and instantly doubled the size of its business in the US market. It also made Danone the world's largest producer of organic foods and plant-based nutrition products.

An acquisition price of $56.25 per share, or almost 25 times earnings (EBITDA), meant that acquiring WhiteWave was not cheap for Danone. However, financial markets didn't seem to mind the hefty price tag, with shares in Danone rising strongly in the hours after the announcement.

INNOVATE OR DIE

Impossible Foods, California, produces plant-based burgers.

CONSUMER TRENDS

In WhiteWave and Beyond Meat, Danone and Tyson have bought into businesses, albeit at very different stages of establishment, that are playing at the very heart of the latest consumer health trends. In other words, both companies are buying into growth.

Putting aside growth targets and profits margins, what does Danone and Tyson's leap into the alternative protein business signal for the traditional protein industries of meat and dairy? The respective investments indicate that both companies are taking seriously the consumer backlash against traditional protein sources. In 2016, retail sales of alternative meat products and substitutes in the US increased more than 15% to reach $700m (€575m). This market is forecast to rise another 25% over the coming years to reach close to $865m (€705m) by 2021.

Beyond Meat burgers will sell in more than 5,000 US stores this year, including retail giants such as Whole Foods and Kroger. Another notable startup in this area is Impossible Foods, a company that makes meat and cheese products from plants. Impossible Foods has raised almost $400m in investor capital since it was founded in 2011. Playing into the emerging trend of alternative meat demand, fast-food giant McDonald's launched a vegan-friendly soya-based burger late last year called the ''McVegan''.

In the dairy aisle, the disruption caused by plant-based alternatives has been even more pronounced. Traditional dairy finds itself competing for shelf space in the same fridges as soya, almond, coconut, rice and even oat-based dairy alternatives on an increasing level.

For 2018, the global market for dairy alternatives is set to surpass $16bn (€13bn) – more than double where it was in 2010. Yet, demand is such that the global market for dairy alternatives is forecast to double again by 2024 to reach $34bn (€28bn).

While the growth in consumer demand for both dairy and meat alternatives is impressive, they remain a fraction of traditional meat and dairy markets. The global market for dairy is estimated at more than $450bn (€370bn) per annum, while the global meat and seafood market was estimated at $720bn (€590bn) last year. For established players such as Danone and Tyson, investing early in the rapidly growing alternative protein sector allows them to hedge against potential disruption further down the line. However, it is important to note that these companies will help to scale up production of alternative proteins in a way we've not seen up to now.

Tyson alone is processing almost 7m head of cattle per year in the US, more than 22m pigs and over 18bn chickens. When the company decides it is in a position to help Beyond Meat or Memphis Meats scale up production, the impact could be dramatic.

Likewise, Danone is seeking to blur the lines of distinction between what the terms dairy and plant-based mean as it further integrates WhiteWave into its core business. The company has repositioned itself as a nutrition and health company and away from its dairy roots.

WHAT IT MEANS FOR IRELAND

The emergence of the alternative protein movement in the US, which has spread to Europe, is a threat that Ireland's food industry needs to monitor. Producing traditional protein from beef, lamb, pork and dairy is the backbone of the country's food industry.

With Ireland exporting more than 556,000t of beef and over 650,000t of dairy product last year (more than 90% of production for both sectors) to world markets, our primary producers are particularly exposed to changing consumer trends around protein and how it is consumed.

Ireland is the world's fifth largest net exporter of beef and, following the abolition of dairy quotas, has grown to become the fifth largest dairy exporter of the EU 28.

With this in mind, a number of Irish companies have made similar moves to those of Danone and Tyson. In February last year, Glanbia announced it had acquired Amazing Grass, a US-based maker of non-GMO plant-based protein products. At the time of the purchase, Glanbia said Amazing Grass would give it a good footing in the plant-based nutrition market and was "complimentary" to its current portfolio of dairy-based brands.

Amazing Grass was established by two tech entrepreneurs in 2002 and manufactures plant-based protein products from cereals and alfalfa aimed at vegan and gluten-free shoppers.

In a similar move earlier this year, Kerry Group acquired Ojah BV, a Dutch company that manufactures substitute meat products from plant proteins such as peas and soya. Kerry is understood to have paid in the region of €20m for the business.

Ojah BV was founded in 2009 and produces over 1,600t of substitute meat products every year, which it markets under its "Plenti" brand in more than 20 countries.

Kerry Group has long-established brands in the traditional meat sector but its acquisition of Ojah BV highlights the company's awareness of this new protein sales channel. Prior to the Ojah BV acquisition, Kerry already manufactured a range of dairy-free, soya-free and vegan plant-based protein products under its ProDiem brand.

Kerry has said a number of its customers have asked it to develop menu options around alternative protein products, further indicating the shifting mindset in the food industry about where protein comes from.

The traditional sources of protein are being disrupted by new science-led businesses that are seeking to eke out a share of a rapidly growing market.

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5 WHAT WILL THE FUTURE LOOK LIKE?

It's long been known that the world population is headed for 9bn people by 2050. Immediately, the question was posed as to how the world can sustain itself and provide enough nutrient sufficient food to feed this population. However, farmers and the agricultural industry are responding to the need to produce more food from less by developing new technologies and production methods that meet the increased demand. And not only at primary level. Technology will continue to disrupt traditional businesses further up the food supply chain, so that by 2050 how we produce and purchase food could look very different from today.

AGRI
BUSINESS
THE FUTURE

SUPERMARKET ARMS RACE MOVES ONLINE

Having survived disruption up to now, an e-commerce arms race is well under way in the supermarket aisles, writes **Lorcan Allen**

In September 2013, the then Tesco chief executive Philip Clarke called time on a decade long ''space race'' that had gripped the UK grocery giants. He said UK shoppers had fallen out of love with large out-of-town supermarkets and were switching their shopping habits towards online, click and collect, and little and often trips to smaller convenience stores.

The space race in UK food retail took off in the early noughties and quickly developed into a near obsession for bosses of the UK's largest supermarkets. At the vanguard of this race, which was measured in square feet, was the UK's largest supermarket Tesco.

By 2003, Tesco operated almost 1,900 stores across the UK giving it 20m sq feet of property. It had taken Tesco more than 80 years to reach this level since its formation in 1919. However, it took Tesco just another 10 years to double its footprint of UK stores to more than 3,700 to reach almost 46m sq feet of property by 2014.

Ultimately, this space race proved near disastrous for Tesco and culminated with the retailer recording a £6.4bn (€7.3bn) loss in April 2015 due to huge write-downs on its property portfolio. This was the largest financial loss recorded in UK retail history.

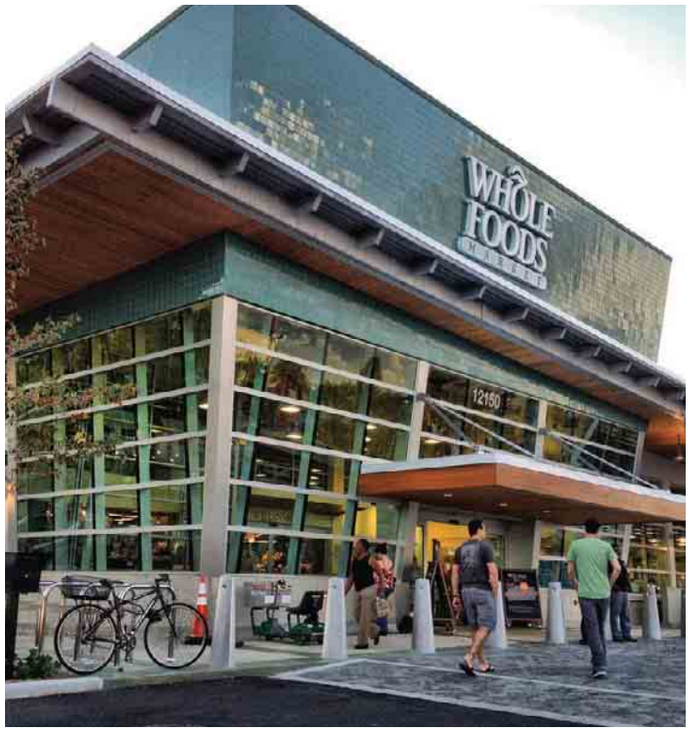
Looking back in hindsight, Tesco chair John Allan described the retail space race as "not a very good idea", which left the grocery sector with far too much property and not enough customers.

"Everyone did it at the time and there was a concern, I guess, that if you didn't take that space then somebody else would, and you would be at a competitive disadvantage," said Allan in a rare interview in 2016.

HERD MENTALITY

What Allan's comments illustrate more than anything is the herd mentality that took hold in the UK retail sector during that period and what was perceived as the winning strategy for the sector. Tesco and the other large UK retailers have since largely worked through the financial issues created out of the space race but are still in the midst of cost-saving programmes.

THE FUTURE



Amazon made its first move into bricks-and-mortar retailing in 2017 when it announced the $13.7bn takeover of US supermarket chain Whole Foods.

However, it is interesting today to see a new type of arms race emerging in the food retail sector, not just in the UK but right across the globe. The advent of online retail has taken hold in recent years and established supermarkets the world over are working to try to avoid disruption from new online competitors they never had before such as Amazon, Ali Baba and Ocado.

On this side of the Atlantic in particular, supermarket bosses have been bracing themselves for an inevitable attack on Europe from Amazon. The e-commerce giant has disrupted everything from music to books to film, and it has made its intentions clear that food retail is the next frontier it plans to dominate in.

What's different to this new race in the online age is that no clear strategy or answer has emerged amongst the established supermarkets around how to solve the online question in the same way that building more stores was seen as the only way to win the space race back in the early 2000s.

Instead, what we are seeing today is a whole host of different strategies being pursued by established supermarkets to try to stave off disruption from e-commerce competitors.

The latest of these strategies was revealed last month when Sainsbury's, the UK's second largest supermarket, announced it had reached a deal to merge with Asda, the UK's third largest supermarket. The new entity will become the largest retailer in the UK with a combined market share of more than 31%.

However, the real significance of the Sainsbury's-Asda tie-up could be in what it means for the group's online strategy in the future. Sainsbury's reported a 7% increase in online food sales for its latest financial year, with the retailer now able to offer same-day delivery to 40% of the UK population from 102 stores.

Almost all online orders processed by Sainsbury's are carried out by staff who hand-pick groceries from existing stores. Mike Coupe, chief executive at Sainsbury's, says the addition of 200 Asda stores to the group will increase capacity for Sainsbury's online grocery-picking operation.

Whether this will work for Sainsbury's remains to be seen but the acquisition of Asda has eased investor fears of a potential takeover by Amazon. The US e-commerce giant made its first move into bricks-and-mortar retailing in 2017 when it announced the $13.7bn takeover of US supermarket chain Whole Foods.

This move fuelled speculation in financial markets that a similar buyout was on the cards in Europe, with Sainsbury's often mentioned as a potential target. Instead, Amazon's first foray into Europe has been to partner with the French retailer Casino Group. The company has also signed a similar partnership with UK retailer Morrisons.

Amazon's approach to food retail is interesting. With grocery spending accounting for about 50% of all retail sales, the e-commerce giant was always going to make a move into this sector.

However, Amazon's strategy has evolved into a move downstream to bricks-and-mortar supermarkets just as established retailers are investing upstream in digital infrastructure and mobile apps.

DARK SUPERMARKETS

The other strategy on the table for the future of online food retail are dark supermarkets. Following the end of the space race, many of the largest UK retailers moved to build dark supermarkets, which are effectively grocery warehouses where online orders are processed.

Most supermarkets still pick the majority of online grocery orders from existing stores but the number of dark supermarkets is rising.

Tesco, Sainsbury's, Asda and Waitrose have all opened dark supermarkets since 2014, in the expectation that 10% of all UK grocery sales will be ordered online by 2022.

At the forefront of dark supermarket development is Ocado, the UK online supermarket with sales of £1.4bn last year. The online retailer currently operates three dark supermarkets, or customer fulfilment centres (CFCs) as they are known, where thousands of robots zip around an enormous warehouse processing online grocery orders.

Ocado has recently completed construction of its fourth CFC facility located at Erith in southeast London at a cost of £250m. The Erith warehouse facility sits on close to 13 acres and will be the largest ever CFC built by the company.

TRANSFORMATION

Interestingly, Ocado is trying to transform itself from an online grocer to a technology company that will supply the robots, hardware and software systems for established supermarkets to make the move to online.

For its 2017 financial year, Ocado generated just over 8% of its annual sales (£116m) and 3% of earnings (£2.7m) from the sale of proprietary technology solutions to other retailers.

The company plans to scale this side of its business to sell its robot technology to other retailers as it will deliver higher margins than traditional grocery sales.

Given the uncertainty around what the future of grocery retailing may look like, investors have bought into Ocado's strategy to back its own technological solutions as a service for existing players rather than trying to disrupt an entire marketplace on its own.

Shares in Ocado have surged by more than 130% in the last six months with investors increasingly taking the view that the company is evolving into a technology pioneer.

The next decade is likely to bring major structural changes to the traditional grocery retail sector as online sales claim more and more market share. What the winning strategy will be remains to be seen but a new arms race is building between the traditional powers of grocery and online disruptors.

READY, TECH, GO

Whether it's a drone or driverless tractor, the future of agricultural mechanisation is in an exciting position. **Michael Collins** looks at some of the technological developments coming to the market

When GPS guidance on tractors was first introduced, it was seen as ground-breaking. Allowing a satellite to steer a tractor was seen by many as a huge leap forward in terms of technology and automation. Today, guidance is installed on approximately 20% of all new tractors sold in Ireland. This percentage is higher in other countries including North America and Australia where large implements such as sprayers and planters are used in larger prairie-like fields.

The benefits are numerous with cost savings being the most obvious. The question we must now ask and one farmers are also wondering is, what technology can we expect to see on tractors in another 20 years? Will we even have tractors as we know them today farming the land?

DRONES

While the *Irish Farmers Journal* can't see into the future, we have seen some ground-breaking machinery and technology in both concept and production phases. Take for instance something that was developed as an unmanned weapon of war – the unmanned aerial vehicle (UAV) or drone. Designed to be used to spy on enemy territory, drones are now widely used in the agricultural sector.

Their functions include crop scanning with compact multispectral imaging sensors. This information can be used to treat specific disease in the crop or target specific areas with variable rate fertiliser spreaders. A more common use for drones is for GPS map creation using an on-board camera. In some countries, larger drones have been trialled to carry loads of fertiliser applying it on the "little and often" principle and even here in Ireland they have been used to check on remote cows inaccessible by normal means on a daily basis. The Chinese drone maker, DJI, has launched a new agricultural drone to the market with the ability to spray crops at the rate of 4ha per hour.

DRIVERLESS TRACTORS

More down-to-earth but equally as notable are unmanned tractors. Early prototypes from Case IH, New Holland and Kubota rely on a combination of high-accuracy GPS signal and use numerous sensors to detect obstacles including people. When Case IH introduced its cableless concept tractor to the world at the Farm Progress Show in Boone, Iowa, in September 2016 it was seen as another huge step forward in agricultural technology. The tractor was revealed to the world planting in a stubble field, even going off course to drive around a pole and regaining pinpoint accuracy again. Controllable from a tablet with the ability to run 24/7, what was once an idea on a computer screen is very much becoming a reality.

ROBOTIC PLANTERS

Closer to home, European machinery companies have also been at the cutting edge of technology development. Fendt, for example, revealed the Fendt Xaver at last November's Agritechnica in Hannover, Germany. The mini-robot concept is designed to work in a swarm with other similarly sized robots. Each 50kg unit which is powered from a 1hp on-board battery can work for two to three hours before recharging. The size and weight of the Xaver is designed to minimise soil compaction and in initial trials, a swarm of robots was used to precision-plant 2ha/hr of sugarbeet. The technology in these mini-robots is so clever that if one gets stuck or goes "off-grid" the others up their output to compensate.

The Fendt Xaver is a product of a research project known as MARS led by the University of Ulm in Germany. While there have been many similar projects in universities and institutes across the world, what is unique is AGCO/Fendt's decision to take on the project since 2016. This, coupled with the stated objective of developing a robot swarm system that will compete with the output and price of a tractor mounted seeder, indicates that this system may indeed become commercial in years to come.

The Fendt Xaver mini-robot concept is designed to work in a swarm with other similarly sized robots in a field.

ELECTRIC TRACTOR

The electrically powered Fendt e100 electric tractor as launched at Agritechnica. The tractor uses a battery instead of an engine built into the chassis of a 50kW (67hp) tractor.

Fendt also used Agritechnica to launch its electric tractor, the e100. According to Fendt, it is the first electrically powered variable-transmission tractor available on the market.

Other companies have launched concepts but according to Fendt the e100 will go into production with limited units available in 2018. The tractor produces 67hp, which lasts for up to five hours under normal operating conditions.

TARGET

The size and width of the tractor would suggest the German company is targeting vineyards and small farmers first.

It comes with both conventional hydraulic couplers and an electric socket in anticipation of the move towards electrically powered implements.

The Case IH autonomous tractor relies on a combination of high-accuracy GPS signal and use numerous sensors to detect obstacles including people.

SMART SPRAYERS

Cutting down on inputs and overheads is always going to appeal to farmers. A company in Australia has developed technology for crop sprayers that can identify weeds using smart sensors. The technology known as Weed Activated Spray Process (WASP) distinguishes between weeds and other background material through the difference in light reflectance. This signal is then used to activate individual nozzles on the sprayer boom to only treat specific weeds or patches of weeds.

Trials claim there are savings of up to 90% on herbicide over conventional systems. The benefits and savings are hard to argue with. Unfortunately, the price of the technology at the moment is out of reach for many farmers who, like farmers all around the world, are relying on the price of their commodity to pay for such investments.

Sensors fitted to a sprayer are designed to only target weeds and reduce herbicide usage by using WASP technology.

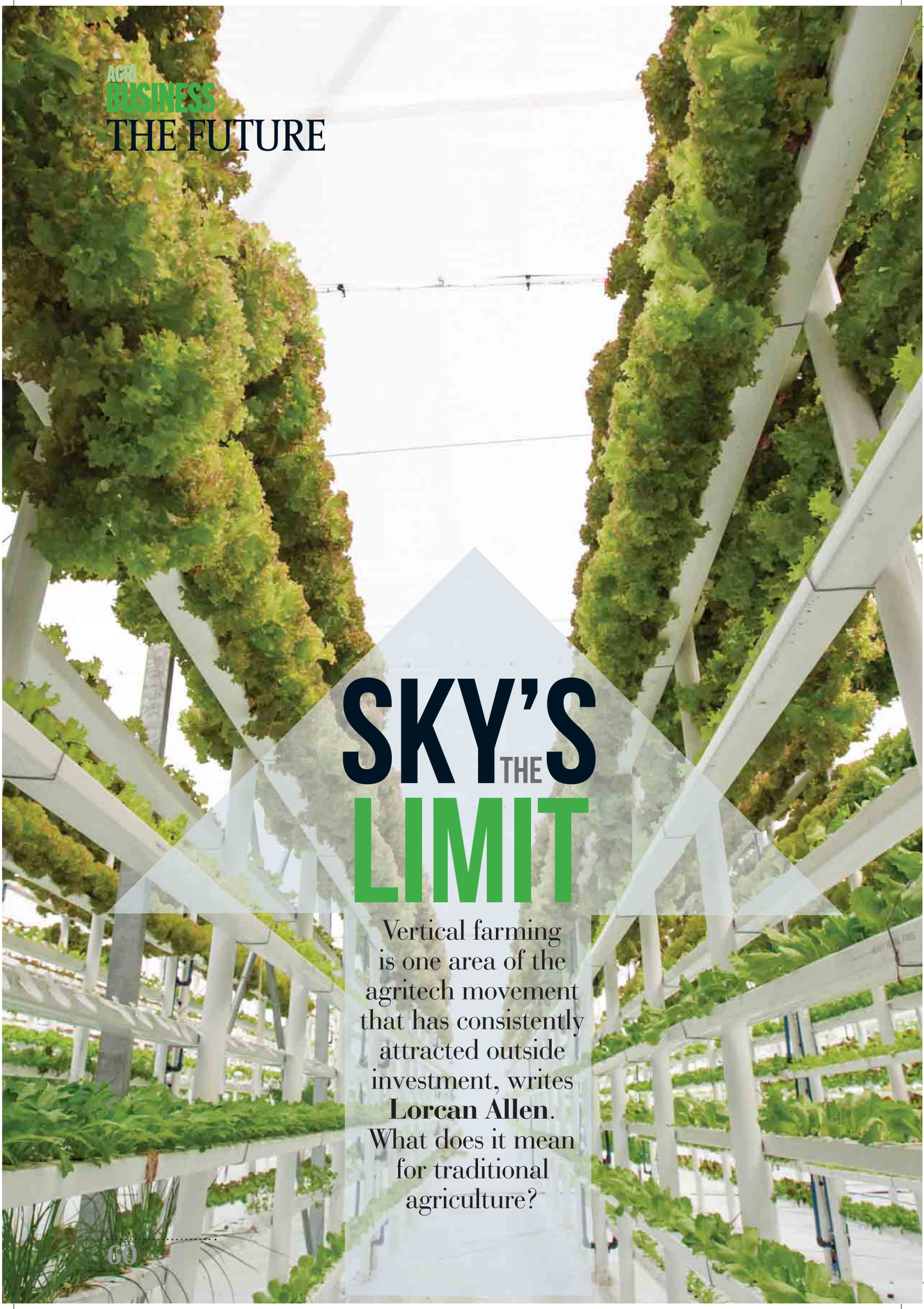
METHANE-POWERED TRACTOR

Indeed, many concepts and ideas have been sold as a solution to a problem in the agricultural world. Unfortunately, these concepts can be sometimes too far-fetched to make it any further than a machinery show. One concept that is on course to go into production as a solution to burning diesel, is the methane-powered tractor from New Holland.

As the name suggests, the tractor burns methane gas instead of diesel which is stored on the tractor in specially designed tanks. We got to drive the tractor recently at New Holland's headquarters in Basildon, Essex, towing a tandem-axle trailer.

New Holland has adapted technology from methane-powered trucks to suit a conventional tractor.

Apart from sounding different to the normal diesel-powered variant, the difference in performance was hard to distinguish. According to New Holland, it has taken tried-and-tested technology from methane-powered trucks and adapted it to suit a tractor. The company is targeting farmers who have their own methane supply from their anaerobic digester plant or access to what is considered cheap clean fuel. New Holland is even boldly claiming the tractor will pay for itself in a just a few years with the money saved over using normal tractor diesel where methane is produced on farm.



SKY'S THE LIMIT

Vertical farming is one area of the agritech movement that has consistently attracted outside investment, writes **Lorcan Allen**. What does it mean for traditional agriculture?

In August last year, Kurt Kelty announced he was leaving Tesla, the US electric car maker, based in California. Kelty had been one of the longest serving executives at Tesla and led the team that developed the battery technology used in the engines of the company's range of electric cars.

Prior to that, Kelty had worked for more than a decade at Panasonic, the Japanese electronics giant. At the time of his departure, Tesla said Kelty was leaving the company to pursue "new opportunities".

To the surprise of many in corporate America, these new opportunities turned out to be taking up a role as head of operations and development with Plenty, a San Francisco-based startup company specialising in vertical farming.

Announcing Kelty's appointment in October last year, Plenty said his role would be to grow its vertical farm footprint by developing indoor growing rooms in cities around the world. Plenty, which was founded in 2014, develops indoor vertical farms that produce fruit and vegetable produce.

Produce is grown on 20ft-tall towers using LED lighting, micro-sensor technology and big data processing. The company claims its system can grow up to 350 times more fruit and vegetables than conventional farms on a similar land area, while using 1% of the water needed for conventional farming.

The idea has struck a chord with investors in Silicon Valley. In July last year, Plenty attracted $200m in Series B funding (its second round of major financing), which was led by SoftBank Vision Fund, a Japanese fund that invests in the technology sector.

This $200m capital injection was the largest ever single investment in an agritech company, with SoftBank betting it has the global connections to accelerate the company's international expansion.

FURTHER INVESTMENT

Plenty is not the only vertical farming company to attract investment out of Silicon Valley. In March of this year, Larry Ellison, executive chair and founder of US computer technology company Oracle Corp, launched his latest startup company called Sensei.

This new company will begin growing organic fruit and vegetables using vertical farming techniques on the Hawaiian island of Lanai, which Ellison paid $330m for in 2012. Sensei said it will build 10 greenhouses on just under five acres of land on the island, with the aim of selling vegetables to the local retail market under the Sensei Farms brand.

VERTICAL FARMING VALUE

7%
increase in the compound rate per annum.

350X
more fruit and veg can be grown.

Sky Green Farms in Singapore (above and left).

These vertical farms will employ hydroponic techniques to grow produce, while energy will be provided by solar-power technology developed in partnership with Tesla. Sensei says this will slash the energy and water usage needed to grow food compared to conventional farming.

Launching his new company, Ellison said agriculture was one of the last major industries that had remained unchanged by software applications and his aim was to transform the sector.

Ellison is right when he says agriculture remains one of the last frontiers to be disrupted by new technology startups, in the same way that the music industry, mobile phone and print media have been utterly changed over the last decade.

Up to now, venture capital funding has been slow to invest in on-farm applications, mainly because investors don't fully understand farming. The seasonality of sowing crops or calving cows makes technology development slower in agriculture and less attractive to investors that are used to companies developing at warp speed.

However, this perception is changing and investors are starting to see the financial returns possible in agriculture, evidenced by John Deere's recent acquisition of Silicon Valley startup Blue River Technology for more than $300m.

CAPITAL INVESTMENT

But vertical farming has always been a concept that has attracted, and will continue to attract, significant venture capital funding. The global vertical farming industry was valued at more than $21bn in 2016 and is forecast to grow at a compound rate of just under 7% per annum up to 2023 when it will reach close to $33bn in value.

The key driver behind the growth in vertical farming is that investors understand the principal that more food will need to be produced from less land to feed an increasingly urbanising global population that is forecast to reach 9bn by 2050.

Producing food from less land and water right in the heart of a large urban centre makes sense for tech investors, particularly when set against a background of global warming and a greater need for controlled climate agriculture.

In a place like Singapore, one of the most urbanised nations on the planet, vertical farming is becoming increasingly important to how the country feeds itself. Singapore imports 90% of its food requirements for its population of nearly 6m people.

While the city-state will always be reliant on importing food, vertical farming is allowing Singapore to create its own food supply that could act as a buffer in times of supply chain disruption. Sky Green Farms became the world's first commercial vertical farm when it opened for business in 2012. The company started from an initial farm of just over 200 towers, after receiving $100,000 in seed funding from the Singapore government.

Today, Sky Green Farms produces 0.5t of vegetables every day from more than 1,000 9m-high A frame towers.

The company plans to invest a further $26m to expand the farms to have more than 2,000 towers growing vegetables on less than 10 acres.

If realised, the company believes it will be able to produce enough vegetables to feed 4% of Singapore's population.

WITH MORE VENTURE CAPITAL INVESTMENT FUNNELLING INTO URBAN FARMING START-UPS, AND PEOPLE LIKE KURT KELTY TAKING LEADERSHIP POSITIONS WITHIN THE SECTOR, VERTICAL FARMING IS ONLY GOING TO GET BETTER AND CREATE A GREATER DISRUPTION IN THE TRADITIONAL AGRICULTURE SECTOR

LIMITATIONS

The concept behind vertical farming is sound, especially as populations become increasingly urbanised. However, there are limitations to these systems. In theory, any crop can be vertically farmed but the system is primarily used to grow potatoes, peppers, cucumbers, lettuce, herbs and fruits such as strawberries. By far the most common item grown on vertical farms are tomatoes.

Overall, vertical farming is likely to have an increasing role in future food systems, particularly in Asia where population growth and urbanisation has been most rapid over recent decades. China, with 1.4bn citizens, accounts for almost 20% of the global population yet it has just 7% of the world's arable land. Of the land that is deemed arable in China, about 40% is suffering from moderate to severe soil degradation.

For countries such as China, where regional food security is a priority, vertical farming presents an opportunity to somewhat alleviate the dependence on food imports for staple vegetables and fruits. The processes of vertical farming still have a way to go with significant challenges remaining around getting enough light to stacked rows of plants as well as improving the overall quality of the end product.

However, with more venture capital investment funnelling into urban farming startups, and people like Kurt Kelty taking leadership positions within the sector, vertical farming is only going to get better and create a greater disruption in the traditional agriculture sector.

A local favourite

Good for farming families, co-ops and local communities.

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Enjoyed everywhere ✔

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