MAP OF AG

HORIZON 2026

An outlook for the agrifood sector

Foreword

Progress with pragmatism

Twelve months is a long time in the world of digital agriculture. In the space of a year we have witnessed the massive adoption of artificial intelligence from being the preserve of the techies to mainstream, everyday tooling that is revolutionising how we all work.

In many ways we are starting to see how the long-promised potential of data-driven solutions can take the guesswork out of food production. The era of intuition and rule-of-thumb is rapidly being replaced by the algorithm, moving us from a world of averages to a world of near absolutes. Whether it is calculating the specific carbon footprint of a single feed delivery or using AI to model financial scenarios via a chat interface, many of the ways of the past are just that: in the past.

But this transition brings an uncomfortable truth. As we chase unparalleled efficiency, we introduce unparalleled fragility. We are building systems that are smarter than we are, but also more brittle. We are replacing the resilience of human adaptability with the binary rigidities of code. As highlighted in these pages, a cyber-attack is no longer just an IT headache for the big corporates. In a fully connected farm, it is potentially a crisis in waiting.

Globally, we see similar risks emerging – from the black box problem where farmers rely on decisions they cannot explain, to the potential deskilling of a workforce that might forget how to farm without a digital prompt. The shift is undeniable and much of it is positive.

Artificial Intelligence and data-driven technology can and will enable the people on the ground to do the job better and more productively. This is essential. With a global population hurtling toward 10 billion and climate volatility rendering historical norms irrelevant, tradition alone cannot feed the world. We need the predictive power of AI to survive.

But we must move forward with our eyes wide open. We are handing the keys of our food producing systems to algorithms. The challenge going forward is not just to adopt these tools, but to ensure we remain the masters of them.

The future belongs to those who can navigate the competing tensions of progress with pragmatism. In other words, exploiting the potential of technology without losing the mud-on-the-boots wisdom that grounded us in the first place. ■

Richard Vecqueray
CEO, Map of Ag

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Is AI rewriting the farmer's almanac?

Data and algorithms are rewriting how we farm, explains Map of Ag's **Iain Lindahl**

For the majority of agricultural history, farming has been a gamble hedged by memory. You planted by the date, you harvested by the calendar, and you prayed that the weather would, more or less, do what it did last year.

This reliance on the assumption that the future climate will resemble the past has been the genesis of the farmer's almanac approach: A world of static rules of thumb.

But the climate no longer plays by those rules. We have entered an era of significant climatic volatility. In the UK, for example, a heatwave in May, or a cold, cloudy summer often renders calendar dates irrelevant. Relying on decades old averages isn't just becoming increasingly ineffective; it is potentially a recipe for supply chain failure.

The modern commercial grower now survives on the specific, often chaotic outcomes of the current season. To navigate this, the industry is undergoing a profound shift from deterministic almanacs to statistical (albeit not entirely precise) intelligence, a transition I have been part of in a previous role.

To understand how AI is changing the farm, you first have to understand that plants don't own watches. In a biological system, time is not measured in minutes or months, but in energy accumulation.

In this sense, the fundamental currency for a crop is a "heat unit" (or Growing Degree Day). The concept is rooted in a simple physiological truth: Biological processes operate at temperature dependent rates. Every crop has a base temperature, a physiological zero below which development effectively ceases.

The maths transform the prediction problem entirely. Instead of asking, "How many days until harvest?", the algorithm asks, "How long until the atmosphere delivers the required amount of thermal energy?". By integrating weather forecasts, the model projects this accumulation into the future.

But more sophisticated models go further. They recognise that a day can be warm but overcast, or cold but bright. By integrating solar irradiance (sunlight) with temperature, the system can calculate "Growth Units." This allows the digital model to differentiate between good growing days – warm and sunny – and stress days, providing a holistic view of plant physiology that a calendar simply cannot match.

The term "AI" is often thrown around loosely, conjuring images of autonomous robots and sentient computers. However, in my experience, the most effective application isn't necessarily a complex neural network, but a system grounded in "adaptive" tuning via a feedback loop.

First, predict a harvest date. Then reality happens. If the crop is ready three days later than predicted, the model can calculate the error and recalibrate for next time. It adjusts its parameters so that, if run again on the same data, the prediction would align with reality. This allows the software to "learn" the specific quirks of different soil types or

varieties and achieve accuracy of +/- three days on growing cycles that ranged up to three months.

The spring of 2020 sticks in my head as the best example of when this approach worked. Unstable demand from a country rocked by Covid and the sunniest spring on record. Crops flew out of the ground, reaching maturity a full two weeks ahead of normal. Without a model, this would have resulted in an unexpected early-season glut and good produce rotting in the field. Thanks to this modelling approach, there was enough lead time to find a market and ensure that valuable crop did not go to waste.

An algorithm is only as good as the reality it perceives, however. A recurring theme in agriculture AI is the extreme sensitivity to data quality and climate differences across small areas. For example, temperature readings can vary by as much as three to four degrees Celsius between fields just a few kilometres apart. In the world of heat units, a four-degree Celsius difference is massive. Weather stations deployed across all growing locations help gather higher resolution data to remove this uncertainty in modelling efforts. With robust sensor systems getting cheaper every year, this only becomes more achievable over time.

Perhaps the most critical insight I've observed is that technology is not a monolith: Its value is entirely contingent on the people using it. Success can differ from farm to farm and country to country. When the data inputs are poor, the predictions are poor. No amount of algorithmic sophistication can correct for a user accidentally selecting "1st April " instead of "1st March". More of that in a moment.

Naturally, farmers are sceptical of "Black Box" AI. But sharing logic helps to build trust. Growers are willing to believe the output when the reasoning behind it aligned with their agronomic intuition.

Does all this effort actually pay off? In my experience, yes. If properly adopted by the business, the investment in the data modelling can be more than offset by cost savings and additional revenue, many times over.

But this value isn't magic. It's the result of data-driven risk mitigation. Knowing a crop is coming early allows the grower to contact supermarkets weeks in advance to adjust the supply plan, preventing the need to "dump" excess product. It allows for optimised labour planning – knowing exactly when to book harvest crews – and logistics planning.

Crucially, the goal isn't perfection. A plus-or-minus three-day error is a manageable uncertainty. But a 14-day surprise caused by the weather is a disaster.

As the industry looks forward, the notion of what some are calling the "Algorithmic Acre" is evolving. While large farming businesses can build their own timing models, they are increasingly outsourcing complex tasks such as disease forecasting. Detecting disease via computer vision requires massive datasets and deep learning architectures that are too expensive for a single farm to maintain.

The next frontier, however, lies in agentic AI – systems capable of reasoning to solve the data hygiene problem, helping deal with the "garbage in, garbage out" conundrum.

Currently, data validation is rigid. But an AI agent can understand context. If a worker submits a planting map that doesn't match the GPS coordinates of the field, or enters a planting date that is logically impossible, an AI agent can flag the anomaly immediately – and potentially correct it. This will shift the value proposition of data platforms from "We store your data" to "We intelligently validate your data", something of interest to us at Map of Ag. By filtering out the garbage, these agents will strengthen the robustness of the resulting insights and decision support.

The transition of agriculture from an art based on intuition to a science grounded in probability is well underway. But the path to value is not paved with magic algorithms. It is built on unglamorous foundations: robust physical infrastructure, a disciplined data culture, and adaptive modelling that respects the biological reality of the field.

As climate uncertainty deepens, the ability to predict the biological response to the environment is ceasing to be a competitive advantage: it is becoming a requirement for survival. We are no longer dealing with concepts for the future but intelligent, data-driven systems of the present. ■

Tips for the future: Algorithm, not almanac

1. **Own Your Data:** Collect and manage your own data. It's a critical asset. Even if you use external models, you need your own ground-truth to validate them.

2. **Invest in local IoT:** Regional forecasts aren't enough. Understanding variations in microclimates are essential for accuracy.

3. **Prioritise adoption:** Identify the technology champions in your business. They will be the ones who will ensure roll-out is successful.

4. **Embrace "Good Enough":** Don't let perfection be the enemy of progress. A model may not be perfect but it might still deliver considerable business value.

Analysis: Why is fauna outpacing flora?

High livestock prices look set to last, according to Craigmore Sustainables' **Forbes Elworthy**

In theory the prices of agricultural commodities should track each other over time. If one product is in short supply, for example wheat became constrained after Russia's invasion of Ukraine, then high prices will lead farmers to take land out of other crops and grow more of the highly priced produce. Thus, farmers sowed less corn in late 2022 and planted more wheat. This helped rebuild wheat stocks, and prices began to normalise.

In 2022 wheat prices peaked at 150% of 2010 levels (see graph). However, prices have now tracked down to only 15% above 2010 levels. And since inflation has lifted farm costs in most countries by about 50% in the same period, cereal farmers in most countries, this year, are seeing much reduced profits, or none at all.

Beef had a brief price surge in 2014 after a mid-western drought lifted prices of feed corn, constraining beef supply. But, other than that, until 2023, beef had not out-performed wheat.

But suddenly in the past two years, prices have surged to twice those of 2010. As a result, red meat farmers all around the world are pinching themselves this year. Farmers are currently making terrific profits on their beef (and sheep) acreage, even if cereals are hurting.

Beef is not alone in this outperformance. Other animal proteins including liquid milk and butter have begun to out-perform their plant-based competitors strongly.

As can be seen in the graph below butter prices have increased to $7,000 a tonne while vegetable oils are around $1,200. Both supply and demand factors have led to the recent outperformance of animal proteins and fats versus their vegetable competitors, even with the small vegetable oil spike in 2022, again a consequence of the invasion of Ukraine.

A key factor in the protein price surge has been droughts in the cattle regions of the US, which reduced the North American herd to 1950s levels. Meanwhile, in the dairy industry, European and New Zealand environmental restrictions have constrained milk (and thus cheese, butter etc) production. There are no such restrictions in the US, which is steadily growing dairy production.

On the demand side, keto-style diets are leading many to eat more protein and good quality fat (for example cheese) and eschew carbohydrates, sugars and vegetable oils and their derivatives: processed foods.

GLP-1 diet drugs may also be leading people to seek out higher quality proteins and fats for their (more limited) food intake.

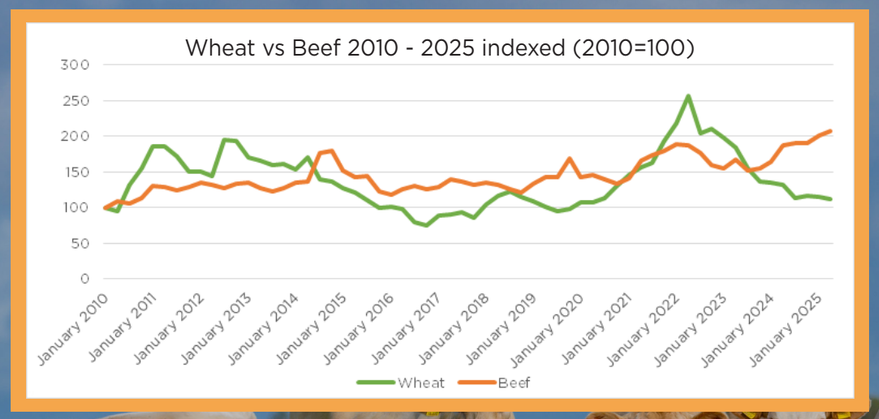
Meanwhile in the US politicians and food service chains have joined diet advisors in weighing in on these trends. Robert Kennedy has urged US restaurateurs to cook food in beef tallow and has mandated the return of full-fat milk in schools. McDonalds USA has replaced margarine with butter for some breakfast items such as McMuffins and eggs.

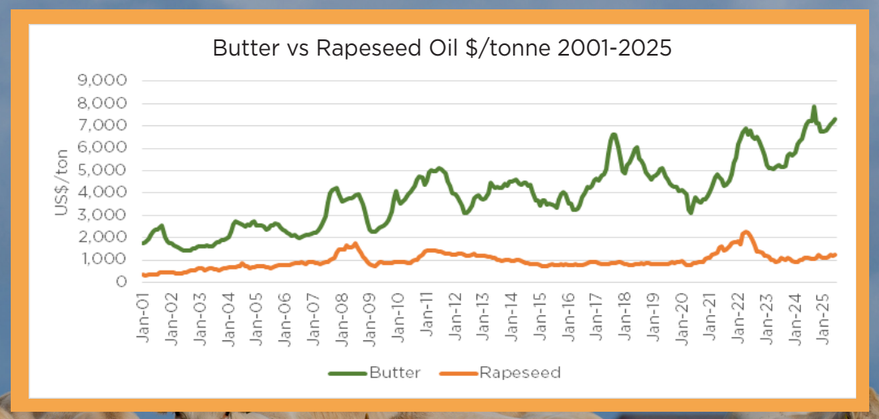
The US beef herd is unlikely to be rebuilt before the end of this decade (high beef prices tend to slow the pace of rebuilding as the incentive today is to eat, rather than breed from the next generation of cattle).

And it does not seem that health trends away from vegetable oils and towards animal products are going away.

As a result, most commentators think current price out-performance of animal proteins and fats is likely to persist. In this context, us farmers are, naturally, growing our livestock operations, and investing less in arable.

In the long run these behaviours should rebalance the pricing relationships of wheat, beef and dairy. However, for the moment, fauna is the place to be. ■





Differentiated by data

Commodity crops are not always easy to differentiate to add value, but one grower scheme in the east of England is doing just that, as Map of Ag's **Ben Hunt** and **Caroline Hope** explain.

In the complex and often challenging world of agriculture, the conversation around sustainability often focuses on the burden of compliance. But there are examples where "doing the right thing" can also be an opportunity for value creation.

It's often said that it is hard to differentiate (from a value perspective) when you are a grower of commodity crops. But a data-centric approach to malting barley can reward action, build supply chain resilience, and – critically – support increasing adoption of sustainable practices.

Leading this charge in the UK malting industry is Crisp Malt, which, in collaboration with Map of Ag, has developed a comprehensive sustainability scheme called Field Forward. The initiative is not just an internal business plan for the maltster, it is a clear, farmer-facing commitment to securing a sustainable future for their supply chain, backed by a robust data framework that offers a compelling financial and insights-rich incentive for growers.

For Crisp Malt, sustainable sourcing is a core business imperative. As Sustainability Coordinator Ellie Wood highlights. "The business is fundamentally reliant on the success of agricultural produce. The core motivation for Field Forward is twofold: to build deep resilience in the supply chain to ensure the long-term availability of malting barley; and to help growers become more resilient against the profound and present threat of climate change."

Significantly, Field Forward was deliberately chosen as the moniker to step away from the term "regenerative." Crisp Malt found the term often alienated farmers, who felt it was a "buzzword" for best practices they had been implementing for generations. And for customers, the term was often misunderstood, leading to vague requests for "regenerative barley."

By contrast, Field Forward is positioned as an all-encompassing framework that embodies the principles of regeneration but goes beyond them to focus on tangible, measurable sustainable sourcing in a language that resonates with both the farm and the buyer.

The success of such a scheme hinges on farmer engagement, and engagement hinges on trust. Crisp Malt's initiative is rooted in the long-standing partnership with its ABC grower group in Norfolk and East Anglia.

Established in 2006, the group consists of 200 farmers, many representing generational involvement, who collectively produce over 90,000 tonnes of malting barley.

The ABC group, named from its founding partners the merchants Adams and Howling, and Banhams, and Crisp Malt, initially focused on creating a direct, local supply chain with long-term contracts to mitigate risk. This existing foundation of trust was crucial. “The trust is already there,” Ellie explains. “Growers want to be engaged with what we are doing because they’re already part of this long-standing group.”

This deep-seated partnership allowed Crisp to involve the group’s committee, which includes both merchants and farmers, in conversations about Field Forward for the 18 months prior to its launch, ensuring the scheme was designed to deliver genuine value back to the farm.

The Field Forward framework is aligned with SAI’s Regenerating Together Framework (RTF), a methodology that is adaptable to different crops and global contexts. Crisp Malt uses the framework to provide third-party verification and certification for the grower group. The RTF focuses on the whole-farm system across four key pillars: soil health, water, biodiversity, and climate.

The data for the scheme is collected via annual surveys, which Map of Ag designs to be as streamlined and palatable as possible.

The combined GHG emissions information and RTF survey data needed takes approximately 30 minutes to complete when farmers have the information ready and prepared. This data collection is not a one-way street. It serves two vital purposes.

First is establishing a baseline. The initial implementation establishes a robust baseline of current practices, such as cover cropping, which provides quantifiable and evidence-backed claims of sustainable agriculture for Crisp’s customers.

The second is delivering value to the growers in return for their data. Farmers receive access to two dedicated Map of Ag dashboards: one for GHG emissions and one for the RTF framework. These dashboards provide detailed insights and benchmarking – allowing a farmer to see their year-to-year trends, emissions split by source, and standing within the group on metrics such as crop rotation, plant species diversity, and soil cover adoption. These insights enable farmers to make data-informed decisions about where they can focus their efforts for improvement.

The long-term incentive is a mechanism that directly rewards the adoption of sustainable practices. There are two parts to this. First, the sophisticated Map of Ag dashboards provide actionable data insights and benchmarking that can improve farm efficiency and performance. Furthermore, the knowledge exchange facilitated by the ABC group is considered a significant factor in farmer engagement beyond purely financial incentives.

Second, the ultimate financial reward is a premium payment for improved performance. The entire grower group will be audited against the RTF and assigned a performance indicator (Engaged, Advanced, or Leading).

Farmers will receive a premium based on improving against that scale in subsequent audits. This focus on rewarding the group as a whole for action prevents individual farmers from being unfairly penalised by factors outside their control, such as poor weather. The SAI audit itself is practice-based, validating the sound adoption of sustainable practices and the approach to farmer engagement.

This system encourages farmers to explore opportunities rather than demanding changes, using data to highlight where the focus and incentives should be directed, such as on increasing the diversity in cover crop mixes.

Looking ahead, the data-driven model opens up a significant view of the future for arable farming. For farmers producing commodities, engaging with the supply chain and improving their environmental credentials is a powerful way to differentiate their product and potentially command a market premium.

The commitment to using technology, such as Map of Ag’s future capability to ingest farm records directly and automatically gather data from fertiliser companies and tractor telematics, also promises to reduce the administrative burden on farmers, solving the challenge of being asked for the same data multiple times.

The real prize, however, lies in potential collaboration. As the group collects comprehensive, whole-farm data, the door opens for the wider supply chain beyond Crisp to potentially invest in areas where they want to influence change, using the same dataset.

This opportunity for external funding – where a farmer’s data and on-farm practices potentially might not only satisfy the needs of Crisp Malt, but also a water company interested in water quality, or another supply chain partner – is essential to ensuring the farmer’s continued engagement. The value proposition must be multi-faceted and robust.

Map of Ag is uniquely positioned to help bring these collaborations together, acting as the nexus for various industry efforts. The complexity of arable farming, with its necessary crop rotations, demands a collaborative approach.

As partnerships develop with entities who are also keen to invest in environmental outcomes, the data collected through a scheme such as Field Forward will become a critical, valuable currency, ensuring farmers are rewarded not just for their barley, but for their positive contribution to a sustainable landscape.

In this data-driven future, sustainability is not a cost centre, it is a path towards product differentiation, supply chain resilience, and a monetised opportunity for growers. ■

Protecting the digital harvest

The agrifood sector is as vulnerable to cyber attacks as any other sector, possibly more so. Agridata expert **Julian Gairdner** looks at the evidence and considers the mitigation strategies.

For generations, the biggest threats to a harvest were visible: a late frost, a swarm of pests, or a prolonged drought. But in the last decade, the agricultural landscape has shifted. Today's farm is not only a food producing business, but a data enterprise. From autonomous tractors guided by GPS to climate-controlled poultry sheds managed by smartphone apps, the modern farm generates as much data as it does produce.

This digital revolution – often referred to as Agriculture 4.0 – is unlocking unprecedented efficiency and yield. But it has also opened the gate to a predator that no physical farm fence can keep out: the cybercriminal.

As the agrifood sector becomes increasingly interconnected, the threat of cyber-attacks has graduated from a theoretical risk to a clear and present danger. The question is no longer if an attack will happen, but when, and more importantly, how resilient our food systems are when the screens go dark.

We need only look at the headlines where we have seen a sharp escalation in ransomware incidents. The attack on JBS Foods in 2021 remains a watershed moment for the industry. The meat processor was forced to shut down facilities across the US, Canada, and Australia, threatening global meat supplies and leading to a reported $11m Bitcoin ransom pay-off. It was a wake-up call that a digital breach could empty supermarket shelves in days.

In 2022, agricultural machinery manufacturer AGCO was hit by a ransomware attack. Disruption to its operation lasted several days, causing temporary shutdowns in countries such as Germany and France.

But it would be a mistake to think that it is the corporations that are the only targets. A sobering example comes from the farm level itself. Just last year, a dairy farmer in Switzerland suffered a hack that disconnected his automated milking and feeding systems, and demanded a $10,000 ransom.

The tragic result was not just financial loss or data theft, but the death of a calf and the necessary euthanasia of a cow because the health-monitoring alerts – which the farmer relied upon – were silenced by the breach. This incident highlighted a chilling reality: in modern farming, cyber safety is now a component of animal welfare.

Why are hackers targeting agriculture? The answer lies in the unique pressures of the food supply chain. Unlike a retail clothing store that can pause sales for a few days, agriculture operates on biological clocks that cannot be stopped. And people need to be fed.

Cybercriminals are astute. They know about seasonality. They know that a grain cooperative cannot afford downtime during harvest, and a dairy processor cannot pause operations when thousands of litres of perishable milk are arriving daily. This creates leverage. The pressure to pay a ransom is immense when the alternative is a rotting product or starving livestock.

Furthermore, the sector has what security experts call a "broad attack surface." The digitisation of the supply chain has outpaced the security of the infrastructure. We have state-of-the-art sensors running on networks secured by passwords that haven't changed since installation. We have legacy operational technology – the hardware that controls factory belts and crop storage facilities – that was designed for reliability, not security, and was never meant to be connected to the internet.

The conversation often focuses on big processors, but the vulnerability begins at the farm. Farmers are now custodians of commercially sensitive data. Yield maps, soil health data, livestock genomic records, and financial accounts are all stored digitally. If a farm's system is breached, it's not just the farmer's bank account at risk.

Consider a scenario where a cyber criminal manipulates data rather than stealing it. If the data feeding an automated irrigation or nutrient delivery system is subtly altered, a crop could be destroyed without the farmer realising until it is too late. Or, consider the integrity of the supply chain. If a hacker gains access to a farm's certification data, they could theoretically falsify organic or welfare status, introducing food fraud that could taint the reputation of an entire cooperative.

The risk also flows upstream. Farmers are often connected to larger cooperatives or suppliers via portals for ordering feed or selling grain. A compromised farm computer can serve as a “backdoor” entry point into these larger, more secure networks. In cybersecurity, you are only as strong as your weakest link, and often, that link is a PC in a farm office running outdated software.

Scary stuff. But how do we move from vulnerability to resilience? We must avoid scaremongering and focus on cyber hygiene. Just as biosecurity is second nature to a livestock farmer, so cybersecurity must become part of the standard operating procedure.

Where might we start? First is what you might call the “human firewall”. The majority of breaches start with a phishing email – a fake invoice or a “click here to view your delivery” link. A culture of scepticism is crucial. If an email looks unexpected, verify it.

Then there’s the issue of network “segregation”. A modern farm often runs the family home Wi-Fi and the farm business operations on the same router. Ideally, good practice should seek to separate these. The kids’ gaming console (a potential entry point) should not be on the same network as the automated milking bot or the farm financial records.

Robust authentication is king. Passwords are no longer enough. Enabling Multi-Factor Authentication (MFA) on every account that supports it, especially email and banking, should not be treated as optional. It is essential. This simple step, requiring a code from your phone as well as a password, apparently stops 99% of automated attacks.

Ransomware works by encrypting your live data and your backups if they are connected to the network. Consider deploying the 3-2-1 rule: Three copies of data, on two different media, with one copy held off-site and offline (unplugged). If your system is locked, you can wipe it and restore from the clean backup without paying a cent.

Finally, just as machinery needs greasing, software needs updating. Those annoying “update now” pop-ups are often patching security holes that hackers have discovered. Ignoring them is like failing to fix a broken latch on the farm gate.

In the wider supply chain – processors, cooperatives, and logistics providers – protection requires a systemic approach. “Good” in the supply chain means transparency and collaboration. The era of hiding breaches to save face is over. The agrifood sector needs to share threat intelligence. If a grain merchant, say in the US, sees a new type of phishing attack, sharing that intel could save a cooperative in Europe.

Vendor risk management is vital too. This means auditing the security of the software and hardware suppliers they rely on. When a cooperative buys a new fleet management system, they should be asking: “Where is this data hosted?”, “Who owns it?”, and “How is it secured?”.

Finally, resilience planning. Cyber-attacks should be treated like natural disasters. Companies need a “digital fire drill.” If the internet goes down today, how do we weigh trucks? How do we pay farmers? How do we trace batches? If the answer is “we can’t,” then the business is not resilient. Reverting to pen-and-paper for 48 hours is a valid continuity plan, but only if the staff knows how to do it.

The threat of cyber-attacks on agriculture is not going to go away. It will evolve as we adopt AI and deeper automation. However, the sector is known for its resilience and adaptability. Farmers have always adapted to changing climates and new technologies. The cyber climate is just the latest “weather pattern” to master.

By treating data with the same care as we treat our soil and livestock – protecting it, nurturing it, and securing it – we can ensure that the food systems of the future are not only efficient but robust.

The goal is not to build an impenetrable fortress, but to build a farm and a supply chain that can take a punch and keep standing. In a world where food security is paramount, protecting the digital harvest is now just as important as protecting the physical one. ■

Five-point farmer “cyber biosecurity” checklist

1. **Isolate your tech:** Don’t run your farm business on the same network as your smart TV or children’s devices.
2. **Lock the digital gate:** Enable Multi-Factor Authentication (MFA) on your email, accounting software, and cloud storage.
3. **Back it up:** Perform a weekly backup of critical data to an external hard drive, and then unplug it.
4. **Verify requests:** If a supplier changes their bank details via email, call them on a known number to verify. Payment diversion fraud is rampant.
5. **Update assets:** Keep an inventory of all smart devices (cameras, sensors, controllers) and ensure their firmware is set to auto-update.

Risk analysis – Where are the vulnerabilities?

- **Dairy:** High risk due to “always-on” nature. Automated milking systems and milk cooling tanks are time-critical. Disruption leads to milk spoilage and animal health crises.
- **Arable/grain:** High risk during planting and harvest windows. Ransomware attacks on GPS networks or machinery dealers can halt field operations. Disruption to grain drying systems can cause crop spoilage in storage.
- **Intensive livestock (Poultry/pigs):** Critical risk regarding environmental control systems. Ventilation and temperature control are automated; failure can lead to mass livestock loss in hours.
- **Logistics/cold chain:** The silent risk. Manipulation of temperature data in cold storage can spoil produce without physical signs until it reaches the consumer, leading to massive food waste and liability claims.

Digital assistance

The relentless advance of Artificial Intelligence is no longer a futuristic concept in agrifood, creating a new breed of professionals and producers as never before, as **Joe Towers**, an agtech specialist and farmer, explains.

For years, the sales cycle in the digital agritech space has followed a predictable, often ponderous, path. A client expresses interest in a new software solution and what follows is a series of meetings, email exchanges with developers and data scientists to scope the idea, and often a lengthy wait for the project to be scheduled into a development sprint.

The result, often weeks or months and thousands of pounds later (hitherto largely unavoidable), is a proof-of-concept that might miss the mark, leading to further revisions and a loss of client momentum.

But Artificial Intelligence is shaking this up as never before, turning what has been a sequential relay into a dynamic, interactive collaboration.

Welcome to the world of the "forward-deployed engineer": A versatile technologist who works directly with customers to address specific challenges using advanced AI and automation platforms. In effect as a client account manager I have become a new breed of professional who merges the client-facing skills of a salesperson with the technical and business acumen of a developer, designer, business analyst and designer.

Entirely self taught, I have developed and evolved a collaborative approach to address client needs by creating rapid prototypes for clients as a practical blueprint for a software or data project. In my case it often begins in a consumer-facing AI tool such as Claude, which can generate an initial "artifact" or user interface based on a detailed "ask" which I have composed to reflect a client's needs.

This first iteration (subject to some tweaks) can be visualised and shared immediately to elicit rapid feedback from the client. From there, I can adopt more powerful AI tech that uses the initial code base and my computer's command-line interface to allow the AI prototype to interact directly with files on my computer and integrate with other applications seamlessly. The code is stored and managed in a repository such as GitHub.

For good measure, it is possible to use a different AI tool to review the code and suggest ideas, creating a "pair" programming dynamic with two AI partners. Finally, to bring the prototype to life, I use a third-party service (such as Vercel) to deploy the application and generate a shareable web link.

This entire workflow, from initial idea to live demo, has condensed months of tasks for several people into a matter of hours for one person. When a client sees the demo and suggests a change, this can be done instantly in front of the client. They are mighty impressed!

It's not just the client facing work that is benefiting. I've been deploying AI to solve my own business challenges, helping me to navigate a trio of platforms: customer relationship management (CRM), time recording and financial forecasting. Before I started using AI, extracting insights required cumbersome monthly data exports and manual processing. But I discovered, one weekend I could create a portal with dummy data which contained a dashboard with working APIs that could pull data from these different systems, creating a unified, customised view of my accounts' performance.

Of course, this was just a concept and any formal deployment would need to run the rigour of data security and a thorough code review. But these use cases demonstrate that instead of being locked into a rigid, one-size-fits-all approach, professionals equipped with AI skills can build their own tools, tailored perfectly to their needs.

The implications for major software-as-a-service (SaaS) businesses are profound. Why pay for a sprawling platform with dozens of features you never use when you can build a lean, efficient application that does exactly what you need?.

While the impact of AI in my role in agtech is game changing, its potential on the farm itself is arguably even more revolutionary. This became intensely personal when my partner and I won a competitive tender for a farm tenancy.

Artificial Intelligence became my assistant. Taking my already detailed agri knowledge one step further, I used AI to help me test and determine my optimum business plan across a suite of tools including Google Gemini, Claude, and ChatGPT. In other words, the analytical power of AI allowed me to test assumptions and scenarios to help me determine how I wanted to run my business.

The AI was no substitute for my farming knowledge – and certainly not the practical skills needed on the ground – but it was like having a team (a huge team) of consultants working away in the background, to an extraordinary level of expertise and detail.

My business plan was comprehensive, with a clearly articulated narrative, the centerpiece of which was a complex set of 25 interconnected financial tables, covering profit and loss for five separate enterprises, five years of cash flow projections, and a final equity position.

The entire financial model was built and held within the AI's memory without a master spreadsheet. When I wanted to change a variable – for example, buying half as many suckler cows – the AI would identify all relevant tables, adjust them, and ensure the entire model remained internally consistent.

I even used different AIs independently to review and evaluate the plan, eliminating any errors and giving me incredibly high confidence in the output; and allowing me to be rapid and agile in making adjustments in my discussions with the landlord.

Artificial Intelligence really was my friend. It helped me to decipher often impenetrable language used in the tenancy agreement. As a new entrant, I could test and interrogate farm strategies such as rotational grazing, stocking densities, and even identifying issues with pasture disease management. And for navigating environmental schemes, I could annotate LiDAR map screenshots, identifying

dikes and hedgerows to inform my stewardship applications.

My next plan is to move beyond off-the-shelf farm management software and build my own farm dashboards, based on my own business plan and tailored to my chosen farming philosophy. Every farm is so unique. With AI, I can really address this. The technology at my fingertips is unbelievable.

But, and there is a big but. You need the right skills. While my experience is a preview of a fundamental shift in how participants might succeed in the agrifood sector, the gap between what is possible with AI and what people are currently able to do is vast, and closing it represents both the biggest challenge and the greatest opportunity for the industry.

For professionals in the agtech sector, I believe the message is clear: Adapt or risk becoming obsolete. There is a new breed of individuals emerging who will be able to deploy their skills and experience from the field to the factory. They will be the ones who understand how to productively use AI to conceptualise, prototype, and leverage data-driven solutions delivering efficiency gains which are too massive to ignore. A single, AI-empowered individual can now accomplish what previously required a team of specialists, shortening delivery cycles and delivering more value than ever before, incredibly quickly.

For farmers, the opportunity is profound. Artificial Intelligence acts as a great democratiser of knowledge and capability.

The sophisticated financial modelling, legal analysis, and strategic planning that was once the exclusive domain of expensive consultants is now available through a chat interface. This allows farmers to take greater control of their business, to test scenarios, to understand risks, and to build hyper-customised management systems that reflect their unique farm context and philosophy.

But to seize this opportunity, a concerted effort towards upskilling is essential. The industry must move beyond viewing AI as a niche technology and recognise it as a core competency for the modern agricultural professional. Initiatives such as the AI Skills Hub (aiskillshub.org.uk), provide access to countless courses and instructional support to learn how to “do” AI.

The future of agriculture will be defined not just by the data we collect, but by our ability to act intelligently upon it. The tools to do so are now more accessible and powerful than ever before. The individuals and organisations that embrace this change, that invest in learning, and that cultivate a culture of digital innovation will be the ones who lead the agrifood sector into its next chapter of innovation, productivity and growth. ■

Data feeds

Significant emissions reductions in UK ruminant agriculture through the understanding of data about purchased-in feeds are being achieved across a number of Map of Ag's clients, says technical specialist **John Warburton.**

The UK's agricultural sector stands at a critical juncture. Contributing around 12% of the nation's total greenhouse gas emissions, the pressure to decarbonise has never been greater.

Within this, ruminant agriculture – primarily dairy, beef and sheep production – is under intense scrutiny. While the focus has rightly been placed on herd/flock fertility, animal health, fertiliser usage, and genetics, a huge and often opaque piece of the carbon puzzle has remained largely untouched: the emissions embedded within purchased animal feed.

This is not a minor detail. For many UK farms, purchased feed represents the single largest variable cost and a significant source of imported environmental impact. Yet, the way we account for it has, until now, been a blunt instrument.

To understand the opportunity, we first have to grasp the problem: When it comes to purchased feed emissions most models use generic emissions intensity for different feed types.

This means a standard 18% protein dairy cake is assigned a single, average carbon footprint, regardless of its specific composition. This one-size-fits-all approach masks a huge degree of variability and, crucially, fails to reward proactive, sustainable choices made by farmers and their feed suppliers.

For example, a farmer making a conscious choice to buy a soya-free feed might not be recognised for their efforts because their neighbour, using a feed with a high soya inclusion rate, calculates their footprint with the same average emissions factor for that class of feed.

This systemic flaw not only produces inaccurate carbon accounts but actively discourages innovation and investment in lower-impact feed formulations – farmers paying a premium for sustainable ingredients see no benefit in their carbon audits.

The source of this variability is largely down to the ingredients. Components such as soya and palm oil derivatives, often linked to deforestation and land-use change in their countries of origin, carry a disproportionately high carbon footprint. A feed formulation that minimises or replaces these ingredients with locally sourced alternatives such as rapeseed or field beans will have a dramatically lower emissions intensity, even if its nutritional profile is the same.

Prompted initially by enquiry from one of our clients, processor Saputo Dairy UK, we have embarked on a mission to move beyond the averages. Initially, our goal was simply to verify the accuracy of the generic feed averages. However, the effort has quickly expanded to identify individual feed emissions intensities and apply them to each specific delivery onto farm. This is no small undertaking. It has involved collecting detailed delivery and product formulation data from over 200 feed companies across the UK.

The process is split into two key parts: first, capturing the transactional data – what product and tonnage was delivered to which farm, and when. Second, securing the product formulation data to calculate a specific emissions intensity for that exact feed.

This is where the challenge of data fragmentation comes in. Unlike in countries such as The Netherlands, where feed data is regulated and uniform, the UK market is diverse.

Currently, we allow feed companies to provide information in their most convenient format, provided it contains sufficient data. This can range from sophisticated data exports from large manufacturers, who may have already calculated their own embedded emissions, to simple ingredient lists (or feed tickets) from smaller mills that meet only the statutory minimum.

Where only an ingredient list is provided, our team works with nutritionists to reverse-engineer the formulation, using known protein percentages and typical inclusion rates to build an accurate emissions profile.

This dedication to detail ensures that even with varied data quality, a precautionary principle is applied: With less granular data,

our emissions estimate may trend slightly higher to avoid any risk of under-reporting.

Managing and making sense of this vast, non-standardised dataset would be impossible without sophisticated technology. This is where we are deploying Artificial Intelligence in a novel, two-tiered system.

The first major hurdle is matching the delivery data from a feed supplier to the correct farm ID in our database. To address this, we have started using large language models to scan the invoice-level data and compare it against the farm details using farm names, business names, and farmer surnames to find the most likely matches.

A second AI then effectively marks the homework of the first, reviewing the proposed matches to assess their accuracy, and thereafter, any remaining errors receive human oversight.

This multi-layered approach automates the vast majority of the painstaking data-matching process, allowing the system to handle huge volumes of information with speed and accuracy. A separate AI process is also used to analyse the product ingredient information to help calculate the carbon footprints.

The next big challenge which AI can help us with is automatically matching the specific product formulation data to the corresponding delivery data. This remains a complex manual process, as product names can vary slightly on invoices versus technical specifications, but it represents the next frontier in fully automating our data pipeline.

In the background, we have robust data sharing and IP protection agreements with farmers, feed suppliers and our clients to ensure all parties are clear about how the data is being used and to what purpose.

Our Farm Data Safe certification with the Farm Data Principles farm data governance scheme underpins our approach to this. The result of this meticulous data work is a uniquely precise carbon footprint for each farm. The specific emissions intensity of every feed delivery is logged and integrated into the farm's overall model. This allows for the carbon footprint of every litre of milk or kilogramme of beef produced to be calculated with a new level of certainty.

The results are striking. On one dairy farm for example, the overall carbon footprint was reduced by 20%, merely by changing the feed from a high intensity formulation to a lower one, without compromising nutrient intake or milk output.

While this was perhaps a more extreme example, it is an illustration of the potential locked within the supply chain. For a processor or retailer targeting a 30% emissions reduction by 2030, realising that a significant portion could be achieved simply by optimising feed sourcing is a game-changer.

And the benefits are not just derived by those processors and retailers. Insights from the data can support meaningful incentivisation for farms. Rather than rewarding simple metrics such as feed efficiency, supply chains can now directly encourage and financially reward farmers for choosing verifiably lower carbon feed products. This creates a direct link between environmental improvement and farm profitability, driving a virtuous cycle of demand for sustainable feed.

So, what if this potential was extrapolated across the entire UK dairy herd? A fag-packet calculation would suggest that if only a 10% feed inclusion footprint reduction could be realised across the UK's approximate 1.8 million dairy cows, the aggregate saving would amount to 574,000t of CO_2e – a monumental contribution to the UK's net-zero ambitions, achieved without reducing national output. This is a genuinely good-news story.

Ultimately, the work we are doing is about transforming an opaque part of the supply chain into a transparent lever for change. It moves the conversation from abstract averages to concrete actions. By providing farmers, nutritionists, and the entire supply chain with better data, they are empowered to make better decisions – for their businesses, and for the planet. ■

Reducing feed emissions

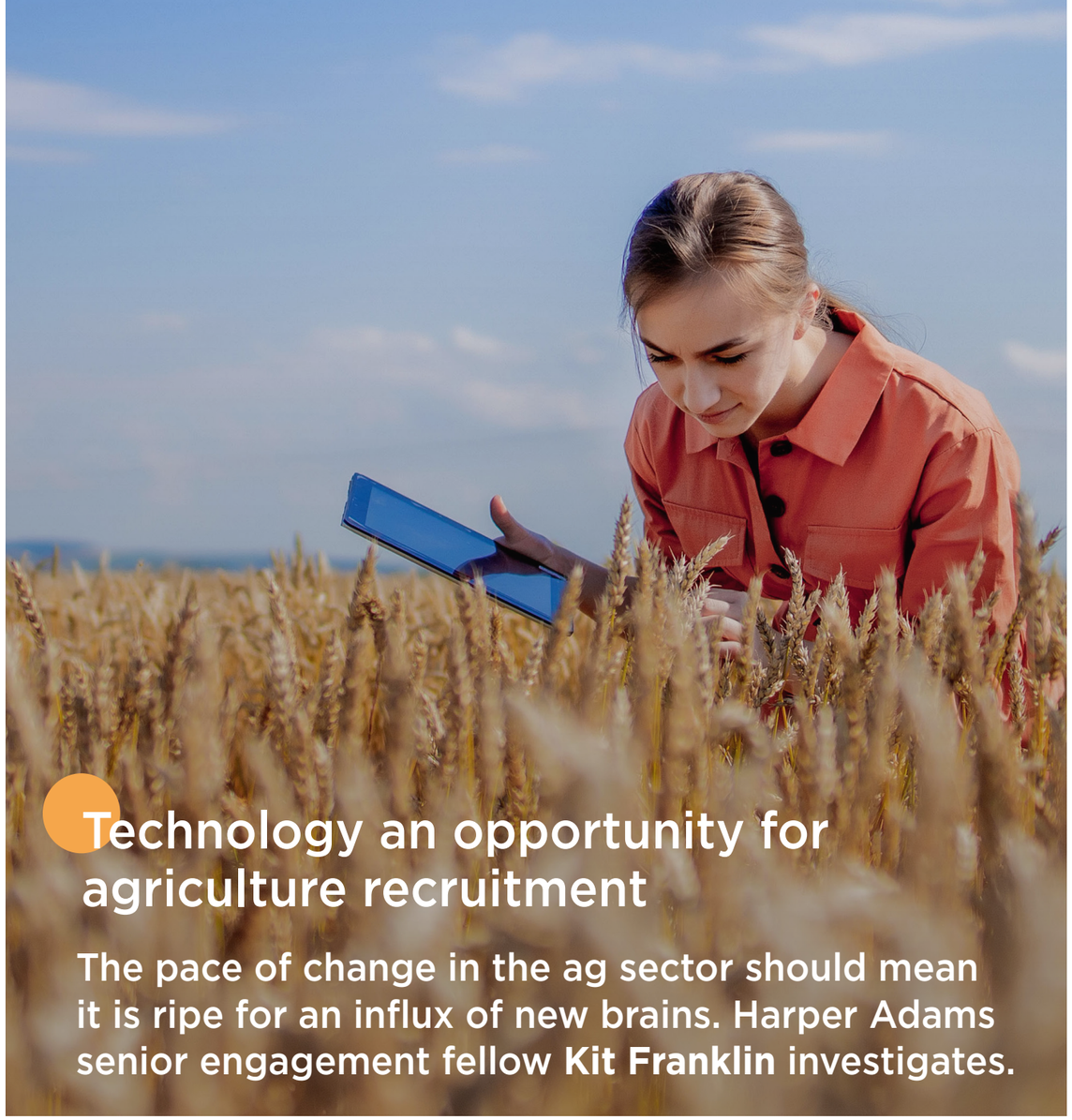
The two key areas to focus on are:
1. Embedded emissions of the feeds
2. Feed Rate
   - Forage quality – always the main driver to decrease feed rate at a given yield. This has a large effect on overall GHG emissions
   - Numbers of youngstock – replacement rate and age at first calving (AaFC)
   - Better overall fertility – more milk with fewer animals

A worked example shows the impact of these two areas. Taking a 180-cow herd of high yielding cows (10,500 kg of Fat Protein Corrected Milk (FPCM) per cow) on a TMR ration (see below) we can see the impact of adjusting the two areas above.

Feed	Tonnes
Compounds	375
Wheat/Barley	150
Soya	150
Soya Hulls	150
Fats	15
Minerals	9

Soya is not the enemy if it is responsibly sourced. By swapping the origin of the soya within the ration from a South American origin to a North American origin, this leads to a ~9% reduction in overall emissions for the farm. If the source of protein within the ration is swapped out from soya altogether to rapeseed/distillers (albeit with a higher feed rate) this gives us a further 2% reduction in overall emissions.

By placing a focus on overall feed rate, we can increase the total reduction in emissions to ~14%, a significant proportion of the farm's overall footprint just through a focus on feed.



Technology an opportunity for agriculture recruitment

The pace of change in the ag sector should mean it is ripe for an influx of new brains. Harper Adams senior engagement fellow **Kit Franklin** investigates.

We live in interesting times. So said former British politician Joseph Chamberlain, framing the expression as a purported Chinese curse heaped upon an enemy.

Curse or not, farming is indeed living through a very “interesting” time, facing as it does the monumental challenge of ensuring global food security while at the same time stewarding the planet’s natural resources against a background of destabilising global volatility.

This, alongside (arguably) unparalleled technological transformation, which has seen more happen in the past 15 years to digitise and automate agriculture than in the preceding 50, has created a critical paradox:

Working in agriculture is demanding more and more highly skilled and creative thinkers to solve macro problems but at the same time there is a very mixed pattern of attracting (and retaining) the brightest minds of the next generation.

This talent challenge is not homogenous between countries. While the “Clarkson Effect” has more recently led to application surges at specific UK institutions such as the Royal Agricultural University and Harper Adams University, broader national data for “Agriculture, food and related studies” from the UK’s Higher Education Student Statistics shows a relatively stable student cohort of around 19,500 over the past four to five years.

In the US, demand for agriculture graduates is strong which may explain why agricultural programmes are holding steady against a backdrop of declining overall tertiary education enrolment, though some of this is in part to a significant influx of international students. In the grassroots the National FFA Organisation (formerly Future Farmers of America) has hit a record of over one million members.

Elsewhere, Australia faces an acute skills gap, with its universities producing fewer than 1,000 graduates a year for a market that demands between 5,000 and 6,000, despite a recent survey of 158,000 tertiary students revealing that agriculture students are among the happiest with the quality of their degrees.

New Zealand presents a mixed picture, with some universities reporting enrolment boosts in agriculture-based studies, but a concerning decline in the number of students pursuing doctoral studies in agricultural and environmental fields, threatening the future of high-level research.

So while, on the face of it, the numbers may not indicate a crisis (perhaps Australia excepted), a more critical question is whether the tertiary enrolments will lead to a population of workers with the right skills for the future.

It’s a tricky balance. Agriculture still needs people who understand the core components of farming and food production (and our colleges for example in the UK are good at teaching this). But what about engineers, data scientists, artificial intelligence specialists and the many new and emerging technological roles that are required? How does agriculture compete for these skills with other sectors?

Perhaps part of the problem is the perception gap. There is a job to be done to deconstruct the myths of an antiquated workplace and present an unapologetically optimistic vision for the future, inviting a new generation not just to a job, but to be part of a hi-tech global solution. How, for example, can we be the next Formula One which itself has transformed into one of the most popular advanced industries in the world? It increasingly showcases technology and engineering opportunity alongside the racing. F1 has always been cutting edge but popularity seems to be increasing through the high level of coverage and access – 10% year-on-year increase in the US according to reports. Being open and engaging is the key. The acceleration of tech in agriculture is not a slow evolution, it is becoming a rapid and disruptive revolution. A decade ago, commercially available agricultural robots were virtually non-existent. Today, companies such as GUSS (Global Unmanned Spray System) are selling fully autonomous spraying machines in decent numbers. These are not remote-controlled novelties, they are machines with no human driving capability, operating entirely on their own.

This leap is mirrored in conventional machinery. Digital systems that would have been alien to operators in the 1990s – such as auto-steer GPS, electrically controlled transmissions, and pre-set headland control systems – are now ubiquitous and standard features. The fundamental job of working with farm machinery has been irrevocably transformed.

However, this technological leap does have a complex landscape of adoption revealing a critical skills gap that is less about operating the equipment and more about understanding the data and insights that ultimately justify the business case. The industry needs a new class of professional – data analysts, business strategists, robotics specialists and more – who can translate technology into compelling, solution-focused and ultimately profitable courses of action.

This technological shift might not, as some are predicting, lead to job losses. As we see a shift towards more analytical skills thanks to the rise of AI and increasing automation (which in some areas such as fruit picking can solve a labour shortage), we will eliminate some of the more administrative and repetitive tasks, freeing up human capital for higher-value, strategic work. This can already be seen with the need for on-farm robotics engineers to maintain the new automated workforce.

Even the more “traditional” farm roles require a new mindset. I recently heard the CEO of a company that converts tractors to run autonomously explain that typical advertisements seeking experienced tractor drivers yielded a minimal response. But ads for a “technically savvy young person with video game experience who wishes to live life in the outdoors” attracted a wealth of applicants.

This is more than clever marketing. It signals a profound change in the cognitive

abilities needed for modern farm management. The job is becoming less about physical endurance and more about managing complex, dynamic systems in real-time – a process remarkably similar to a sophisticated strategy game.

The operator of an autonomous fleet is not a driver, they are a systems operator or fleet commander, managing variables, optimising resource allocation, and responding to live data. This reframes the work as an intellectually stimulating challenge that should appeal directly to a generation fluent in digital interfaces and complex problem solving. And one that values the outdoor lifestyle.

Technology is the key enabler of farming's "monumental challenge". Automation makes previously impractical, biodiversity-enhancing practices viable, for instance, strip cropping – growing multiple crops such as wheat, barley, and beans in narrow bands within a single field – which is difficult with large, conventional machinery but perfectly suited to smaller, selective automated harvesters.

Such an approach provides a direct pathway to implementing tangible biodiversity benefits, while maintaining food production.

These changes (and challenges) we are seeing haven't gone unnoticed by creative thinkers from outside the sector. Even musicians (such as Andy Cato of Groove Armada fame who co-founded Wildfarmed) are seeing the new opportunities the sector has to offer. Professionals who have spent a number of years, for example, in other tech sectors and in finance are seeing a move over to ag as one that might offer more fulfillment.

These "outsiders" are powerful because they are creating new, accessible narratives about farming. Cato provides the story of purpose – fixing the planet through food – while the aforementioned Jeremy Clarkson provides the story of relatability – it's a tough, complex, but ultimately engaging business to be in. Together, they grant cultural permission for people from non-agricultural backgrounds to take an interest in the sector, breaking the old paradigm that one must be "born into it."

But agriculture is, nevertheless, competing for talent. And that means it must aggressively recast its value proposition. This involves moving the conversation beyond a simple salary figure to a more holistic view that encompasses financial rewards, lifestyle benefits, and a technologically enabled work-life balance that was previously unimaginable.

It is important to acknowledge the perception that the sector struggles to pay competitively. United Kingdom data for October 2023 showed average weekly earnings for agriculture, forestry, and fishing workers at £492, well below the national average of £619.

However, these headline figures can be misleading because they frequently ignore the substantial value of non-housing and a work vehicle, significantly reducing major living expenses.

This financial package is particularly compelling within the context of a broader societal shift. The next generation is increasingly prioritising "living well" over the pursuit of often seemingly unattainable financial goals such as home ownership, with a trend towards greater participation in outdoor pursuits (in the UK, US and elsewhere). Agriculture therefore does not necessarily offer poor reward but an alternative economic model that is increasingly attractive to a generation locked out of traditional wealth-building milestones.

Historically, agriculture's biggest recruitment challenges have been the gruellingly long hours, social isolation, and a poor work-life balance. But technology has answers to this. Robotic milking systems, for example, have been a game changer, often for small family dairy farms by facilitating time off to break the relentless 24/7 cycle of the job.

And automation, by elevating the job from a physically draining chore to an intellectually engaging one can offer a direct response to the mental health challenges in the sector, which are often linked to lone working and overwhelming stress.

With roles that are intellectually stimulating, a mission that is critically important to the future of the planet, and rewards – when viewed holistically as a package of wealth, lifestyle, and purpose – that are competitive, agriculture should be a go-to sector for the next generation.

With the changing dynamics and a technology revolution underway, now is the time to reposition our offer to the workforce of tomorrow. Just as Formula One has morphed from dipsticks to data, so too our industry should be able to attract the diverse melting pot of talent it needs.

We have to be positive. It may not be Monaco but it's far from mundane. ■

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