

# Landwards <sup>@IAgrE</sup>

The professional journal for the Institution of Agricultural Engineers

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- **People** – Early career insight
- **Profession** – Continuing Professional Development
- **Practice** – The digital vineyard
- **Technical** – Hydrogen engine development



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**Dr Emma Wilcox**

Chief Executive Officer of the  
Society for the Environment

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## Editors Welcome



I can't open this edition of Landwards without first paying tribute to Geoff Freedman. For yours truly, it feels like he was always there, as a senior and longstanding member of the Institution. With his sly humour, kind counsel and excellent engineering instincts, it's a big loss. Geoff's full obituary opens Membership matters (p32).

Elsewhere, we focus on several engineers at different stages of their careers, from just starting out (p12 and 28) to mid-career (p16), whilst keeping an eye on what is needed to succeed with some timely CPD advice (p22).

One can't open a magazine at the moment without being assaulted by the latest thinking on alternative power sources for farming. Landwards has joined the throng

with a look under the bonnet of JCB's hydrogen engine, fascinating stuff in Technical (p46).

For those who like a drink, it's refreshing to find out more from a recent lunchtime lecture about the appliance of science to the humble grape, see Practice (p26). There is also the opportunity to enjoy some insights from the wider world with a report on the debate at this year's Oxford Farming Conference on the future of human labour on farms (p24).

I hope you find this spring edition thought provoking.

*Andy Newbold*

Andy Newbold

Editor

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## Pentair Hypro EU Ltd wins the IAgRE Ivel Innovation Award

Pentair Hypro, a supplier of pumps, nozzles and components to sprayer manufacturers and distributors around the world, has won the Ivel Award for best new product or environmental innovation at LAMMA 2023.

Presenting the award at LAMMA Charlie Nicklin CEO of IAgRE said:

"Safely handling agricultural chemicals has been an industry challenge for many years, not only from an operator safety perspective, but also making sure we're mindful of waste, recycling and the effect on the environment.

"Pentair has very much solved the industry need with their innovative system, which longer term will be adopted by chemical and equipment manufacturers. The novel close-coupled transfer system allows chemicals to be decanted into the sprayer and the containers washed without the operator having any contact with the contents or even having to open the container. This winning solution protects operators, reduces waste and demonstrates

professional practice, whilst caring for the environment. A clear engineering solution."

Roger James, Product Manager for Cleanload Nexus, who was presented with the award at LAMMA said: "I am delighted to receive this award on behalf of Pentair Hypro and for the recognition that this important new technology is receiving."

Cleanload Nexus is a mechanical device for closed transfer of agrochemicals. Used with a compatible easyconnect cap, it will open a container, remove the contents (fully or partially) into the sprayer tank, then clean and reseal the container.

It is designed to protect sprayer operators from the splashes and spills that inevitably occur when pouring from a bottle, but without slowing down or adding complexity to filling operations.

It can be plumbed into any sprayer that has suction (usually drawing from the bottom of an existing induction bowl)



and may be permanently mounted on the sprayer, or alternatively on a wall, stand or bracket (in which case it is connected to suction during filling using dry break couplings and also to clean water for rinsing).

Pentair Hypro EU Ltd is confident the easyconnect cap will become the industry standard across Europe over the next few years. When the user is ready to use the chemical, all they have to do is to remove the dust cap from the container, invert it and locate the cap onto Cleanload Nexus, no unscrewing or adaptor is needed because the cap is factory pre-fitted to the container.



## Co Tyrone entrepreneur wins IAgRE / LAMMA Young Engineer Award

*An agricultural engineer and entrepreneur from Co. Tyrone has won the 2023 Young Engineer Award at LAMMA, the UK's leading farm machinery show.*

Daniel Broderick, from Omagh, was revealed as the winner on day two of the show at the NEC, Birmingham for his Cubi-Care machine. The machine, which Daniel has been working on since 2013, makes the process of cleaning dairy cow cubicles much quicker and easier.

It was the second time the organisers of LAMMA have teamed up with the Institution of Agricultural Engineers (IAgRE) to run the award. Daniel and the other two finalists, Connor Wise from Hereford and Christopher Chavasse from London, were shortlisted by a panel of judges with the winner decided through a combination of public and panel votes.

"After a lot of years' hard work it is fantastic to be recognised with this award," said Daniel. His inspiration came from seeing how laborious the process of manual cubicle cleaning was on his uncle's dairy farm. "I decided there had to be a better way of doing it." After developing a prototype which his uncle trialled, Daniel started to develop it commercially. "My ambition now is to start supplying farms across the UK via dealers and I am already working with a dealer in the north of England and south Scotland."

As well as helping with the promotion of his product Daniel, has appreciated the networking aspect of the award. "It was great to meet the other two finalists. I hope we will stay in touch and maybe work together in the future. It was also great to be able to attend LAMMA as I haven't been before. The size of the show is really impressive, and I would like to come back as an exhibitor next year."



Charlie Nicklin, Chief Executive of the Institution of Agricultural Engineers (IAgRE) said it is important to support young engineers coming into the industry, which needs new entrants. "There are so many vacancies within agricultural engineering despite it

being an engaging, rewarding and fulfilling field. We need to support and reward entrepreneurs with novel designs and to encourage others. The Young Engineer Award at LAMMA is ideal for this purpose."



## Hands Free Farm team marks six years of success – and looks to the future

*Despite the Hands Free Farm winning numerous awards and receiving significant media interest from across the globe, its true value has been in helping to drive forward commercial research, policy development and learning for Harper Adams students across a variety of courses.*

The team set out to prove that fully autonomous vehicles – and the specialist new careers roles required to build and operate them – could be the future of farming. Six years on, they have not only met their objective, but scaled it up and recently the team behind the Hands Free Farm took the opportunity to reflect and celebrate.

On the fields of the 35-hectare robotic farm at Harper Adams University, and in the Agri EPI Midlands Innovation hub, researchers, sponsors and VIP guests united to celebrate the unique research, learning and teaching opportunities offered by the world-first autonomous agriculture project – and to look forward to the next steps in their sector transforming journey.

The event came shortly after the Hands Free Farm completed its 2022 harvest.

A group of around 50 industry representatives and VIP guests were invited to mark six years since the launch of the Hands Free Hectare; the first project of its kind in the world to grow, tend and harvest a crop without operators in driving seats or agronomists on the ground.





After a special presentation at the Agri-EPI Centre on the Harper Adams campus, the party headed out to the now 35ha Hands Free Farm itself to see its autonomous tractors and combine harvester in operation, while networking over a barbecue lunch.

The project has been run in partnership between Harper Adams and Precision Decisions, along with the UK division of Australian precision agriculture specialist Farmscan AG.

Hands Free Farm Principal Investigator (IAgrE Exec member) Kit Franklin, Farmscan AG Director Callum Chalmers, Precision Decisions (a Map of Ag Group company) Operations Manager Martin Abell and Professor James Lowenberg-DeBoer (holder of the Elizabeth Creak Chair in Agri-Tech Applied Economics), then set out how the farm had developed practically, technologically, and in research terms over the past six years.

Among those organisations who have visited or worked with the farm are the British Standards Institute, NFU Mutual, OFCOM and the Health and Safety Executive.

Meanwhile, the project has drawn a wide range of guests, including Harper Adams University Chancellor Her Royal Highness The Princess Royal, the then Environment Secretaries Rt Hon Michael Gove MP and Rt Hon Andrea Leadsom MP, the then Leader of the Opposition Rt Hon Jeremy Corbyn MP, and many more.

Kit told attendees that, despite the Hands Free Farm also winning numerous awards and receiving significant media interest from across the globe, its true value had been in helping to drive forward commercial research, policy development and learning for Harper Adams' students across a variety of courses.

He said: "Going forward, the Hands Free Farm project comes to an end – but we have a unique opportunity to do more and keep learning.

"When we look at the range of equipment here at the Hands Free Farm, we have small equipment by modern standards, but with this sort of equipment and the precision of our autonomous system, it opens the Harper Adams University future farm – right here, right now – to starting an autonomous strip crop field."

As this new project develops, academics from across Harper Adams and beyond will work with the Hands Free team to examine everything from soil quality to insect life and biodiversity on the site, which will be prepared for spring crops to be established and harvested in 2023.

## From the CEO's desk

Charlie Nicklin CEng  
FIAGrE



*As you read this, spring should be well and truly with us, the countryside looking a lot more colourful and evenings a tad lighter. Unfortunately, it goes little way to offset the constant doom and gloom that appears on the news daily and often makes me feel I should just switch it off! With the ongoing challenges of energy costs, inflation, conflict and strikes the media has no shortage of negative material; there must be something positive going on?*

In the machinery world there is, as the year kicked off well with a very busy LAMMA show in January. I think it's a shame only a handful of the major tractor brands supported what's becoming a great indoor show, but there was certainly plenty of other equipment to see. I understand shows like this are expensive for manufacturers, so a balance has to be struck on attendance of this and other

shows around the world. IAGrE were pleased to support the event with both the Young Engineer Award and the Ivel Innovation Award. The winners Broderick Engineering and Pentair have both been featured in various press articles and in this edition of Landwards.

### Skills needs

Some of you may be aware of the Government's Local Skills Improvements Plans (LSIP), which is an employer focussed initiative to better match supply and demand of skills around the country. In Gloucestershire they clearly recognised the land-based sector as a key employer and an event was held at Hartpury University which brought together farmers, growers, engineers and alike to discuss skills. This prompted me to look around my local area of Cheshire, Staffordshire and Shropshire to see what was happening with regards to LSIP in our sector; the answer was not a lot! Hopefully this will now change with the involvement of two well-known university colleges, as it's really important to ensure our sector is fully represented.

### Capacity challenge

On the subject of skills, we often talk about a lack of young people coming into the industry, what I'm certainly seeing is more of a capacity issue. Colleges and apprenticeship schemes are oversubscribed and can't train people fast enough for industry.

This capacity issue is fundamentally because of a shortfall in lecturers. I'd suggest this is now at crisis point. Interestingly former ministers Lord Knight and Lord Willetts are leading an enquiry into the acute lack of skills in engineering/manufacturing and the declining numbers of apprenticeships.

Our land-based apprentice figures are actually increasing; however, this is a great opportunity for me to raise the staff funding shortfall that's crippling providers.

On the training theme I visited Writtle University College to talk to staff and students on the recently started CNH Apprenticeship Scheme, also not

without its staffing challenges. Agricultural Engineering hasn't been taught at Writtle for many years, so I'm hopeful it will lead onto full time courses and maybe even degrees again. The new provision is in its early days and is being supported directly by CNH at Basildon. The apprentices I spoke to were certainly enthusiastic and had plenty of questions for me, albeit quite a few about match ploughing and JCB!

### EngTech

IAGrE has supported many members with professional registration at EngTech level for a number of years, often for those working in technician roles with vocational qualifications.

EngTech can also be seen as a stepping stone for someone whose long term goal is either IEng or CEng, via an engineering degree. The first couple of years of a degree, such as a Harper Adams University BEng will allow you to meet the academic requirements for EngTech. Then it's a case of meeting the competency requirements from your prior experience, work placements, etc.

Coming out of university armed with EngTech registration will make your CV stand out from others, showing your commitment to your professional development and career. It may be the decider between you getting an interview and someone else not!

### Find out more

On the operational level, to aid communications we have recently launched a mobile text message service. We don't intend to bombard you with messages, but just keep you informed of important news, events and alike. Please do also check out the website, the mobile app and our social media to keep abreast of events that are coming up. We have some great speakers lined up for our Lunchtime Lectures and Podcasts.

Finally, many thanks to those who have paid their 2023 subscription and also a warm welcome to the new members who have joined us this year, we hope you enjoy the content on offer.



# President's Musings

Steve Constable



## The Boiling Frog

*The debate regarding the use of arable land to produce electricity is raging in Lincolnshire following a planning application which could lead to a solar farm which is 36 times larger than the largest current UK installation and covering an area equivalent to 5000 football pitches.*

This will industrialise around 10,000 acres of grade 3b productive farmland. Assuming an average yield for winter wheat (taken from Defra) this development could potentially remove 33,000 tonnes of wheat from the food chain each year. Take this with the developers' estimate of a 40-year service life then a total of 1.3million tons could be lost.

This solar farm is not going to affect any other parts of the country but as more and more developments occur over time, it might be prudent for someone to consider the total effect on farmland loss before the balance tips; especially when you consider that in 1984 the UK was 95% self-sufficient in indigenous food types but the most recent (2009) figures have shown a decline to 72% (Defra) we need to avoid the boiling frog syndrome.

### A call for efficiency

The reduction in food productive farmland and efficiency should be a call for engineers to continue to do what they do best and come up with

solutions to increase productivity and efficiency with smart solutions as they have always done. Hopefully this need is recognised and funding for this effort will be comparable to those offered to the energy initiatives.

How then do we ensure that we can feed the population safely in the future? Well, the question should be, is the situation really that critical that we should look to increase yields and output in an endless quest for volume, are we missing something?

### Thought provoking

I have just spent some time at the Lincolnshire farming conference organised by the Lincolnshire Agricultural Society, the subject was "Healthy soils, Healthy minds" where a couple of very talented and informed speakers got me thinking.

The government UK population projections by the Office for National Statistics concludes that the rise in population growth previously forecast to be 6.9% over the next decade is now forecast to be reducing to 3.2%

with further growth reductions up to 2040. I mentioned previously that indigenous food self-sufficiency has declined. However, this isn't the whole picture, we are producing up to eight times the volume required for feeding the UK in the top five crops by quantity so maybe the solution is not increase but to rethink the landscape in order to nurture the land and feed the populus.

### The capacity for change

We do have the capacity to help change the landscape and as engineers we should not only be looking at current crop management but also thinking outside the box, developing, and offering smart solutions to increase production of lesser grown crops in an economic way.

The current move to regenerative farming methods is an ideal springboard to start developing solutions which can be presented as a package to the government to consider funding opportunities and to show growers that there are alternatives to wheat, barley etc.

# Biosystems Engineering

Biosystems Engineering, owned by the IAgRE, and the official scientific journal of EurAgEng, is published monthly with occasional special issues.

Head to <https://www.sciencedirect.com/journal/biosystems-engineering> to view the full article list of the

latest edition and to find out more about depth and breadth of articles accepted for publication.

Reduced subscriptions are available to IAgRE members. Go to <https://iagre.org/biosystemsinformation> for details of the preferential rates for

## Biosystems Engineering

Volume 223, Part A, November 2022, Pages 56-77

### Workload and production assessment in the avocado harvesting process using human-robot collaborative strategies

Juan P. Vázquez, Fernando A. Auat Cheein  
Faculty of Engineering, Universidad Andres Bello, Santiago, Chile

National Robotarium, Edinburgh Centre for Robotics, Heriot-Watt University, Edinburgh, UK

Human-robot collaboration strategies for agricultural applications are still a challenging research topic that is in its early stages of development. The analysis of the production and physical workload measures during the harvesting process can be useful to obtain relevant information to improve production and farm management. The assessment of the avocado harvesting process under different scenarios is presented. Two simulation

environments were created and compared based on the obtained information from a Chilean farm. The first scenario uses only a human-based workforce to perform all the avocado harvesting-related tasks, whilst the second scenario is based on a human-robot cooperative strategy proposed to improve the harvesting procedure. A total of 41 different tests for each simulated scenario was performed, and then a comparison of them in terms of production and expected human physical workload was obtained. Results showed that the use of a cooperative strategy during harvesting tasks can increase the production measured from the cargo zone from 15% to 80%, as well as the total harvested production from 23% to 85%, whilst the human workload only increases from 1% to 16%. These results enclose the possibility of using production and workload measures as metrics for a human-machine interaction cooperative approach design, in benefit of the harvesting process management and decision making.

## Biosystems Engineering

Volume 224, December 2022, Pages 68-79

### Non-destructive detection of codling moth infestation in apples using acoustic impulse response signals

Department of Biosystems and Agricultural Engineering, University of Kentucky, Lexington, USA

Department of Electrical and Computer Engineering, University of Kentucky, Lexington, USA

Department of Entomology, University of Kentucky, Princeton, USA

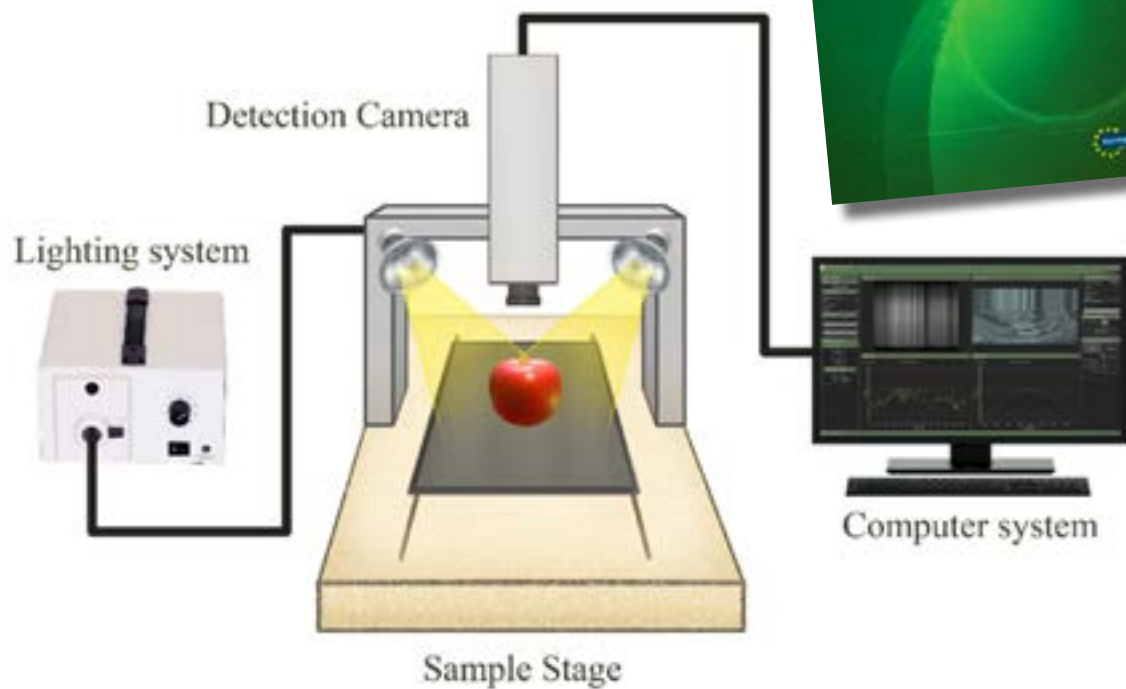
Codling moth (CM) is the most destructive pest for apples, causing large economic losses when not properly mitigated. Efficient detection methods can limit the spread of this pest in the apple supply chain. Non-destructive methods have several advantages over the current methods in that they can be applied to every apple (or a much larger sample) thereby reducing the possibility of missed detection. This paper examines the feasibility of acoustic impulse response methods for detecting CM larvae-infested apples. Experiments were performed on control and artificially infested apples from three different cultivars. Signals were recorded with a contact sensor, and 21 signal features were proposed and extracted to characterise relevant properties of the response. The 21 features were evaluated with 11 machine learning algorithms to determine if the features or their subsets contained information that could reliably determine if an apple was/is infested. Classification test results using a 10-fold cross-validation indicated accuracy rates between 80% and 92% for Fuji apples, between 92% and 99% for Gala apples, and 63% and 97% for Granny Smith apples. The impulse response required between 60 and 80 ms for each apple (not counting setup/transition time). These results from this study suggest that active impulse response classification can potentially improve the detection of post-harvest apple CM infestation detection along the supply chain.





both paper and electronic versions.

The managing editor of Biosystems Engineering, Dr Steve Parkin, has kindly summarised a selection of papers published in the past three issues, which will be of interest to IAgRE members.



### Biosystems Engineering

Volume 225, January 2023, Pages 54-68

#### Correlation between power harrow energy demand and tilled soil aggregate dimensions

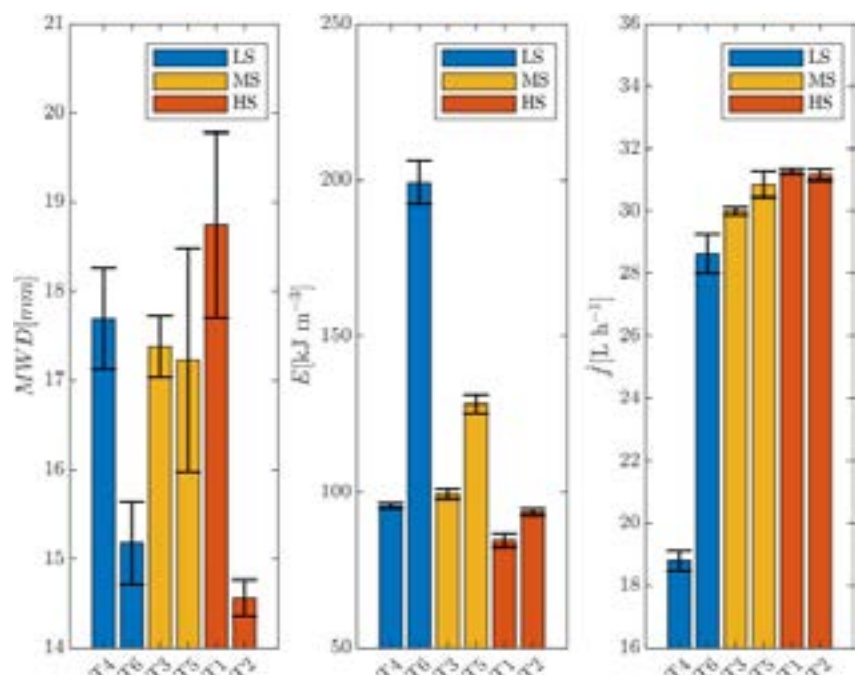
Massimiliano Varani, Michele Mattetti, Giovanni Molari, Alessandro Biglia, Lorenzo Comba

Department of Agricultural and Food Sciences University of Bologna, Bologna, Italy

Energy demand of soil tillage implements has been reported based on different operating conditions and the chemical and physical soil properties. However, tillage operations cannot only be evaluated according to their energy consumption; the soil structure improvement and the consequent agronomic benefits must also be considered. Power harrows can adjust soil clod size by varying the velocity ratio of the machinery which is calculated from the ratio of the peripheral speed of the tine rotors and the vehicle's advancing speed. This paper aims to gain a deeper insight into controlling the soil structure and find correlations with the power harrow's energy requirement in different setups. Field tests were conducted on a 3m working width power harrow coupled with a tractor

with 107kW of rated engine power. Field tests were performed by varying from 1.46 to 7.90 while tractor parameters, such as speed, engine power, fuel rate consumption, draught, and power take-off (PTO) speed and torque, were acquired

with a datalogger. The results show that the optimum conditions for a high-quality seedbed are obtained with high values of implement-soil impact speed, whilst should be kept as low as possible to minimise the fuel consumption per ha.



## People

Early Career Insight  
Maisie Wildgoose



## Info Ag tech

*IAgrE member Maisie Wildgoose is a management trainee with East Anglian John Deere dealer Ben Burgess. She kindly spent some time with the editor discussing what led her down the road to agricultural engineering.*

### Q Where did it all start?

I come from a non-agricultural background; both of my parents are in the creative industry, and I

didn't know anyone from a farm when I was growing up.

I went through school and A-Levels with no real direction and when it

came to university choices, I just wasn't sure. I got offered places at some fantastic universities but was never convinced that I wanted to commit to any of the courses.





**IAgrE member Maisie Wildgoose -  
Management trainee with East Anglian John Deere dealer Ben Burgess**

I wanted a degree I knew I would both love and utilise in a relevant industry after university .

I was desperate to leave home and as soon as I got my A-Level results I was off to America to stay with my family. After a few months in California, North Carolina and Washington, I was ready for my next adventure. At the time I'd wanted to go to New Zealand for the favourable climate and low number of killer creatures. However, the visa prices determined that I was instead going to Australia.

In Australia, I took a 17.5 hour journey from Brisbane to the Outback for my first job in a pub. It was here that I first discovered the world of agriculture. I would work in the pub from 8am to 4pm, then head out in the buggy to check stock, help with branding, load cattle or fix troughs. I loved it so much that I'd offer my free time to help on stations of friends, grandparents of friends and even strangers!

After this I was hooked, I worked in South Australia with beef and sheep; then did a cotton season with a

contracting company all across New South Wales.

I decided to try agriculture in the UK, starting with a dairy farm in North Devon in the cold, wet summer of 2018. While I loved being with the cows and calves, it was a totally different agriculture to what I was used to. Much more intensive, dairy involved a lot more slurry and a static caravan takes some getting used to.

But the biggest difficulty I had was the lack of progression. I'd be up at night asking what am I doing, where do I go



Maisie and her favourite tractor, on the display floor at Langar during her placement year

from here, what are my options?

Luckily, we had a family friend who encouraged me to consider an agriculture degree. We talked about my interests and he suggested Harper would be best.

At Harper I really enjoyed the first year mechanisation module, and developed an interest in machinery and technology. In the second year, I chose to study non-chemical weed control with a focus on automated machinery. For my dissertation I studied the adoption of precision agriculture technologies by vegetable producers.

However, I found that the work was removed from the technology side I was interested in.

I was fortunate enough to be offered a management trainee role at Ben Burgess where I have been given the opportunity to move around various business departments further expanding my dealership knowledge. I am working in the service department as a Service Advisor, where I proactively organise jobs based on machine alerts triggered by telematics analysis.

### What role does volunteering play in your life?

I volunteer when I can, most recently I spent four nights behind the bar while my Young Farmers group did their panto. One of the best things I have volunteered to do, was supporting a 250 mile bike ride from Harper to Scotland to raise money for Edale mountain rescue, George Crawford Legacy Trust and FCN in memory of friends we'd lost over the course of our degree. I was the 'social media manager' of the trip, and in total £10,000 was raised, five times more than the £2,000 goal.

Having just moved to Norfolk for work and given that I haven't been out of university for very long, I haven't had



Maisie and her dissertation on Precision Ag Uptake outside Harper Adams University

During the holidays I worked at a single depot Deutz dealership in Essex, and then did my placement year at Langar with John Deere with the intention of expanding my agricultural dealership experience and knowledge from just parts. There, I worked with the marketing, dealer development and finance departments.

### What about your journey following qualifications?

Following university, I wanted to go down the precision agriculture route, and got a job working at SOYL writing up variable rate fertiliser plans.



Maisie got to explore her interest in PA during her placement year, here she is putting a StarFire receiver on a forager before it goes out on demo



much of a chance or the time to do much volunteering. Now I am settled with my living situation and job, I am looking forward to looking into more volunteering opportunities.

### Where do you see your career going?

I want to get more involved in precision agriculture. I work closely with the Precision Ag manager for the East at Ben Burgess and have learnt so much from him. I have been working on projects with the Precision Ag team such as Tractor Optimisation Days where I have had the chance to learn more about John Deere technology and system integration. Hopefully throughout my trainee scheme, I will continue to help the precision ag team where I can.

### What are the key issues facing agricultural engineering?

Following my dissertation on the uptake of precision ag, I'd have to argue at least a little bit, that getting people to invest in new machinery is a large issue. We can produce all this cool technology, and bring all these new ideas but we have to know what

people are looking for, and what people will invest in. These new products are expensive, and for a farmer to part with so much money on a product that looks likely to be outdated before it's been paid off.

There are key issues that I think help ag engineering too, while the lack of staff and environmental pressures from the public and government are big issues for farmers, this opens up opportunity for agricultural engineers, creating a demand for product with clear objectives.

### What advice would you offer to anyone heading into the industry?

There are many opportunities, with a variety of companies selling the most incredible assortment of products. As an agricultural scientist, as opposed to an engineer, I always worried that I wouldn't have the qualifications to work for the companies I want to, but it's not the case.

Just because I don't fit the mould, doesn't mean I can't offer something else to the company. Don't forget companies will train the right person. Don't let lack of qualifications or experience stop you, apply anyway.

## The Landwards podcast

*A series of podcasts have been commissioned with a monthly news podcast and a monthly interview with an agricultural engineer or influential person in the land based sector. The Landwards podcast is on*

*iTunes, Spotify or click on <https://www.buzzsprout.com/1067353/episodes> for the latest one.*



Having been awarded two scholarships in her final year, Maisie was able to go to machinery shows and events, invest more money in researching her dissertation and support her final year studies

**“Don’t  
let lack of  
qualifications  
or experience  
stop you,  
apply anyway.”**

## People

Vimbai Pachawo



### First in the field

*As the first woman to study Agricultural Engineering at the University of Zimbabwe, Vimbai Pachawo is used to blazing a trail. Landwards caught up with her and found out more.*





**My duty was to ensure the grain silos were filled every season**

### **Background**

I was raised in a country where farming is a common activity, with every household having a vegetable garden, so I knew from childhood that farming is the main source of

livelihood. I am both an agricultural professional and a commercial farmer.

### **First steps**

From high school, I went straight into a technical college and studied

fabrication engineering and had lots of workshop exposure. I proceeded to the university a year later and did both industrial attachment and farm attachment during vacations. So, I was groomed for both industrial and fieldwork.





Field survey



Pipe laying

### What led you to agricultural engineering?

I have always wanted to be an engineer and agricultural engineering (AE) suited my country's agro-based economy. The programme was not popular back then and when I checked the university intake requirements, it seemed like they never enrolled females in AE so I was so curious and gave it a try. I found myself being the first and only female in the programme at the University of Zimbabwe in 1999. It's the best decision I have ever made and I am a proud Chartered Engineer, thanks to IAgRE. I studied a BSc Honours in Agricultural Engineering and then a Masters in Water Resources Engineering and Management, both from the University of Zimbabwe.

### After graduation

I got employed by the government of Zimbabwe as an Irrigation Engineer in Mashonaland West Province and advanced to become head of province four years later. After five years in employment, I took a short break to pursue graduate studies for one and a half years. I remained with the same employer for 13 years and then decided to take a career break to pursue Doctoral studies full time in 2019. In the Department of Irrigation, my overall role was to plan, design, construct and maintain irrigation systems. I looked at the whole cycle from feasibility, needs assessment, design, procurement, construction, operation and maintenance. An irrigation project is considered a lifetime investment and it was my duty to make sure expectations



Pivot assembly





Intake point



Hose reel commissioning



Balancing tank

were met. The aim was to ensure food security for the country despite recurring droughts. My province, Mashonaland West was considered the breadbasket of Zimbabwe and it was my duty to ensure the grain silos were filled every season.

I believe in team work, hence we performed in-house construction where possible and involved beneficiaries all the way giving them a sense of ownership and appreciation of the technology; making it easier for them to operate and maintain the project.

### The day job

I am currently on a career break and pursuing a PhD in Sustainable Built Environment at the University of Minho in Portugal. My Doctoral Thesis is on Analysis of Land use change impacts on water resources of a semi-arid catchment: case of Manyame Catchment in Zimbabwe. I am looking at issues like rapid urbanization growth, shrinking water

bodies, wetlands conversion and degradation with focus on stakeholder involvement in land and water resources sustainability.

### Next steps?

I am interested in pursuing an international career in the water and environment sector, I believe I will be an excellent team player considering my academic qualifications, professional experience and passion.

I am now more interested in sustainability issues as they are leading the global agenda as we deal with the effects of climate change. I want to educate the populace on their responsibility towards sustainable water management. I also want to be an irrigation consultant to ensure food security around the globe.

### As a volunteer

Volunteering gives me a chance to perform and grow 'outside the box'. I use my cross-cutting skills to uplift lives of those in need and also mentor peers as they pursue their goals. I also learn and improve myself as I associate with professionals from different backgrounds. Volunteering gives me an opportunity to rediscover myself and showcase my capabilities. IAgRE has given me the platform to volunteer, and I also had the great opportunity to be mentored.

### Key issues facing the discipline

The sector has been overshadowed by relevant qualifications and the agricultural engineers are in for a competition without any priority and end up unemployed. In the end, it becomes difficult to encourage upcoming professionals to join the sector.

## What advice would you offer to anyone heading into ag engineering as a career?

Agricultural engineering is so broad and cross-cutting into other fields. Post first degree, one needs to specialise into the area of interest like post-harvest technology, farm machinery and equipment, or soil and water. Specialising gives room to pursue and excel in your passion.

## Profession

### CLAAS Scholarship Awards



## CLAAS SCHOLARSHIP AWARDS – funding for young ambitious enthusiasts in agricultural engineering

*The Helmut Claas-Scholarship has been running since 2000. It is one initiative of the CLAAS Foundation and was set up by Mr Helmut Claas with a number of educational objectives, but principally to support universities and their graduate students in the pursuit of Agricultural Engineering and general agricultural development.*

There are a number of functions in support of this aspect of agricultural education, through various fundings such as scholarships and special prizes for innovative projects designed to enhance the state of the art in Agricultural Engineering. In addition to universities, these include research centres and schools with agricultural or STEM related projects.

The Helmut Claas-Scholarship is aimed at students, who have completed their Bachelor's degree in such topics and are then developing their research projects through a Master's programme. There are four main prizes, and also four bonus prizes awarded each year for winning students submitting their Bachelor thesis.

### An international focus

It is open to students from all countries, with submissions in either

German or English language, on topics related to Agricultural Engineering, or agricultural development subjects. The submissions are judged by a panel of experienced industry people in the UK and Germany who are drawn from a mixture of academia and industry.

In October 2022, CLAAS welcomed the winning students, together with their respective tutors to their Headquarters in Harsewinkel, Germany, for the Foundation's annual Awards Ceremony. This was the first event held in person, after an enforced two-year break due to Covid restrictions.

All the visitors had a relaxed evening where students could present their work to key members of the CLAAS business and their engineers, as well as other visitors, including professors from various universities. This was followed the next day, by

a tour of the recently modernised CLAAS factory at Harsewinkel and then a formal presentation of prizes, by Cathrina Claas-Mühlhäuser, Chairperson of the CLAAS Group and Chair of the CLAAS Foundation's Board of Trustees.

### UK winners

Harper Adams University (HAU) featured strongly in the awards as they often do, with third in the main prize category, plus two students winning a bonus prize, out of a total of eight submissions from Harper Adams University.

It should be noted that MEng students can submit their work for this Scholarship as it is classified as an undergraduate level.



## The overall results for 2022 were:

**Main Prizes: (PhD) 1st €7,200; 2nd €6,000; 3rd €4,800; 4th €3,600**

**1<sup>st</sup> Patricia Ulbricht - Leipzig University** – Analysis of Regenerative Agriculture

**2<sup>nd</sup> Paul Speitelsbach – Hohenheim University** – Light Robot based traction system

**3<sup>rd</sup> Richard Geary – Harper Adams University** – Automated Maize head picking plates

**4<sup>th</sup> Lasse Clausen – Neubrandenburg University** – Pre-Series Combine evaluation



Richard Geary HAU (centre)



John Morgan HAU



James Shaw HAU

**Bonus Prizes: (BSc) Ca €1,500 each**

**John Morgan – Harper Adams University** – Poultry behaviour image managing system

**James Shaw – Harper Adams University** – Anaerobic pellets in centrifugal distributor

**Nathaneal Ebertshaeuser – Hohenheim University** – Tractor tyre rolling resistance

**Jessica Emminghaus – Hohenheim University** – Electrification power in agriculture

## Apply for a scholarship

**A reminder for all students of Agricultural Engineering and agricultural related subjects – why not submit your work to the Helmut Claas Scholarship?**

**Application deadline for 2023 is:** Monday 26<sup>th</sup> June 2023

Applications are reviewed and judged over the summer months

Intermediate information is relayed to students in September

**Prize winning Awards presentation will be on the:** 17<sup>th</sup> & 18<sup>th</sup> October 2023

Go to **[www.claas-stiftung.com](http://www.claas-stiftung.com)** for additional information

Application details, typical topics and judging criteria will be made available from your Institute.

## Profession

Continuous  
Professional  
Development



## Continuous Professional Development

### **Why does the IAgRE care about CPD?**

The IAgRE is obliged as a professional institution and as part of its licensing agreement with the Engineering Council and the Society for the Environment to ensure that its members keep up to date in their industry. We therefore review a random sample of IAgRE members' CPD records annually.

As the Membership Committee Chairman, Malcolm Carr-West comments: "A CPD Review is a very valuable membership benefit. The fact that your professional peers are reviewing your learning and feeding back their comments to you is of immense value to your career." IAgRE cares about CPD as it demonstrates your professionalism and your commitment to your career.

### **Who should be keeping records?**

All members should keep records of their CPD. The IAgRE provides a couple of simple tools: A spreadsheet where a list of activities and their benefits may be listed and mycareerpath, a dedicated CPD tool designed by the Engineering Council. Mycareerpath may be accessed both through the IAgRE website and by





**It is a great idea to keep a record of new skills and experiences**

using the IAgRE app, you can quickly upload CPD to expand on later.

### **CPD and the early career engineer**

In the early days of your career almost all you undertake is CPD as many aspects of your role will be new to you. It is a great idea to keep a record of these new skills and experiences as they form an excellent living CV that you can share with your employer to demonstrate your progress.

Planning your CPD is very useful and deciding in advance what areas you wish to improve can be a useful way

to progress your career. The mycareerpath tool has a planning section that can help with this.

If you want to pursue registration with the Engineering Council or the Society for the Environment then CPD records are excellent to help you demonstrate competence.

### **CPD and the mid-career engineer**

For a mid-career engineer CPD is still a very important demonstration that you are maintaining your professional skills. Although you may now be an experienced engineer there are always new

things to learn, and maintaining your CPD is a valuable way to share your increasing knowledge with your employer and ensuring you can attain promotion or change roles.

Planning to acquire management and leadership skills can help to focus your aims and a living CV is an excellent way of ensuring you include all your skills in your appraisals.

### **Senior engineers**

Many members, as they reach a senior position, feel that maintaining CPD records is no longer a priority. However, we know that senior managers do not lose their inquisitive nature and continue to take an interest in innovation and learn new things as they have always done. Keeping a note of these activities, even in an informal way will ensure that you maintain the requirements of professional status. Although the need for planning and formal records in relation to career development is, of course, not so critical to this group.

### **Finally**

If you are asked to submit your CPD for review in 2023 please DON'T PANIC! It's not a difficult process and help is on hand. A few informal CPD activities are perfectly acceptable:

- If you've attended a lecture or conference online or in person, that counts.
- If you've read Landwards, Profi, Farmers Guardian or Farmers Weekly, that counts.
- If you've Googled your way round YouTube learning how to do something new, that counts.

If you have any questions about CPD or want some 1:2:1 training on mycareerpath then please get in touch with Sarah, the CPD Lead at IAgRE and she will be happy to help.

[Secretary@iagre.org](mailto:Secretary@iagre.org)

## Practice

### OFC Debate



This house believes that humans will not be needed on farms in a generation

*The 2023 Oxford Farming Conference debate in the historic Oxford Union debating chamber was an opportunity for agricultural engineering to argue for autonomous agriculture. A pair of eminently experienced and able IAGrE members made the case.*

First up for the motion was Professor Simon Pearson from the Lincoln Institute of Agricultural Technology (LIAT). The proposition's contention was that this prophesy is already happening. With official figures showing that within 100 years (one lengthy lifetime), in 1921 just under 1m people were working

on English farms, by 2021 this was 301,000 of which only 67,000 were regular workers and 41,000 were casuals.

In 2019, according to the ONS 63,000 EU citizens worked seasonally on UK farms, now, with Covid, Brexit, the war in Ukraine and

the age/urbanisation demographics that number is much reduced. In 2021, farms could not and did not secure the labour they needed.

The UK labour crisis is well documented, so the driver of technology in farming is not to replace labour in farming systems,





### Professor Simon Pearson opens the debate

it is to find machines and technology to fill this labour gap.

Going back to the premise of the debate's motion, it's not just a question that workers 'are not needed' on farms, they are simply not available.

To sum up, Prof Pearson said: 'Technology is on the march, British robots in Ocado pack and distribute food on a massive scale, they have a market capitalisation £5.6 billion larger than Sainsbury's, and as we speak robots on Mars are sampling the soils!'

### "Guys, you are wrong"

David Rose from Farmeco in



Kit Franklin eyes up the opposition as he heads into the debate

Nottinghamshire rose to his feet in opposition to the motion. He contended that: "there should be more people involved in farming." He felt strongly that tech has not solved all the problems it has set out to do.

"Technology is removing our ability to think creatively. We need to think and look at partnerships on the land." He stated that partnerships used technology to reduce chemicals and fertiliser use.

Farming will need more highly skilled people to do the job better and harness the technology.

Mr Rose urged the audience to vote against the motion and herald in a new agricultural era of people and the countryside.

### The few feeding the many

Kit Franklin, lead investigator of the Hands Free Farm project at Harper Adams University was straight back up in defence of the motion as its second.

"If the technology is ready and raring, what is this need for automation?" he opened. "Let us remember what agriculture is? The

## Ground truth

NASA's chief engineer for the Saturn V rocket programme said: "one good test is worth a thousand expert opinions." Mr Franklin asked delegates if they would stand with naysaying opinions on the opposite bench or with Professor Pearson and himself, the testers, with hard earned first-hand knowledge of farm robotics and automation? Voting for this motion would save future generations the drudgery and danger of farm work whilst making Net Zero sustainable businesses a reality.

ability of the few to feed the many through the adoption of ever emerging science and technology. In current times that means a mere 1% of the UK population producing food for the 99%, down from 5% 100 years ago and if you stretch back to the Roman era 70-80% were working the land."

### Silent fields

OFC director Ben Taylor Davies closed the opposition with 60 seconds of silence to remind the audience of what farming sounds like without people. He made the correlation between science and technology adaption on farm and the reduction of people on the land.

Ben said that the argument in favour of the motion was "trivial in comparison to the suicide statistics in farming."

When we look at agricultural engineering there have been many successes, "but a farm which runs around people is a farm which cares," he closed by saying.

The motion was convincingly defeated by 234 for the noes and 76 for the ayes.

## Practice

Lunchtime  
lecture



## Precision provides perfect pinot

*Using precision tools to layout vineyards could help managers run them with increased use of robotics, both reducing manual labour requirements and improving yields.*

So says Ian Beecher-Jones, who detailed the ideas he is trying at Jojo's Vineyard, near Henley on Thames to a recent IAgRE lunchtime lecture.

As well as being of interest to the growing number of UK vineyard owners, he suggested the ideas have potential to be deployed more widely across the row crop sector. Mr Beecher-Jones – who works

as a consultant on yield mapping software systems with CNHi and is a former Director General of BAGMA – runs the vineyard with his wife Tess on their smallholding.

Four years ago they planted 9,000 vines of seven different varieties on five acres. And they have plans to start developing their own winery at the end of the year.

Mechanising vineyards is the way forward, he says, pointing out that it took a two-man crew just six hours to plant 70% of the vineyard mechanically, using RTK to ensure accuracy.

Supply issues meant the rest of the vines arrived late, and the contractor had moved on.

So, the remaining 30% of the vineyard was planted manually,





**Tess and Ian Beecher-Jones run Jojo's Vineyard, near Henley on Thames**

## The stats on Jojo's vineyard

**Named** - after Jojo, the dog!

**Area** - 2.2ha

**Number of vines** - 8,769 vines

**Varieties** - seven

- Pinot Noir
- Pinot Blanc
- Pinot Meunier
- Seyval Blanc
- Chardonnay
- Fruhburgender
- Bacchus

**Number of rows** - 92.

**Support posts** - 1,800.

**Support wires** - 70 kilometres.

an operation that took two men three days.

But when the contractors had finished their work, he was shocked that they could not provide a map showing precisely where every vine was located:

"It seemed strange that we are going to have a product in the ground for 30 years and – with all the technology available – nothing was being recorded".

### Exact position

He wanted to know the exact position of every vine and every row, and then add other important information such as the locations of soil sampling points.

If they had that information available, he suggests, it could make subsequent management of the vines easier and more effective:

"If there's one piece of knowledge I brought in from broad acre farming, it is that if you don't have a shareable infrastructure it becomes

much harder to do other things."

Consequently, he has worked with Innovate UK and a range of business partners on a project to map the vineyard's digital infrastructure and make it sharable to a wide range of partners:

"If we can share our infrastructure model with technology partners we have the potential to speed up implementation and reduce costs, which is beneficial for us all," he explains.

Watch again



*This is but a snippet of the lunchtime lecture which can be watched in full on the IAgRE's YouTube channel see:*

<https://www.youtube.com/channel/UCCiJwRVjGizSE3EZ-KQ3uVg>



## Practice

Josie Lynch  
PhD Student



## The effects of conservation tillage on soil

*Josie Lynch is currently a full-time PhD student in the School of Science and the Environment and a member of the Sustainable Environments Research Group at the University of Worcester (UW). Her main research interest is monitoring the effects of conservation tillage on soil erosion using drones.*

Josie is interested in understanding landscape change and became fascinated with the way in which drones can map and monitor this at very high resolution (e.g. 0.5cm/pixel) and accuracy (1-3cm) by

producing 3D ground elevation models from drone photographs. Josie aims to explore issues with soil erosion and its impact on the economy, environment, and farmer livelihoods. She hopes her research

will help farmers understand how much soil, and therefore money, they are losing and in turn how to reduce this.





**Aerial photograph taken with DJI Matrice 300 RTK drone of a gully at one of Josie's study sites in North Worcestershire, UK.**

Josie's background involves gaining a BSc (Hons) degree in Geography and a PGCert in Research Methods (both also from UW). Josie holds a CAA Approved Drone Pilot Licence and worked as a Research Assistant at UW gaining extensive experience using drones for projects including;

1. Analysing drone elevation models and their accuracy in relation to the amount and placement of ground truth measurements
2. The application of Real-Time Kinematic (RTK) drones to measure soil erosion in Herefordshire (funded by the Environment Agency)

3. Using drones for snow depth estimation in the Arolla Valley, Switzerland.

When Josie isn't flying drones and studying soil erosion, she enjoys being active by cycling or hiking and also likes to play the trumpet and piano.

### **An overview of the work**

Josie's PhD research uses ultra-high resolution drone assessments to monitor the effects of conservation tillage on soil erosion rates in arable fields within Worcestershire and Herefordshire.

Soil provides a variety of positive functions including water runoff control and attenuation, plant composition, biodiversity, ecosystem productivity and carbon sequestration. Erosion of fertile topsoil is of local, national, and global importance as this can result in lowered crop yield, increased river pollution and heightened flood risk. Some farming practices, such as conventional ploughing, leave soils more vulnerable to erosion due to the heavy overturning of soil. Consequently, the Environment Agency in England (2016) declared soil erosion and sediment





DJI Matrice 300 RTK drone used to obtain high resolution aerial photographs to create Digital Elevation Models (DEMs) and Orthophotomosaics for Josie's PhD research.

management an important research priority and that UK soil management must be sustainable by 2030. The approach of 'conservation tillage' (minimum tillage and no tillage) is considered a more sustainable approach to agriculture, providing benefits to biodiversity, improved soil fertility, reduced labour requirements, and most significantly, reduced soil erosion whilst optimising yields. However, detailed studies at field scale are very limited.

### Soil erosion monitoring techniques

Traditionally, soil erosion monitoring (e.g. using erosion pins, tape measures, catch pits) was labour intensive, time consuming and provided low resolution data (confined to individual points) which is not representative of overall erosion rates. However, technological advances using drones can collect rapid, very high-resolution data with relative

ease and complete coverage of the soil surface. This method - termed 'Structure-from-Motion' - involves undertaking drone flights to collect hundreds of highly overlapped photographs to create 3D models of the soil surface. By obtaining a drone survey prior to the erosion event and subsequent repeat monitoring, Geomorphic Change Detection software (developed by Joseph Wheaton at the Utah State University in 2008) can be used to take measurements enabling field scale analysis of the amount and location of soil erosion.

Nevertheless, it is typically challenging to gain the soil surface information before the erosion event has taken place to quantify the 'starting volume' of soil. This is due to weather conditions or labour requirements, for example. Without the survey prior to the erosion event, the reconstruction of the (potential) original soil surface is required. Consequently, Rillstats was created by Markéta Báčová and colleagues at Czech Technical University in 2019.

This algorithm can perform semi-automatic calculations of soil erosion without the need for the pre-erosion data.

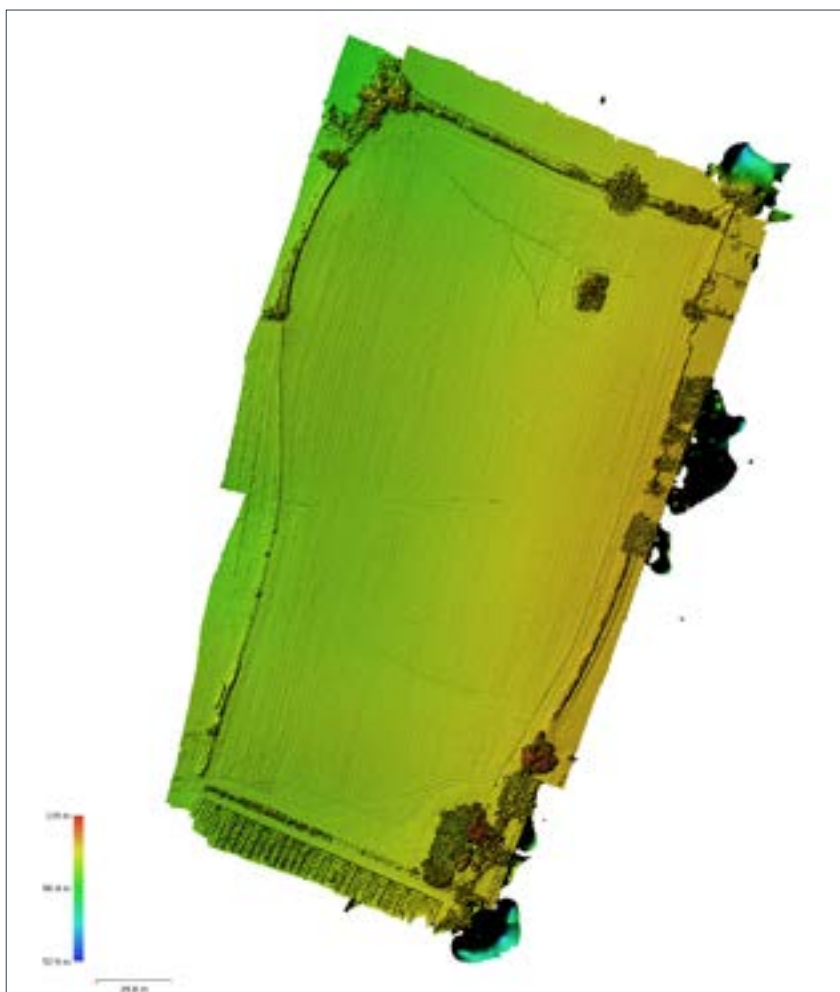
Josie's PhD research aims to utilise drone technology to determine whether conservation tillage reduces soil erosion compared to conventional ploughing techniques.

### Progress thus far

When using the Geomorphic Change Detection approach (by collecting a drone survey before and after the erosion event), thus far Josie has found:

- The GCD algorithm will provide a volume ( $m^3$ ) of soil erosion/deposition occurring and visually display where this has happened in the field. The results are collected and processed with relative ease and complete coverage of the soil surface.
- However, this technique presents some challenges:





Example of a high resolution Digital Elevation Model (DEM) created using the photographs obtained with the DJI Matrice 300 RTK and processed using photogrammetry software (Agisoft Metashape Professional).

1. Working together – obtaining the initial survey prior to the erosion event requires working closely with farmers/landowners to understand e.g. when the field is sown and the soil is bare.

2. Drones don't have X-Ray vision - the drone photographs will map what we can see with our eyes and not see through the crop to the soil surface. As the crop grows this will display as deposition (i.e. that the ground has raised). Therefore, mapping must take place while the soil is largely bare.

3. Erosion or compaction? – it is visually apparent that the formation of rills and gullies is a result of erosion. However, it is challenging to understand whether lowering of the overall field (sheet erosion) or erosion located inside

tramlines is a result of soil erosion or compaction. Therefore, manual soil samples for lab analysis are still required.

4. ERROR! – when overlaying two elevation models to see erosion and deposition overtime, there is an element of error in both models produced. If the models do not line up exactly, this will show as 'change'. Therefore, a threshold must be applied (minimum level of difference) to only account for 'real change'.

Arguably, the Rillstats technique is a promising approach for a rapid and non-invasive assessment of soil erosion as the calculations are semi-automatic and do not require a pre-erosion survey. The results thus far indicate:

- It works! - manual cross section measurements were obtained to

provide ground truth validation.

These results gave Josie 97% confidence that drone data reflects the actual soil surface.

- Flying height – similar results were presented when the drone was flown below 95m (2.60cm/pix). However, flying higher than this resulted in a significant reduction of soil erosion volume estimates.
- Polygon - how detailed the polygon is drawn around the rill/gully shows an insignificant relationship to erosion volume calculated. However, the polygon size does influence the results with a larger polygon showing more soil erosion.

## A word from Josie about the Douglas Bomford Trust's support

I am really interested in how drones can be used to solve problems. There is a lot of negativity in the press surrounding the use of drones. Funding from the Douglas Bomford Trust has provided me with the opportunity to research one way we can use drones for good! My grant has enabled me to engage entirely in a full time PhD and contribute to knowledge and understanding in the field of technology and sustainable agriculture. The personal and friendly ethos of the Douglas Bomford Trust has been fantastic and I am extremely grateful for their critical early support in my career development helping launch my academic pathway.

## Membership Matters



Farmoor bridge

## Obituary – Geoff Freedman HonFIAgrE

*Geoff Freedman, who has died aged 76, was a leading rural engineer and bridge designer who spent much of his working life with the Forestry Civil Engineering division of the Forestry Commission. Chris Whetnall writes.*

Apart from work (and vacation) related international travel, he spent most of his life living and working in Edinburgh and, realising it would not be for him, avoided going to work in the family accountancy business. Instead, following an apprenticeship with Blyth and Blyth Consulting Engineers, he attended Heriot Watt University graduating with a BSc in Civil Engineering in 1971.

Geoff worked for several engineering contractors before joining the Forestry Civil Engineering department of the Forestry Commission (FC) as a Structural Engineer. He then held the positions of Structural Design, Research and

Development and Contracts Engineer ending up as Head of Structures, Research and Contracts and Commercial Manager.

### **Sustainable rural structures**

Internationally known as a leader in the development of sustainable rural structures, Geoff pioneered the construction of stress laminated timber bridges and, in 2006, was awarded a PhD from Napier University on The development of transversely stress-laminated timber arch bridges for pedestrian and minor vehicle use. He later developed these bridges to carry the much heavier (35t+) vehicles

used in forest timber extraction. Not only were these bridges functional, but they were also often things of beauty exemplified by Geoff's sensitivity to the environment and genius loci.

Geoff's work with the Forestry Commission post gave him the opportunity to try many new ideas while he worked under Crown Exemption rather than on the public roads system where he would have been hampered by regulation.

### **Working with IAGrE**

Geoff Joined IAGrE in 1985. He was instrumental, in 1988 with others,

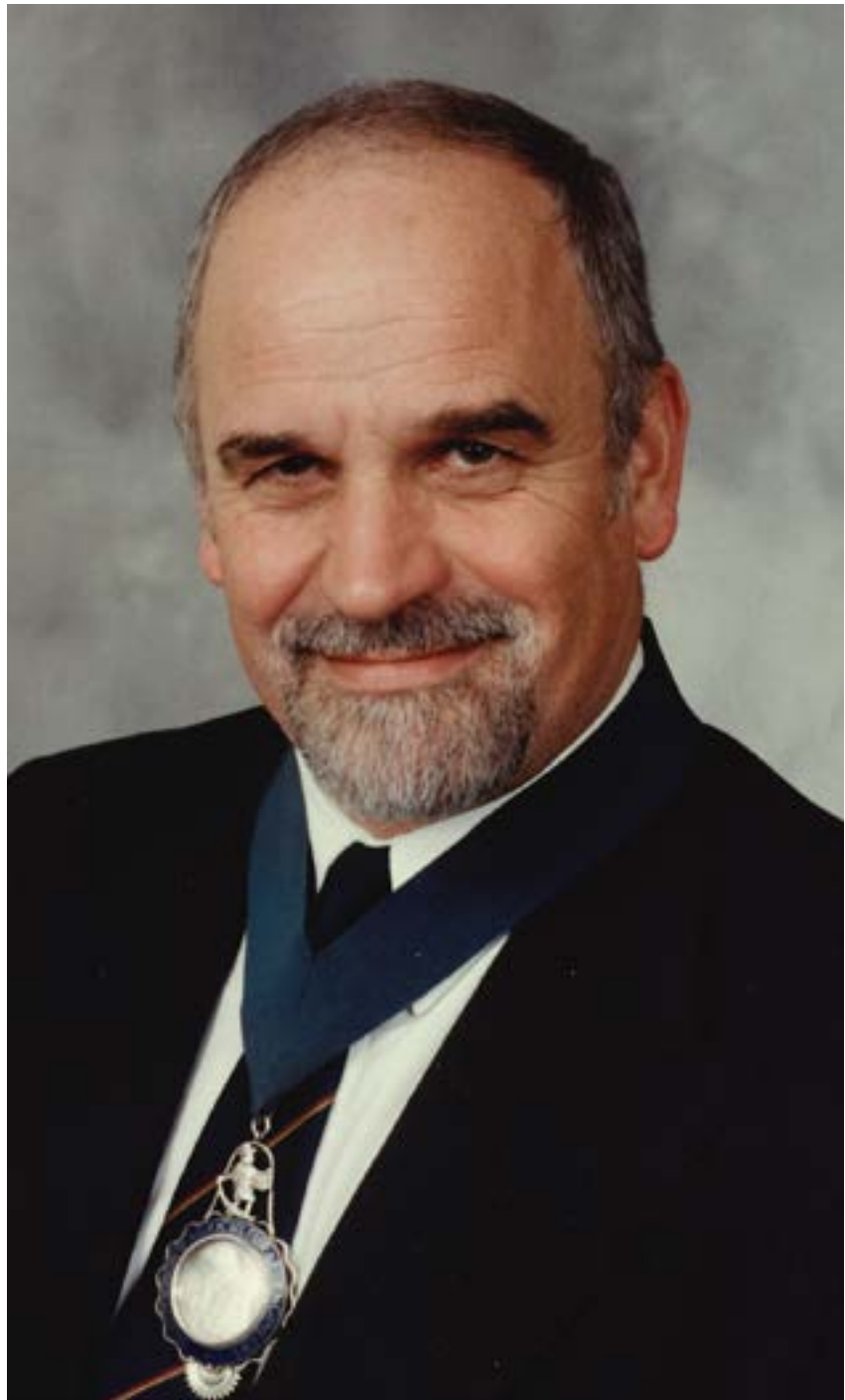




in the establishment of a Forestry Engineering Specialist Group (FEG) within IAgRE. He transferred to Fellow in 1991. As a founding member and Past Chairman of FEG, he served on the committee for 27 years.

FEG was almost unique within IAgRE in that membership of IAgRE was not a pre-requisite for membership of FEG, allowing membership (and participation on Committees) by those who might not wish (or qualify) to become members of IAgRE. This resulted in the active participation of senior and high-profile representatives from the commercial forestry and forest engineering sector in the planning and working of FEG.

Geoff worked with other FEG members to convene annual symposia, usually held at Newton Rigg College and always well attended. FEG holds in excess of 300 papers – the thinking of the industry in the UK.



Geoff Freedman HonFIAgRE

His international work demonstrated to Geoff that there was a need for an international coming together of like-minded people and so, in June 1999 FEG convened the 1<sup>st</sup> International Conference on Forestry Engineering entitled Forestry Engineering for Tomorrow which was held at the University of Edinburgh. Geoff was the lead convenor which was held over three days and attracted 70 papers and over 200 delegates from 25 countries.

Geoff was appointed as IAgRE President in 2000, was awarded Chartered Environmentalist status in 2005, received the IAgRE Award of Merit in 2006 and made an Honorary Fellow in 2016.

### Other Awards and Activities

Apart from these IAgRE awards, Geoff has received in excess of 20 other major awards for his work and structures in sustainable engineering and bridge design.

## Membership Matters

Geoff published about 50 papers, several which were peer reviewed. One of these papers (Forest Engineering Structures – co-written with Abdy Kermani) received a Douglas Bomford Trust Paper Award. He spoke at various ASAE/ASABE meetings in Chicago, Minneapolis and Sacramento on Timber Research, chaired the Innovative Timber Structures in the Countryside network (InTec), led a DTI ITS mission to Sweden and Norway in 1999 to look at the possibilities of introducing Scandinavian concepts of non-bitumised roads to minor rural roads in the UK, and advised the Royal Academy of Engineering in Helsinki at a global convocation of Royal Academies entitled World Forests and Technology.

As well as convening the 1<sup>st</sup> International Conference on Forestry Engineering in Edinburgh, Geoff (and IAGrE/FEG) co-sponsored the 2<sup>nd</sup> International Conference on Forestry Engineering in Sweden.

### The year of engineering

In November 2018, as a Past President of IAGrE and Fellow of ICE, Geoff represented the Institution by reading a prayer at Westminster Abbey at the National Service to celebrate the Year of Engineering. This was a particularly poignant occasion for Geoff as, soon after, he had to have his voice box removed as part of his cancer treatment.

He started a landscaping business to gainfully occupy himself at weekends later working together in this business with his son Mark. Proficient at most trades, he was an able plumber and electrician.

Mentoring others was also a passion



of Geoff's and many owe their career development to his encouragement and guidance.

Outside of work, Geoff was very active. His mantra was to have fun in all he did.

Geoff played the piano, painted and in the latter part of his life, took up bowls and archery.

Geoff suffered from throat cancer which spread to his lungs and, latterly his spine.

A keen golfer, he was told to give up the game after the cancer affected his spine. Never one to give up, he developed a hockey swing which obviated the need to twist his cancer wracked spine. He managed a birdie!

Geoff's wife Lana predeceased him and was a great support throughout his career. As a great raconteur, he was renowned for going off script when speaking in public, Lana would

prepare his speeches, with input from Geoff, to ensure he didn't overrun his allotted time. She would also vet his jokes beforehand, but this did not prevent Geoff from occasionally delivering an unvetted joke, sometimes with unforeseen consequences!

He moved to North Berwick in his later years to benefit from the care and companionship of Elaine, Geoff's friend and partner during his last few years. One of his final acts was to complete, and find a publisher for, his book entitled Design of Rural Bridges.

His funeral took place in Edinburgh on February 2<sup>nd</sup> and was well attended with in excess of 200 people in person and many others via a webcast. Many of his colleagues (including IAGrE and FEG members) were there. His coffin was "piped" into the Crematorium, to the tune of Highland Cathedral, by Bruce Hamilton, IAGrE Member and





Finally, it is perhaps fitting to quote the prayer Geoff delivered in Westminster Abbey:

Let us pray for those who work to meet the needs of the hungry and thirsty and for all involved in promoting sustainable agriculture and the health of the environment; and that we may all be committed to meeting the basic needs of people everywhere.

long-standing secretary to the Forest Engineering Group. Eulogies were delivered by Iain Hampson, Geoff's colleague of many years, his son Mark, his daughter Susanna and Elaine. The common theme throughout was that of fun with much laughter filling the room.

As those who knew him would have expected, the assembled throng were invited to sing along with Frank Sinatra's My way.

Geoff is survived by his daughter Susanna and son Mark to whom we send our condolences. Both Susanna and Mark provided Geoff with grandchildren who Geoff doted on.

**Note:** The obituary is repeated at <https://iagre.org/members-memories>

If you have any memories of Geoff which you would like to share, please email Sarah McLeod:

[secretary@iagre.org](mailto:secretary@iagre.org)



## Membership Matters

### Northern Ireland Branch

#### Technical meeting -

**Avant loaders and CAFRE's 2 year City and Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering Course**

*Report by Terence Chambers*

*Held recently in the Machinery and Buildings Centre (MBC) of Greenmount Campus, Antrim. This involved two separate technical presentations. The first, about compact loaders, was by Mr Chris Slane, MD of Coagh-based, Essener Equipment.*

*The second by Mr Peter Verhoeven, a Land-based Engineering Lecturer at the CAFRE Greenmount Campus, gave an overview of their two year City and Guilds Level 3 Advanced Technical Extended Diploma in Land-based Engineering Course.*

#### Technical meeting -

**Crop Sprayer Developments and Technology**

*Report by Terence Chambers*

*The guest speaker at a recent technical meeting of the Northern Ireland Branch of IAgRE was Mr Kerry Day from Spraysure. He started this company 20 years ago following his career experience with GEM Sprayers, CASE IH and Househam Sprayers. The company now provides comprehensive specialist support including calibration, parts, NSTS testing, hydrostatic drive servicing and a seven day breakdown repair service to its customers across England and Northern Ireland.*

*It has branches at both Lincoln and Downpatrick, Co. Down. Spraysure is also sales and service agents for FarmGEM Sprayers, TeeJet*



The Avant 630 at the NI branch meeting

Technologies, Poclain Hydraulics and other product brands.

Sadly due to space the branch reports cannot be reproduced in full, but can be read here:

<https://iagre.org/northern-ire-land-branch-reports>

### West Midlands Branch

#### Technical meeting -

**Atomic Tractors**

*by Campbell Scott October 22*

*When you have spent all your career marketing tractors what do you do when you stop working as a director for a tractor manufacturer? Why, set up your own tractor company. Report by William Waddilove.*

*If that company was the company that developed 'The Little Grey Fergie' the tractor that made that renowned pioneering breakthrough, then you follow in Harry Ferguson's footsteps.*

*He believed in light and versatile tractors.*

*Campbell Scott thinks the same. However, he is aware of the need to move away from fossil fuels. So what to do?*

*One of the design criteria at Massey*

*Ferguson was that a tractor should be able to work a 10 hour day without the need for refuelling.*

*Tiny garden tractors are well catered for. In agriculture there is a move to big tractors but they obviously need a lot of power, so batteries are out as far too heavy to even consider.*

*So back to the small light tractor. Campbell Scott can see aiming for something about 35kW (45hp) is probably a good size.*



Atomic Tractor



## Next is the fuelling

He is aware that in the days when Harry Ferguson launched his revolutionary TE20 it was usual for 1/3<sup>rd</sup> of the farm to be dedicated to fuelling the other 2/3<sup>rd</sup>s. (Food for horses.) The Grey Fergie permitted more land to be available for farm production but was using fossil fuels.

The 10 hour target could just be achieved with batteries, even though they would weigh well over 2 tons. The merit of that is that the electricity could be generated on the farm. However, if the farm were generating hydrogen, all the fuel could be farm produced with a zero carbon rating.

Campbell's thoughts and planning are towards a small tractor but using a hydrogen fuel cell. It would fit all the criteria and permit on-farm fuel production. Although far from production he is working closely with Aston University and several other organisations to develop hydrogen fuel cells and how they can be adapted to agricultural use.

Very interesting, but very much watch this space.



## Western Branch

### Branch meeting -

#### Visit to Bromham Biogas Ltd October 22

by Mike Whiting

*A pleasant sunny late October afternoon saw Western Branch members and guests visit this Anaerobic Digester system between Chippenham and Devizes in Wiltshire.*

A lunch at the local pub, the Greyhound at Bromham (unofficial Western Branch HQ!) gave an opportunity for Branch members to catch up on the latest news. After which we travelled the short distance to Bromham House Farm where our host Jim Butler and his assistant Andy Mercer gave a detailed and interesting tour.

The site opened in 2018 after a £9 million pound investment fully supported by the local Devizes MP Claire Perry, who at the time was also the Government Minister for Energy and Clean Growth. That meant it had the correct level of support at the highest national level.

The Branch has visited AD systems before but the main difference at Bromham is that not only does it employ the usual Combined Heat and Power (CHP) system, using an IC engine to generate electrical power and heat, but it also exports biomethane gas directly to a gas main running close to the site. Known as "Gas to Grid" this is an additional capability which adds another level of technical complexity to the operation. To quantify the output of the site, between 4-5MW can be exported to the Grid and 0.5MW to the CHP system.

### Two digesters

It comprises of two main digesters both of which can be fully monitored and controlled 24hrs per day via PCs and mobile devices. The software has been written specifically for the Bromham site and can be used to remotely set feed rates to each digester. Alarms alert the on-call operator to any potential issues. Jim

and Andy both commented that the software can provide totals for the amounts of CO<sub>2</sub> both produced and saved by the system which can measure the green credentials of an agricultural enterprise far more accurately than vaguer calculations based on generalised principals which are often employed. The software can print daily reports for the Environment Agency to summarise the amount of time the system has to flare off excess methane. As methane is an ozone depleting gas this reporting is mandatory.

The mixed gas produced in the digester can be treated to split CO<sub>2</sub> and hydrogen sulphide from the biomethane. Carbon filters remove the hydrogen sulphide. The cleansed biomethane is mixed with bought-in propane to enrich it and make it suitable for injection into the gas grid. The propane is added at a ratio of 30kg per 400cubic meters of biomethane.

### CO<sub>2</sub> issues

Unfortunately, commercial limitations prevent further treatment of the CO<sub>2</sub> to make it suitable for bottling and sale to third party users such as the food industry so it is currently vented to the atmosphere. Jim has plans to build glasshouses next to the site totalling 46 acres which will act as a carbon capture facility for the CO<sub>2</sub> produced. This is currently in the local authority planning stage. The site produces 450 cubic metres of CO<sub>2</sub>/hr which over a year totals 32 million tonnes. Another possible offshoot of the business is a small scale bio-methane storage facility and an electric vehicle charging point.

The feedstock is partially ensiled before introduction to the digester as partially fermented material which helps speed up reaction time in the digester. Waste milk, chicken muck and slurry can all be added. As long as it is organic and not animal body parts it can all be consumed.

One material that digesters don't like being introduced is sand. As many dairy units currently bed animals

## Membership Matters



The usual suspects at Bromham Biogas

on sand it has been found on other sites that this is a bad idea when you have an AD system. The sand fills the digester and eventually the amount of organic matter reduces and the reaction stops. Removal of the digester cover, removal of the sand in an enclosed space (requiring specially trained operators wearing PPE) and re-starting the reaction can take up to

ten weeks and cost tens of thousands. For this reason, Jim still beds his 400 head of milking cattle on rubber mats covered with straw where there is no problem of it being introduced to the digesters.

Of Jim's total acreage on average 2000 acres (60-70%) is planted with feed maize, 1000 acres (25-30%) is

planted with rye or oats and the rest as grass. He mainly rotates the maize and rye/oats. The end digestate is then spread back on the land as it is high in phosphates and potash.

Long term Jim's plan is to build a third digester. This additional 50% capacity would allow the digestate to remain in the higher volume system for





longer which in turn gives 20% more for a 15% reduction in feedstock added.

Thanks go to Jim Butler and Andy Mercer for their time and hospitality. Also to branch committee members Richard Robinson and Nigel Anstee for organising the visit.

## A 'Sweetman's' reflection - James Sweetman NOA NDAgEng M.B.E

Dear Editor,

Thank you very much for the 50 year certificate; I have enjoyed very much browsing Landwards and keeping up with the incredible developments over the half century; particularly the work towards a more sustainable future.

My student days in agriculture in the 60s were when the approach to "Health and Safety" on farms (in my experience) was "If it doesn't kill you keep doing it"; I'm sure many of us still wake up in a cold sweat! However, it did prepare me for an 'adventurous' international career in R&D and engineering.

This included diving for marine parks in the USA, diver/technician with New Zealand Fisheries Research, 15 years managing mechanised sugar cane harvesting sections firstly in Swaziland (Lonrho Sugar), then with B.A.I. in Somalia, Papua New Guinea and Sri Lanka.

In 1989 I was fortunate to be employed in The Ivory Coast by Tate and Lyle to rescue a failing procurement business for supplies of the frozen arils of *Thaumatococcus daniellii* for the extraction of the thaumatin protein, said to be over 2000 times sweeter than sugar by weight.

I finally retired after doing this for 25 years when the French company Naturex felt safe enough to acquire the business following the end of various wars between 2000 to 2011. We stayed on in Cote D' Ivoire to help establish a local man ( Zran Medo, Ivoire Nature Trading ) in competition with Naturex, to supply other buyers such as NATEX UK and EPC Chem until the Covid crisis sadly stopped exports of frozen product.

Of course, it was purely coincidental that these companies employed a "Sweetman". My wife, Barbara, has been very courageous to accompany me since we moved to Swaziland in 1974 and where our two children were born. Barbara is a biologist and has helped to do considerable work on the cultivation of *Thaumatococcus* in rubber plantations.

We are now retired in Sidmouth. We both are on LinkedIn having published some reports concerning the cultivation of *Thaumatococcus daniellii*. I am eternally grateful to the Institution without which I may not have been qualified for many opportunities.

Kind regards, James Sweetman NOA NDAgEng M.B.E.



# Membership Changes

1/11/22 to 31/01/23

## Admissions

### Fellow

### Member

Mr Mark Biddulph (Wrekin)

### Associate Member

### Affiliate

Mr Tim Main (East Anglia)  
Mr Patrick Butler (West Midlands)  
Mr George Sly (South East Midlands)  
Mr Muhammad Adnan (South Eastern)

### Technician

Mr Andrew Shorten (Australia)

### Student

#### Harper Adams University

Jake Leeds  
George Elliott  
George Smith  
Christopher Davies  
Ben Middleton  
Elsa Marsh  
James Pickup  
Rhianna Schoemaecker-Knell

#### CAFRE

Nathan McKnight  
Jordan Sayers  
Thomas Suffern  
Nathan O'Neill

#### Coleg Sir Gar

James Adams-Phillips  
Joanna Shand  
Derick Ablitt  
Kyle Francis  
Iwan Llewellyn  
James Houlsby  
Gareth Williams  
Tomas Morgans  
Gareth Breese  
Owain Jones  
Jack Priddey  
Steffan Davies  
Sam Evans  
Hywel Jones

#### University of Lincoln

Bemigho Ogbadu  
Wisdom Akprarah  
Mopelola Adeniji

#### Wiltshire College

Arthur Swatton  
Max Brain  
Alex Richardson  
Guy Kyte

#### Writtle College

Sam Spalding  
Adam Simpson  
Alfie Fletcher  
Dylan Liddicoat  
Max Harris  
William Scull  
Cameron Kemp  
Luke Gosling  
William Felce  
Louie Widdicombe  
Reuben Beer  
Luke Poddington  
Joseph Moore

#### Cranfield University

Theo Welby

#### Evesham/Warwickshire College

Grace Cooper

#### University of Worcester

Josie Lynch  
Munster Technological University  
Darragh Quinlan  
Kevin Dineen  
Charlie Dunilan  
Peter Reid  
Simon Jennings  
Michael Rowe  
Stephen O'Loughlin  
Mairead McCarthy  
Edward Daly  
Reuben DeKock  
Patrick McGrath

## Readmission

### Member

### Fellow

Mr Tomas Norton (Wrekin)

## Deaths

*We have recently learned of the death of the following members and we send our condolences to their family and friends:*

#### **Mr Robert R Rattray** **IEng MIAgrE**

A member of the Institution for 60 years. He joined in January 1963 as an Affiliate and transferred to Member grade in 1970. Mr Rattray gained his Incorporated Engineer registration through the Institution in 1973.

#### **Dr Geoffrey J H Freedman** **CEng CEnv HonFIAgrE**

A member of the Institution for 37 years. Dr Freedman joined as a Member in 1985, transferred to Fellow grade in 1991 and was awarded Honorary Fellow of the Institution in 2016. He gained his Chartered Environmentalist registration through the Institution in 2004. Dr Freedman was President of the Institution from 2000 to 2002 and was an active member of the Forestry Engineering Group.  
*(see obituary on page 32)*

#### **Mr Stephen Haresign** **MIAgrE**

Originally joined the Institution in the nineties as a student member and went on to re-join as a full Member in 2016.

## Transfers

### Fellow

Mr Dominic Barraclough  
(East Midlands)

### Member

Mr Ray King (Western)

### Associate Member

Mr Matthew Brown (Yorkshire)  
Miss Maisie Wildgoose (East Anglia)  
Mr Nick Taylor (Wrekin)  
Mr John Morgan (Wrekin)



## Long Service Certificates

	Name	Grade	Date of Anniversary
60 years	Robert Robertson Rattray	MIAgrE	11 Jan 2023
	David Anthony Skinns	MIAgrE	11 Jan 2023
	Maurice Arthur Keech	FIAgrE	28 Mar 2023
50 years	Peter William Waggitt	MIAgrE	25 Jan 2023
	John Gough	MIAgrE	25 Jan 2023
35 years	Clement Krishnanand Sankat	FIAgrE	01 Jan 2023
	John Ward	FIAgrE	14 Jan 2023
	Mark Andrew Parnham	AMIAgrE	02 Feb 2023
	William Thomas Green	AIAgrE	12 Feb 2023
	Francis Gerard Ward	MIAgrE	12 Feb 2023
	Damian Neil Kilshaw	AIAgrE	16 Feb 2023
	Martin John Troughton	MIAgrE	15 Mar 2023
25 years	Sam Woods	AMIAgrE	22 Jan 2023
	David Sayer	MIAgrE	19 Jan 2023
	Colin Melvin Johnson	MIAgrE	02 Mar 2023
	Michael James Thakoordin	MIAgrE	04 Mar 2023
	John Victor Stafford	FIAgrE	09 Mar 2023
	Jeremy Cale	AIAgrE	09 Mar 2023

## Academic members

### Askham Bryan College

Askham Bryan, York, YO23 3FR

### Berkshire College of Agriculture

Hall Place, Burchetts Green, Maidenhead, Berks, SL6 6QR

### Bishop Burton College

York Road, Bishop Burton, Beverley, HU17 8QG

### Brooksby Melton College

Asfordby Road, Melton Mowbray, Leics, LE13 0HJ

### City College Norwich

Easton, Norwich, Norfolk, NR9 5DX

### Coleg Cambria – Llysfasi

Rhuthin, Sir Ddinbych, LL15 2LB

### Coleg sir Gar

Gelli Aur Campus, Llandeilo, Carmarthenshire, SA32 8NJ

### Cranfield University

Cranfield, Bedfordshire, MK43 0AL

### Duchy College

Stoke Climsland, Callington, Cornwall, PL17 8PB

### Greenmount College

CAFRE, 22 Greenmount Road, Antrim, Northern Ireland, BT41 4PU

### Harper Adams University

Newport, Shropshire, TF10 8NB

### Hartpury College and University

Gloucester, GL19 3BE

### Lincoln Institute of Agri-Food

Technology, Lincoln University, Lincoln, LN6 7TS

### Manchester University

School of Electrical and Electronic Engineering, C39, Sackville Street Building, Sackville Street, Manchester, M1 3WE

### Munster Technological University

Tralee Clash, Tralee, Co Kerry, Ireland

### Myerscough College

Bilsbarrow, Preston, Lancashire, PR3 0RY

### Newcastle University

King's Gate, Newcastle Upon Tyne, NE1 7RU

### Plumpton College

Ditchling Road, Lewes, East Sussex, BN7 3AE

### Reaseheath College

Reaseheath, Nantwich, Cheshire, CW5 6DF

### Royal Agricultural University

Cirencester, Gloucester, GL7 6JS

### Salesian Agricultural College

Pallaskenry, Co Limerick, Ireland

### Sparsholt College

Sparsholt, Winchester, SO21 2NF

### SRUC – Auchincruive

Auchincruive Estate, Ayr, KA6 5HW

### Suffolk New College

Suffolk Rural Campus, Charity Lane, Otley, Suffolk, IP6 9EY

### University of Manitoba

Winnipeg, Canada, MB R3T 2N2

### Warwickshire College Group

Warwick New Road, Leamington Spa, CV32 5JE

### Wiltshire College Lackham

Lacock, Chippenham, Wiltshire, SN15 2NY

### Writtle University College

Lordship Road, Writtle, Chelmsford, Essex, CM1 3RR

## Forthcoming events - East Midlands Branch Programme 2023

*The East Midlands Branch meets the second Tuesday of the month, with 5 meetings April through to September with no meeting in August. Each meeting is planned to start at 7pm.*

**April 11<sup>th</sup>** - Visit to Russells Ltd (formerly RES Tractors) Waltham Lane, Harby, Leics LE14 4DB

With 9 branches in the Midlands, they are one of the largest New Holland dealerships in the UK.

**May 9<sup>th</sup>** - Visit to the new Farols Ltd facility, Godfrey Drive, Overfield Park, Windthorpe, Newark, NG24 2UA

**NOTE:** The Post Code NG24 2UA has been known to take you past the entrance, so note the following: on the A17 just where it meets the A1 & A46, turn in as if entering Starbucks, and follow the internal road around and that will take you there.

**June 13<sup>th</sup>** - Visit to Lincoln University, Riseholme Hall, Riseholme Park, Lincoln, Lincs LN2 2LG

A visit to learn about the latest robotic work with fruit and veg. On arrival at Riseholme Hall park in either P1 or P2 (free). From here first go to Woodsworth House (which is directly opposite Riseholme Hall) to sign in with Security.

**July 11<sup>th</sup>** - Meeting arrangements yet to be confirmed.

**September 12<sup>th</sup>** - Visit to Severn Trent Green power Ltd., Stoke Bardolph Estate, Stoke Lane, Burton Joyce, Nottingham, NG14 5HL. I am sure you will remember a very interesting meeting here some 6 or 7 years ago. Apparently much work has been carried out since to update this works, and there is much to see and hear about.

A very varied and interesting programme has been put together/ PLEASE NOTE.....if you plan to attend a meeting PLEASE email me at [richard.trevarthen@gmail.com](mailto:richard.trevarthen@gmail.com) and let me know. Please can you let me know how many will be attending.



# Commercial Members

## **Ace Aquatec Ltd**

16B City Quay, Camperdown Street,  
Dundee, DD1 3JA

## **Agri-EPI Centre**

Easter Bush, Roslin, EH25 9RG

## **Agricultural Engineers Association (AEA)**

Samuelson House, 62 Forder Way,  
Hampton, Peterborough, PE7 8JB

## **AGCO Ltd**

Stoneleigh, Abbey Park, Kenilworth,  
Warwickshire, CV8 2TQ

## **Alvan Blanch Development Co**

Chelworth, Malmesbury,  
Wiltshire, SN16 9SG

## **Amazon Ltd**

Orchard Farm, Hurst Lane, Aukley,  
Doncaster, South Yorks, DN9 3NW

## **Autoguide Equipment Ltd**

Stockley Road, Hedington, Calne,  
Wiltshire, SN11 0PS

## **BAGMA**

225 Bristol Road, Birmingham,  
B5 7UB

## **Case New Holland**

Cranes Farm Road, Basildon, Essex  
SS14 3AD

## **City and Guilds**

1 Giltspur Street, London, EC1A 9DD

## **City Farm Systems Ltd**

25 Hepplewhite Close, High  
Wycombe, Bucks, HP13 6BZ

## **Claas UK Ltd**

Saxham, Bury St Edmonds,  
Suffolk, IP28 6QZ

## **David Ritchie (Implements) Ltd**

Carseview Road, Suttieside, Forfar,  
Angus, DD8 3EE

## **Douglas Bomford Trust**

The Bullock Building, University Way,  
Cranfield, Bedford, MK34 0GH

## **DSL Systems**

Adbolton Hall, Adbolton Lane, West  
Bridgford, Nottingham, NG2 5AS

## **Fullwood**

Grange Road, Ellesmere, Cheshire,  
SY12 9DF

## **Househam Sprayers**

Roughton Moor, Woodhall Spa, Lincs,  
LN10 6YQ

## **HSS Hire**

Building 2, Think Park, Mosley Road,  
Manchester M17 1FQ

## **John Deere Ltd**

Harby Road, Langar,  
Nottinghamshire, NG13 9HT

## **Knight Farm Machinery**

Wireless Hill Industrial Estate, South  
Luffenham, Rutland, Leicestershire,  
LE15 8NF

## **Magna Specialist Confectioners Ltd**

Magna House, Stafford Park 3,  
Telford, Shropshire, TF3 3BH

## **Marks & Clerk LLP**

90 Long Acre, London, WC2E 9RA

## **Mastenbroek Ltd**

83 Swineshead Road, Boston,  
Lincs, PE21 7JG

## **Merlo UK Ltd**

The Paddocks, Headlands Business  
Park, Salisbury Road, Ringwood,  
Hampshire BH24 3PB

## **National Fluid Power Centre**

Turner Road, Worksop,  
Notts, S81 7AE

## **NFU Energy Services**

Stoneleigh Park, Kenilworth,  
Warwickshire, CV8 2LS

## **Nick Young Tractor Parts**

Unit 2, The Forge, Moor Road, North  
Owersby, Market Rasen, Lincolnshire,  
LN8 3PR

## **Ploeger UK Ltd**

Holt Road, Fakenham,  
Norfolk, NR21 8JH

## **Reesink UK Limited**

1-3 Station Road, St Neots,  
Huntingdon, PE19 1QF

## **Shelbourne Reynolds**

Shepherds Grove Ind Estate, Stanton,  
Bury St Edmunds, Suffolk, IP31 2AR

## **Spaldings Limited**

25-35 Sadler Road, Lincoln,  
Lincolnshire, LN6 3XJ

## **Spraying Systems Ltd**

Headley House, Headley Road,  
Hindhead, Surrey, GU26 6UK

## **Teagle Ltd**

Blackwater, Truro, Cornwall, TR4 8HQ

## **Witham Oil and Paint Ltd**

Outer Circle Road, Lincoln, LN10 6YQ

## Professional

The Douglas  
Bomford Trust



From L - R: RAU's Felicity Crotty, David O'Connor and Chris Frazer, with Olena Melnyk (SNAU), Nick August (DBT), Mark Horton (RAU) and Major Ben Unwin (Kings's Royal Hussars) on Salisbury Plain

## A Conflict of Interest

*Secretary Alan Plom reports on the Trust's recent involvement in a far-reaching international project:*

In response to a request from the Royal Agricultural University (RAU), the Douglas Bomford Trust is supporting an environmental monitoring and remediation project in Ukraine, by sponsoring travel and equipment together with advice from our Chairman Nick August (a local farmer, user and consultant in cutting-edge technology associated with precision farming).

This research will help to alleviate the significant damage to large areas of productive agricultural land impacted (in more ways than one!) by extensive shelling and bombing, missiles and land mines spread

around a country 2.5x the size of Great Britain. The damage to soil is obviously extensive and, not surprisingly, contamination is yet to be assessed.

RAU has worked closely with its 'twinning' academic institution in Ukraine – the Sumy National Agrarian University (SNAU) - to urgently develop remote sensing and soil chemistry sampling protocols, and to train Ukrainian non-combatants to identify soil pollution and collect pertinent data on which to base environmental remediation decisions.

### RAU's Statement on Ukraine

In response to the war in Ukraine, RAU vowed to "stand in solidarity with the people of Ukraine. As the 'bread basket of Europe', the people of Ukraine share the same passionate commitment as us to farming and to the land – they are our kith and kin in spirit."





Following an initial virtual seminar between SNAU and RAU staff, and specialists from geospatial and environmental companies last year, the Trust funded Ukrainian Professor Olena Melnyk's travel to the UK, to develop research protocols at RAU.

Whilst in the UK, she also held meetings in Westminster with DEFRA and the Foreign, Commonwealth and Development Office. RAU also gave a presentation to Lord Benyon and HALO (a global network of universities and start-ups enabling partnerships with industry).

### Ground survey equipment

In addition to travel costs, the Trust has sponsored ground survey equipment (including drones and software) required for the pilot research on three impacted farms. The equipment and proposed

procedures, were trialled by the RAU/SUMY team on Salisbury Plain, helped by others from outside RAU, including Nicholas Mellor (interested in forensic archaeology and founder of a company exploring how the fusion of aerial surveys and advances in augmented reality can be used to protect endangered world heritage sites) and retired Rear Admiral Anthony Rix.

They were accompanied by our own 'Action Man', Trust Chair, Nick August. My vision of Nick and the research team dodging Challenger tanks appearing on the skyline was not far off, as the artillery trundled close by while the RAU Team were waiting for clearance to fly their drones!

This made #WorldSoilDay even more poignant for all involved. As Nick observed: "Imagine coming over from Ukraine and ending up on a military training ground with Challenger battle tanks, Apache helicopters and C17s flying overhead, Ukrainian and British forces charging around, while analysing soil in shell craters at 2C. Home from home!" Ukrainian people are wholeheartedly committed and made of strong stuff though, and we salute them too.

The first phase of this vital project will be completed with the data and samples collected being analysed in UK by RAU and ARUP Geospatial. RAU staff are giving their time and lab costs free of charge, as part of their contribution to the project.

The  
**DOUGLAS BOMFORD**  
SUPPORTING AGRICULTURAL ENGINEERING Trust



For further information, see the Trust's website:

[www.dbt.org.uk](http://www.dbt.org.uk)

or contact the Secretary Alan Plom via:

[enquiries@dbt.org.uk](mailto:enquiries@dbt.org.uk)

You can also follow:

[@BomfordTrust](https://twitter.com/BomfordTrust)

on Twitter and on LinkedIn, for news of interesting events, opportunities, or developments.

## Technical

### Road to net zero

## The (off) road to zero emissions

*In the frenzy of innovation around oil alternatives, one UK-based global manufacturer has developed a working hydrogen internal combustion engine from scratch. JCB recently invited a small group of journalists for a technology day to find out more. Andy Newbold went along.*

In 2020 Lord Bamford, the company's Chairman, laid down his 'Chairman's Challenge' to the JCB engineering team to develop a fossil fuel free alternative to the diesel engine.

Going electric proved relatively easy for compact, lighter duty products, with the company bringing battery powered mini diggers, dumpers and a telehandler to market promptly. Although only about 5% of the tailpipe emissions of JCB products were accounted for with this group.

The company's assumption was that the whole product range would be electrified in due course. In reality, issues of battery energy density and cost quickly crystallised.

The remaining 95% of JCB's tailpipe emissions, lie with medium duty and heavy-duty products, think Loadalls, Fastracs and excavators.



## No case for electric?

Comparable electric machines became considerably more expensive and heavy for equivalent power outputs.

Tim Burnhope, JCB's Chief Innovation and Growth Officer presented an example of the implication of electrifying a 300hp Fastrac 8330. With a 16 hour duty cycle, typical of say a long day cultivating in autumn, an electric Fastrac would need approximately £400k of batteries to provide c1000kWh of power, its cost would increase 4.3x with an additional 10,000kg of weight. Clearly not an economic option.

The scenario played out in modelling to a greater or lesser extent across the mobile work equipment ranges.

The company's customers, be it in the field or the building site, resoundingly wanted a diesel-like fuelled product, with comparable refuelling characteristics and an equivalent cost.





Both the Fastrac refueller and the Loadall are powered by spark ignition hydrogen engines



## Hydrogen part 1

The company's first step with hydrogen was to replace the diesel engine in a 20t excavator with a hydrogen fuel cell. The fuel cell works by passing hydrogen through a matrix to produce electricity, which is then stored in on-board batteries, or used to power electric motors.

Two prototypes were built, to assess cost and practicality. The transient response of a fuel cell is poor, ie how quickly the unit responds to the throttle, which directly impacts the useability of a fuel cell powered machine. Also, the hydrogen fuel cell excavator needed 2.7 times the cooling capacity of its diesel cousin. The prototypes were complicated, not robust and did not perform to the standard of diesel. Typically, a standard 20t excavator costs approx. £120k, the hydrogen fuel cell equivalents cost was north of £350k.

In summary, a lower performing, less reliable and more expensive alternative. Not what customers need.



In the automotive world, there are around 11 thousand hydrogen fuel cell powered cars produced annually, versus 7 million or so electric cars, having proven the point with the hydrogen fuel cell excavator, fuel cells were not the answer for JCB.

### Don't start from here

Sticking with the theme of hydrogen, next up was the hydrogen combustion engine. On paper, it's an internal combustion engine, so the technology is familiar, with similar operational and maintenance characteristics to diesel.

Ryan Ballard, Engineering Director for JCB, explained the approach which led to the hydrogen engine. First, the company reviewed 76 existing technical projects and did a desk-based survey to draw some initial conclusions: Everyone else had converted a diesel or gasoline engine.

The hydrogen engine needed to be a ground-up, optimal solution, not a hydrogen fuel system just cobbled onto an existing engine. Hence JCB set about designing and developing a brand new hydrogen fuelled engine using a clean sheet of paper.

## The hydrogen engine

One kilogramme of hydrogen has the same energy density as three litres of diesel, but it comes in a gaseous form. The engine therefore has to have a gas-based fuelling and ignition system.

Fuel/air mixing with air has to occur before ignition, with the challenge of mixing higher density air with low density hydrogen to ensure a clean burn. The engine is fitted with a variable geometry turbo, to ensure a clean burn and efficient fuel/air mixing across the full rev range.

It's a relatively low temperature ignition, and unlike diesel is a spark ignition process, with an engine compression ratio somewhere between that of petrol (at c 10:1) and diesel (20:1).

The development process started with a spark plug designed for a Le Mans car, which only lasted for 25 hours of operation. JCB has since worked with the supply chain to develop a custom spark plug, designed for a 1000 engine hour service interval.

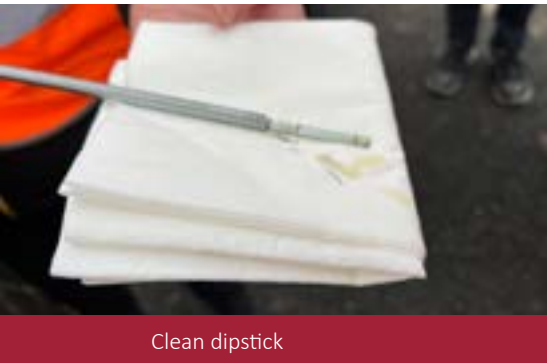


Lord Bamford with a hydrogen engine

## Steam and oil

The engine has zero tailpipe emissions, but does have 300°C steam coming out of the exhaust. This also can mix with the oil, so a specific hydrophobic oil was developed, to prevent oil and water mixing, and potentially impact reliability.





Clean dipstick

As an aside, due to the clean burn, on the dipstick inspected, the oil was clean and will remain clean throughout its service life.

### Fuel storage and delivery

Hydrogen fuel does bring technical challenges outside of the engine, around storage and distribution. As it is gaseous, it needs to be stored at pressure. The tank on the machine (be it Loadall, Fastrac or excavator) is at about 350 Bar, with the mobile bowser running at 500 Bar. The law requires that vessels at these pressures require routine, third party safety inspections.

There is also the issue of immature hydrogen production and distribution

networks, which will need to develop to support the new engines.

### Production status

With a daily output in the UK of about 200 engines from JCB's plant, and some commonality of parts, the company has the potential to ramp up hydrogen engine production rapidly.

Over 50 units have been made and are in testing, either on site in the company's multi bay engine test facility or on the company's farms and quarries. Field testing will be rolled out with key customers for real life duty cycle analysis throughout 2023.

### A great step forward

Despite the arguments regarding the green source (or otherwise) of hydrogen as a fuel, JCB has ably demonstrated its ability to tackle a practical challenge and come up with a working zero tailpipe emissions engine in short order.

The finished engine drops straight into existing products to replace diesel, with an equivalent performance, cost and reliability to its diesel predecessors.

It is a credit to the vision and ingenuity of Lord Bamford and JCB's engineers that this innovation has so swiftly come to fruition.



Engines



The mobile refueller stores hydrogen at 500 Bar



## Technical SWM Conference



## Potential goodbye to mined potash

*Britain could break its reliance on imported, mined phosphate if a new application of a well-known scientific technique being tested at Harper Adams University proves successful.*

“Electrocoagulation” is already used to remove heavy metals from water leaking from mine workings and landfills.

At HAU researchers have used the system to separate phosphate from slurry, and are now testing whether the phosphate is in a plant-available form.

Delegates at the Soil and Water Management Conference had a chance to visit the test unit at HAU’s dairy unit, where the trial work is being staged.

Reporting her own and predecessors’ work, Dr Marie Kirby said there is enough phosphate in the nation’s slurry to meet the whole arable sector’s needs.

HAU is now conducting crop trials to assess how available the phosphate is to plants. If it is, the UK would have its own source of phosphate and might not be dependent on imports.

### Getting technical with slurry

Utilizing slurry was also discussed by Agrii’s Ian Rudge, who reported on

his experience gained when working with Bedfordia Farms.

In that role he tried both umbilical spreading and Vredo machines to distribute thousands of tonnes of slurry and muck from the estate’s pig unit.

The slurry provides almost half the nitrogen needed by wheat and oilseeds, while also helping raise soil organic matter by 0.5-0.8% over 10-15 years.

Both systems have strengths and weaknesses, he reported.





### Applying slurry via tramlines ensures nutrient application throughout the growing season

The umbilical system uses the farm's existing tractors and much lighter equipment, so it is cheaper and less likely to cause soil damage.

But the system can't be used near water courses, on sloping land, or once crops reach a height where the trailing pipe would cause damage.

The contractor's Vredo spreaders are bigger and heavier, creating more wheelings travelling back and forth to filling points.

But they can reach parts of the field that the umbilical system cannot, and – because they use tramlines – can work until crops are more fully grown.

#### Soil organic matter

Maintaining good levels of organic matter can help protect soil against

extremes of both drought and flood, suggests Philippa Mansfield, Catchment Sensitive Farming lead for Natural England.

Whenever soil is lost it takes a lot of expensive and valuable nutrients, she adds:

"As organic matter levels rise the soil's ability to store water rises, which is very important in a drought year.

"And in a wet year it could hold more water in the upper catchment, which could help reduce flooding downstream."

#### A more diverse landscape

Encouraging a more diverse landscape could help improve, crop yields suggests Chloe MacLaren from Rothamsted Research.

Talking to the Soil and Water Management Centre's conference, she said there need not be a pay-off between efficient production and enhancing the environment.

And a creative approach to poor yielding parts of any field might help the productivity of the better parts.

Putting awkward corners and margins into wildlife habitats might reduce field size a little, she admits.

But if those habitats become home to pollinators and species that prey on pests then they can help raise yields on the remaining land.



The Institution of Agricultural Engineers

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