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PRECISION FARMING

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PRECISION FARMING: The future of technology in farming

“The global food system faces formidable challenges today that will increase markedly over the next 40 years. Much can be achieved immediately with current technologies and knowledge, given sufficient will and investment. But coping with future challenges will require more radical changes to the food system and investment in research to provide new solutions to novel problems.”

FORESIGHT. THE FUTURE OF FOOD AND FARMING (2011).

Precision farming is a major part of these solutions. Boiled down, the idea is that a farmer can get optimised results by precisely honing in on using the right tools and the right crop in the right fields at the right time. The same principles also apply to precision livestock farming

Technology is what underpins and makes precision farming possible, and new systems are ready to be developed and commercialised in the UK. On the following pages we'll take a look at some of the most common practices as well as future scenarios and the readiness of the UK to embrace these.

HOW THE KTNS AND TSB FUNDING IS HELPING THE DEVELOPMENT OF PRECISION FARMING IN THE UK

There are several UK government funded initiatives underway to assist with the development of precision agriculture in the UK. The Biosciences KTN and the Electronics, Sensors, Photonics KTN have collaborated closely in recent years to assist agricultural companies to innovate, through utilisation of new electronics and sensor technologies. This has included a collaboration with the Environmental Sustainability and Information and Communications Technology KTN and the University of Manchester, who have an “e-agri” research initiative which explores the potential of “e”-technologies to address agricultural challenges. A workshop involving 100 representatives from industry, academia and government was organised to identify the challenges and opportunities in this area. For more information, see: tinyurl.com/eagri2011

The BKTN and ESPKTNs have also collaborated to help companies benefit from funding available from the Sustainable Agriculture and Food Innovation Platform, which aims to stimulate the development and adoption of new agri-food technologies. This scheme provides about £90m over a five year period for applied collaborative R&D projects, funded by the Technology Strategy Board and partners. This has included organising consortia building workshops for funding competitions, such as “Measurement technologies for agri-food systems”. This 2013 scheme allocated over £8m for new projects, most of which were relevant to precision farming. For more details see: tinyurl.com/sustainableagriculture

espktn.org

biosciencesktn.org

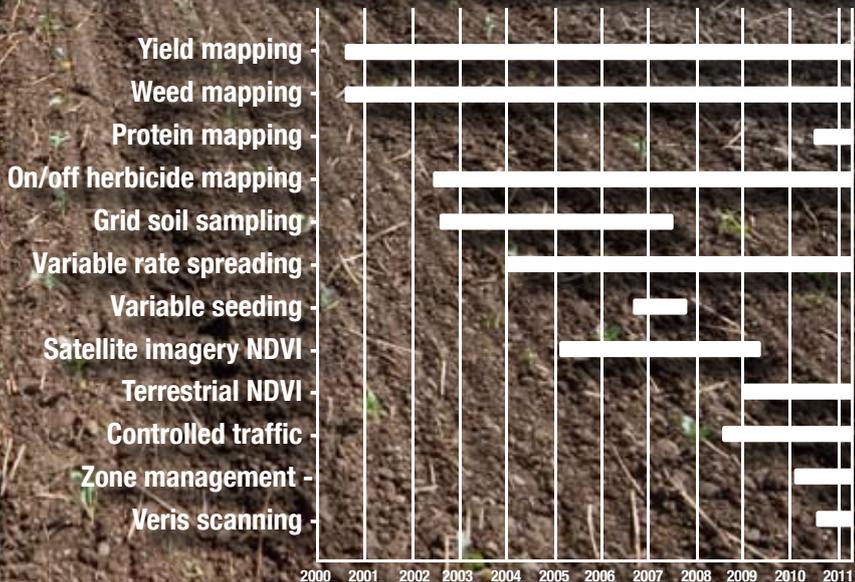




AUGUST FARMS

PRECISION FARMING IN ACTION

UPTAKE OF PRECISION FARMING BY AUGUST FARMS





Nick August's tractors are very ordinary on the outside but, once inside, you're met with such an array of screens, controls and buttons that you'd be forgiven for thinking you're sitting in the cockpit of a plane, rather than a farm vehicle.

Among the gadgetry in the tractor are GPS receivers, sensors, computer screens of various sizes and, most impressively, the tractors steer all by themselves, although August is quick to point out that bends still need to be negotiated with the help of a human operator. GPS dropout can be an issue, which is why we won't be seeing driverless tractors anytime soon.

Much of the technology inside the tractor is dependent on satellite navigation. The most straightforward form of precision farming, it can be used for many purposes, including guiding a tractor. When signals from GPS satellites are combined with a farm base station, the tractor can drive itself with an accuracy of 2cm – better than the most skilled human operator – avoiding overlapping applications of seed, for example, and saving fuel.

It's not, contrary to first impressions, too difficult to set up a job either. The operator simply keys in the farmer's name, the field and selects the parameters.

One computer screen is dedicated to showing the field mapped out in different colour zones. It is, in fact, a replica of what's on Nick August's desktop system, where he seems to spend just as much time, if not more, than out in his fields.

So, is he a geek or a farmer? Or perhaps a geek farmer?

"I'm doing it to get more knowledge of the field," he says, "to find out more about potentially high yielding areas and how to manipulate each part of the field to its optimum."

"Precision farming won't make a good farmer out of a bad farmer," he believes. "But it does make the job easier, less tiring and more productive. In low visibility, for example, there's no need for markers, so guesswork is unnecessary. It's all about managing your resources."

Precision farming has, in fact, been defined as the "management of farming practices that uses computers, satellite positioning systems, and remote sensing devices to provide information on which enhanced decisions can be made" (Agriculture and Horticulture Development Board).

The focus is on optimising returns while preserving resources. However an optimum level of field management can't be achieved without at least some techni-

cal know-how and August is the first to admit that, for a novice, the technology can be a bit daunting. Training is a good idea.

Nick August set up his Cotswold's business in 2000 to provide services for land-within-family ownership, tenanted fields and contract farming for neighbours. He's currently farming over 500 hectares on a rotation basis, with crops including wheat, oil seed rape and peas. He's been precision farming increasingly since 2002 and has invested heavily in the equipment necessary for Control Traffic Farming (CTF) and yield mapping. He's also installed software for weed mapping, protein mapping (to determine nitrogen efficiency), Soyl grid sampling (using equipment provided by Soyl, a UK company which currently services over 1m hectares of land in the UK), variable rate seeding and zone management.

"Precision farming won't make a good farmer out of a bad farmer"

The latter is possible when a farmer, having gathered a variety of data, knowledge and experience, creates zones within fields. These take into account soil texture, stone content and soil depth, among other variables.

In countries such as the US and UK, where uptake of precision agriculture is most advanced, much of this technology is already in use, on up to half of all large arable farms.

According to Nick August, CTF for instance (see techniques section), is used on about 15,000 hectares of arable land in the UK, out of a total of some 6,017,540 hectares. In other countries, it's becoming standard practice. However, the size of the holding is an issue, equipment costs currently prevent farmers with less than 20 hectares from reasonably justifying the use of many precision tools.

For larger holdings, precision farming equipment is not expensive, compared to top-line agricultural machinery. It can add around £15,000, or 10%, to the cost of a fully equipped new tractor. However the investment does pay off much more quickly on larger farms, although some funding is available for smaller landholders.

A study by the UK Agriculture and Horticulture Development Board

Satellite Navigation

Many of the developments in precision farming have been made possible by improvements in satellites, and guidance systems are the most popular area of precision farming. Remotely sensing crop-growth and health, cheap (or free) data, higher spatial resolution and more frequent access to variation in crop productivity are among the benefits.

With satellite navigation, farm machinery can also be more precise in planting and treating crops, eradicating overlaps and making it easier to selectively treat plants. Drivers can operate equipment more quickly and cover more acres with fewer hours of operation.

There are also environmental benefits: with better positioning, less fertiliser is necessary. Yields can be increased while fuel consumption decreases.

New satellite navigation services offer the agricultural sector improved accuracy, timing and precision - the basis for precision farming.

Limitations

Real Time Kinematic (RTK) is the most precise type of satellite navigation system (to 2.5cm or 1 inch). It uses the drifting satellites as well as a fixed base on the land. It's limitation is that it doesn't always work in hilly rural regions.

The alternative is a Virtual Reference Station (VRS) which is similar except it uses the mobile phone network. The limitation here is reliance on there being a phone signal.

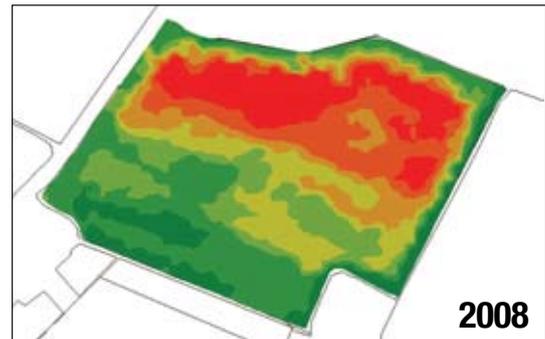
Automated weed mapping

Rising input costs, increasingly stringent environmental regulations and an ever-diminishing arsenal of effective herbicides, coupled with the build-up of herbicide resistance in target weeds, are major challenges to arable crop production.

Automated weed mapping, allowing targeted herbicide application, is one way of optimising weed control in this increasingly constrained environment. By combining state-of-the-art sensing and imaging technology with weed recognition software and GPS positioning and application control systems, farmers will potentially be able to identify and monitor specific problem areas within fields, and deploy precise, targeted, control strategies that optimise product efficacy and minimise unnecessary chemical use. Whilst many of the constituent technologies already exist, albeit in relatively generic form, there is a need to accelerate their development and integration, to improve system and software accuracy and broaden the range of target weeds that can be controlled in this way.

Selective Farming

Due to natural variation in crops and high specifications by the supermarkets of what a crop should look like, approximately 40-50% of a harvest may be thrown away. Selective harvesting could reduce this wastage dramatically. A selective harvester is a robotic machine that uses optical recognition and sensors to only harvest the crops of saleable value, although, such systems are still in their infancy.



opment Board estimated that the net benefit over cost of investing in a precision farming system on a typical arable farm was about £6 a hectare on a 300-hectare farm, £10 a hectare on a 500-hectare farm and £19 a hectare on a 750-hectare farm.

With the recent forthcoming release of the UK's first Agricultural Technology Strategy and following the publication of the Foresight Report "The Future of Food and Farming", there's been a growing recognition that the industry must embrace innovative and technology-based approaches. Delivering 'more with less' is now the established mantra.

Not only that, but the emergence and evolution of precision farming techniques has the potential to revolutionise the way farmers and growers address the perennial challenges of crop production, such as the control of problem weeds in broad acre crops.

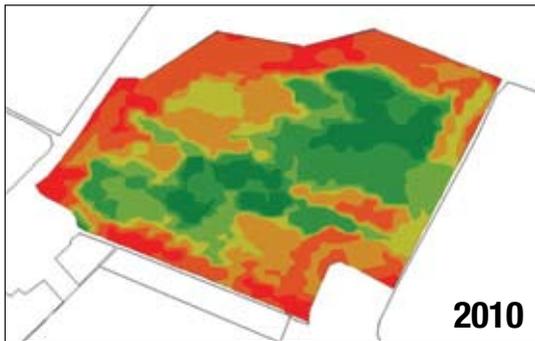
These are the challenges Nick August is keen to tackle when he goes out into the fields with a mobile or GPS device and records what's been done to the land, looking at how the area has performed in the past and its potential for the future, so that input can be tailored.

He believes that, of all the precision farming techniques, yield mapping is the most important and is underrated by many farmers. There's no argument with quantitative information which can identify, to the centimetre, which areas may need further management.

Precision farming becomes most interesting and rewarding when it takes account of variability within fields, so that fertilisers and other inputs can be applied automatically at the rates best suited to the crop and soil conditions.

Detailed records, August believes, are the key. Looking at how zones have performed in the past helps him to monitor how the crops have reacted to the variable applications he's been using.

Images from Earth observation satellites are being used increasingly to monitor individual



fields and adjust agricultural inputs accordingly. The radiation reflected from crops into space can reveal their health, levels of moisture and essential nutrients, soil properties and likely yields. With images from remote sensing satellites steadily improving, it's thought that these overviews will increasingly replace the tractor-based sensors that many farmers, including Nick August, rely on today.

“Detailed records are the key”

He stresses that these techniques and equipment don't necessarily improve yield but they are more efficient and more environmentally friendly, reducing the input of fertilisers and pesticides, for instance, as well as the fuel used for vehicles.

“We are using a lot of fossil fuel to create fertiliser,” he says, “and using a lot of pesticides and fungicides. These are starting to contaminate our water so we need to be more intelligent about how we use them”.

But systems are becoming more intelligent too. As well as satellite and space technology, robotics is an area which is increasingly impacting on agriculture and the farm of the future is likely to be fully automated and run by swarms of robots. On a par with key developments in genetics, engineering is at the heart of successful agricultural innovation, according to experts such as Professor David Leaver, President of BIAC (British Institute of Agricultural Consultants):

“The future sustainable intensification of crop and livestock production systems will require a high level, precision farming approach for its delivery,” he believes, “and agricultural engineering R&D will be pivotal to this achievement.”

The UK's first Agricultural Technological Strategy, released in June 2013, can be found at tinyurl.com/UKagritechstrategy2013

Yield Mapping

Fields are not homogenous, yet traditionally, agricultural chemicals have been applied in a blanket fashion. Ideally, they should be used only where needed.

Yield monitors work by using sensors GPS or GIS (Geographic Information Systems) to measure the amount of a crop harvested. This data, with a +/-3% accuracy rate, is recorded, together with location information, onto a storage device and transferred to a computer package for analysis. The package then produces maps showing yield variations and year on year trends. These can be integrated into farm management decisions to improve crop productivity.

Automatic Steering

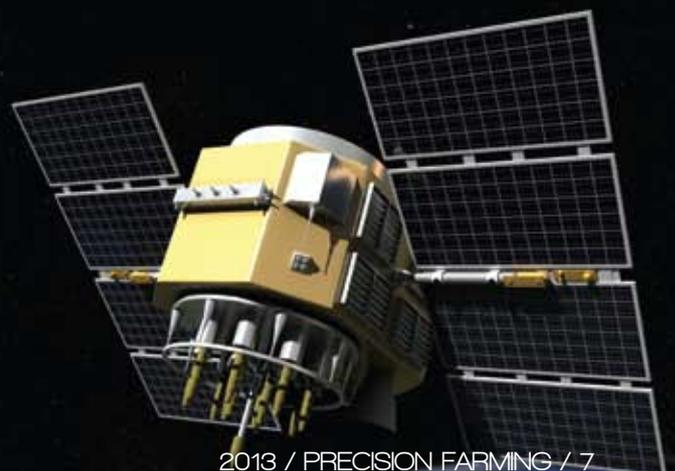
Any task requiring the monitoring of many parameters can lead to information overload and thus operator fatigue. A tractor which uses satellite guidance can be allowed to steer automatically, leaving the operator to focus on equipment and performance. Depending on the GPS system used, accuracies to within 1 cm are achievable. Other benefits include:

- Elimination of overlaps or underlaps (e.g. in fertiliser application)
- Savings in fuel, time and costs
- Reduced machine wear
- Reduced operator fatigue
- Reduced soil compaction with fewer tracks
- Controlled traffic farming.

Controlled Traffic Farming

High precision GPS also makes it possible to practice Controlled Traffic Farming (CTF). CTF is all about keeping the effect of heavy machinery on the soil to a minimum, and the machinery runs up and down exactly the same tracks in the field every year, using appropriate guidance systems. This cuts fuel costs, increases productivity and yield, protects and enhances the soil via reduced soil compaction (an expensive problem) and is more profitable for the farmer.

A scoping report has been produced: Sensor and Data Fusion: tinyurl.com/sensordatafusion





THE MECHANISATION OF AGRICULTURE

The American Society of Mechanical Engineers has recognised agricultural mechanisation as the fourth most important achievement of the 20th century, after the car, Apollo and power generation.

Mechanisation has reduced the drudgery of what was a grueling and laborious business. The advances in the last 100 years in drainage and irrigation, in tractors, tillage and crop protection, harvesters and cool chain management all derive from agricultural engineering innovation.

Now we have a new revolution: in information and control technologies and the engineering science, to understand the performance of highly complex systems and provide routes to optimise operations. These advances can provide similar benefits in the 21st century, not just to the farmer, but also to the environment, the food chain and the global consumer. The vision of the future for agriculture suggests that there is not only a major opportunity but a real demand for further innovation and its translation into practice.

STEP CHANGING RESEARCH OF THE PAST

Norfolk 4 course rotation

Fertilisers & mechanisation

Borlaug & Swaminathan, Fathers of the Green revolution – for their success in introducing and developing high-yielding varieties of wheat



THE UK POSITION

“ The UK has an excellent record of innovation within agriculture”, says the Foresight Report, “and should serve as a paradigm for how temperate countries with high population densities can respond to the challenges facing the global food system. ”

The agricultural engineering business sector in the UK is substantial, with a significant focus on the production of lower volume, higher value, specialist machines, such as back-hoe loaders, sprayers and supporting components, including those with sensor and data fusion capabilities.

However, with the exception of JCB and New Holland, none of the global manufacturers of high volume machines, such as tractors or combine harvesters, now have UK-based global R&D facilities. This is partly the result of weak public investment in relevant R&D, infrastructure and human resources.

However the sector is still dynamic and innovative, with many SMEs more than capable of grasping the opportunities to take advanced technologies into practice. Although with Harper Adams University College now the sole UK provider of undergraduates in this sector, the rising demand for skills required to meet the sustainable food production challenges needs urgently to be addressed.

Source: Iagre: Agricultural Engineering: a key discipline enabling agriculture to deliver global food security 2013



THE UK'S AGRICULTURAL ECONOMY IN FIGURES

4%

Share of global sales

£386m

UK annual spend on
agricultural and
related research

£1.8bn

Value of exports for farm and
related outdoor machinery

£2.5bn

Annual domestic market for
farm and related outdoor
machinery

£4.6bn

Net farming income

£20bn

Income from wider UK
agricultural sector

Source: IagreE 2013



UK STRENGTHS

World leading science research in applicable fields: molecular biology and genetics, IT and engineering

Skilled work force

Larger farms than much of the rest of the EU

Good soils and climate

UK WEAKNESSES

Burden of regulation, EU and UK

Regulatory and procurement decisions not always evidence based

Fragmented research base

Depletion of applied science capacity





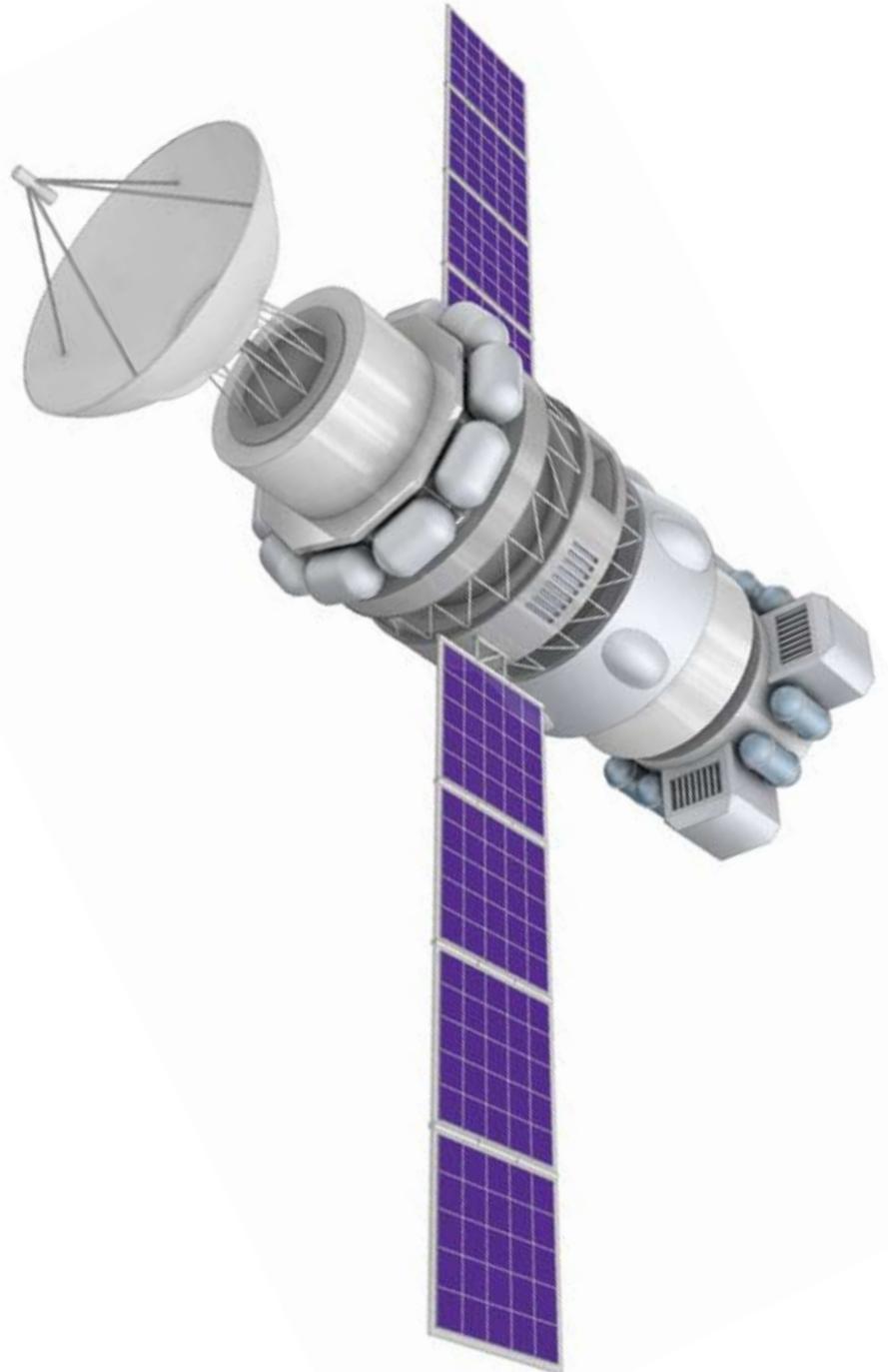
We want entrepreneurs, people from the agricultural sector and business leaders to harness data in order to make agriculture more productive and more profitable.

In fact, Britain is very good at it, we're very good at small satellites - cost effective satellites - we've got really smart companies that are already trying to analyse and harvest this data. Whereas other countries have tended to focus on great big expensive launch vehicles, we don't have rockets, instead, we have satellites and very smart software to analyse the data from the satellites and I think that puts Britain in a very good place for the future.

There will be, I hope, people thinking we could do some really smart things with [for instance] weather forecasts, we can track the movement of agricultural vehicles for you, we can monitor crop performance across an area in order for people to plan when harvests are going to be collected. There are lots of ways in which this data can be used so we can all live and do our business more efficiently.

David Willetts

MINISTER FOR UNIVERSITIES AND SCIENCE



PRECISION FARMING: HOW MUCH OF AN ADVANTAGE?

Better planning and scheduling of machine operations has the potential to reduce costs by 25%.

Improved animal health and welfare (e.g. dairy cow fertility sensing) can reduce methane emissions by 15%.

Soil management technology encourages deeper rooting and increased water holding capacity.

Farm systems models can demonstrate the impact of changes.

In the developing world, mobile telephony is opening access to market information and improved post-harvest decisions.

Ergonomically-optimised engineering can empower workers traditionally seen as less physically able, women for instance.

Wastage in food supply chains can be limited.

Automatic steering delivers 10 - 15% reductions in use of fuel, fertiliser, seed and operational time.

NATIONAL CENTRE FOR PRECISION FARMING

The National Centre for Precision Farming (NCPF) is a new initiative to bring “smart” agricultural machinery into wider and more productive use in UK, and global, farming. The centre is based at Harper Adams, a university which specialises in agricultural and related topics located in Newport, Shropshire.

The NCPF organises lectures, seminars, technical days and other knowledge transfer events to help farmers meet today’s political, economic and environmental needs through the use of smarter systems. The aim is to place the UK in the strongest possible position to develop and commercialise new technology systems.





PRECISION FARMING IS NOT A NEW SCIENCE



Jake Freestone, manager of an arable and sheep LEAF (Linking Environment And Farming) Demonstration Farm, argues that elements of precision farming have always existed.

“ Farmers have been using precision farming techniques ever since the domestication of farm animals and the first crops were planted. They didn’t have global positioning or geographic information systems; but they used their knowledge, skills and experience over time to work out the best ways of doing things with the tools available.

One example is the use of tram lines to mark out the same wheel tracks for subsequent operations when spraying grassland or pre-emergence herbicides. Another is rabbit netting, flags, sticks or small children to provide a pathway.

You see an area of a field that is not performing, in this case due to rabbit grazing, so you fence that area of the boundary – thus stopping predation and increasing yield. Fields were divided up years ago by our farming forefathers. They knew the boundaries where the soil type changed; the areas of the field that flood or the fact that one end of the field “just doesn’t do,” and they planted hedges to split the field up.

They even grew different crops in those areas. In our eagerness to maximise food production we removed these boundaries and started putting fields back together, mixing up sites with different characteristics. To my mind, precision farming techniques allow us to manage ‘fields within fields’. ”

Why Precision Farming now?

In 2009 Government Chief Scientific Adviser, Professor Sir John Beddington, spoke of an emerging 'perfect storm' of factors which argue for a revolution in agricultural policy:

1. An increase in world population to 9bn, needing yield increases of up to 50% to maintain current levels of nutrition.
2. Increased per capita incomes, leading to increased resource consumption and demand for meat and dairy products.
3. Increased competition for land for both urbanisation and alternative uses such as bioenergy and biorenewables.
4. Increased competition for water, amplified by shifts in availability in certain regions.
5. Potential negative effects of climate change on yields in lower latitudes.
6. Increasing competition for (and expense of) key inputs (fertilizer, fuel agrochemicals etc.).
7. Slowing of increases in agricultural productivity.
8. Increased awareness of the need to protect (or improve) the provision of non-costed ecosystem services derived from farming.

Precision farming meets many of the challenges of global food security. It balances future demand and supply sustainably, with more efficient use of key resources such as water. It also meets the challenges of a low emission world, reducing energy demands of both vehicles and processes and maintains biodiversity and ecosystem preservation, through, for instance, better targeting of pesticides.

Additionally, precision farming addresses the threat of future volatility in the food system and can buffer against local or regional disruption.



FARMING THE FUTURE



THE FUTURE IS NOW
Future precision farming technology



“In a world where farmers feel like their future’s threatened, the great news is the technology is there to help them”

TIM BLANK, TOWER GARDEN

ARABLE CROP SPRAYER TECHNOLOGY

The UK industry has led the adoption of new approaches to pesticide application, increasing precision and efficacy, and halving off-target application.

Key features include: spray nozzle technology to minimise the incidence of drift; boom suspension systems and computer based control systems that adjust output to match variations in speed and minimise overlap.

COMPUTER VISION AND MACHINE GUIDANCE FOR WEED CONTROL

A commercial product for rapid non-chemical weed control – a computer vision-guided hoe - has established a significant UK and worldwide market and, in 2010, won a Queens Award for export achievement for Garford Farm Machinery.

VOLUNTARY (ROBOTIC) MILKING SYSTEMS:

Machine vision, robotics, RFID tagging and online biosensing can work together to allow accurate feeding regimes for animals.

Dairy farmers can use these technologies to tailor systems to individual cows, this means milking can take place voluntarily, as and when the cow desires.

Wider use of sensors, particularly biosensors, can radically improve the welfare of animals and also reduce environmental emissions and impact.

CONSERVATION AGRICULTURE

A suite of practices for sustainable intensification, Conservation Agriculture is the future of smallholder farming. It emphasises soil cover, minimal disturbance and effective field rotation. Of particular note are “No-Till” planters, which can deposit the seed and fertilizer at the depth and placement required, with minimum soil disturbance.

Touching on sustainable agriculture in the developing world, a scoping report has been produced: Diagnostics for the Developing World.

tinyurl.com/diagnosticsdevelopingworld

LASERS TO KILL WEEDS

A team from the Leibniz University in Hannover, Germany have developed weed-killing lasers in an effort to stop the unchecked distribution of herbicides

into soil and water. The project, which is funded by the Deutsche Forschungsgemeinschaft (DFG), is able to adjust the energy of the laser precisely in order to kill a weed by targeting the plant’s base.

To correctly identify what plant needs to be destroyed, the researchers have developed a system using cameras to record the plants and then to generate a piece of software able to measure the contours of each plant to optimally position the laser beam for each weed species.

The system can currently only treat about a square metre of growth in a greenhouse, where the apparatus can be mounted on rails for pin-point control. However, the team believe they can scale up the system.

HYDROPONICS, BITPONICS AND AEROPONICS

Hydroponics is the practice of growing plants without soil, using instead a reservoir of nutrient solutions in water. Bitponics can essentially automate hydroponic systems, using sensors to monitor how plants develop and store the data in the cloud. A web app provides a grow plan, with notifications of a plant’s needs provided by text or email. Aeroponics, where plants are grown in the air and sprayed with nutrients, is another form of the technology. These are systems perfectly suited to urban farmers and hobbyists.

The Bell Book & Candle restaurant in Manhattan, U.S.A, uses a vertical, aeroponic growing system called Tower Garden to grow vegetables, a solution to the lack of outdoor space.

The restaurant’s roof top is full of these white towers, with seeds planted up along each structure’s spine. Each tower has its own reservoir at its base. They run on a timer and are equipped with a water pump which sprinkles the roots of the plants every 12 minutes.

Tower Garden was created by U.S. developer Tim Blank, who believes that: “In a world where farmers feel like their future’s threatened, the great news is the technology is there to help them.”

But the concept of vertical farming is not new - the phrase was first coined by the geologist, Gilbert Ellis Bailey, in 1915 in response to increased pressure on already limited farmland. Bailey’s book “Vertical Farming” explains the process of growing produce either in a skyscraper greenhouse or, as described, in a tower.



ROBOT FARMERS

Robots are perfect for a variety of manual jobs which take place on a farm. Weeding is a prime example. Employing robots to do this most onerous of tasks would mean that the use of pesticides could be decreased. Robots can already recognise weeds which are dangerous or place small amounts of weed killer; they can work continuously, in all weather, and even at night.

Seeding is another area ripe for robotic disruption. Currently, most seeds have only an 80% germination rate. This is largely due to established seeders producing void areas and intra row competition between plants. The development of technology to control seed depth, and orient seeds, would reduce competition and bring rates up to the optimum.

Smart machines which take the drudgery out of agriculture are being developed by the engineering department at Harper Adams University. One of the projects the engineers are working on is the EU's Future Farm which aims to create a network of smart vehicles to collect data and share it with the rest of the fleet, thus cutting the amount of herbicides, pesticides and fertilisers used.

The idea is that each vehicle has a specific function. For instance, a 'scouting robot' would measure plant health, using lasers and sensors to take in growth rates, crop height, leaf colour and nitrogen uptake.



For a farm worker, this is a laborious task that involves transcribing a great deal of data. Finding qualified staff can be an issue. It's also weather dependent and can be expensive.

None of these factors are an issue for scouting robots, which can also be programmed to inform the rest of the fleet where to apply fertiliser and how much pesticide to spray.

Smart machines which take the drudgery out of agriculture

Much smaller than typical farm machinery, robot fleets will be able to act co-operatively and carry out jobs such as spraying with a boom (waiting for any wind to die down for optimum efficacy) and using lasers for multiple tasks, from harvesting to weeding.

Tractor operations like ploughing, disking and harrowing always create soil compaction and also typically disturb more than 65% of the field area during their operations. Studies show that 90% of the energy employed in cultivation is to repair damage caused by tractors. Lightweight robots moving on low pressure tyres and only cultivating the minimum volume of soil are an effective solution. The future is also likely to bring flying robots, which can be used to manage sheep, for instance.

Harvesting of delicate fruit, such as apples, is perhaps the final challenge for robotics. Vision and handling systems will have to be developed, and the obstacles are significant but there have already been trials on sensors designed to artificially "smell" ripeness.

The robot needs to not only identify which fruits are ready to pick but also then handle them without either bruising or scratching. The technology is not there yet but the hope is that one day we will have robots that don't just harvest apples, they will colour and size-grade them too.

They can work continuously, in all weather, and even at night

So, robot farming offers multiple advantages from seeding to harvesting. Supported by accurate GNSS (Global Navigation Satellite Systems) positioning systems, robotics can be also be used for livestock management to scouting and plant care; from precision weeding to spraying of herbicide.

With a command and control centre monitoring activity and people overseeing the task, working on a farm may, in future, require a skill set just as focussed on engineering as agriculture.

The Robotics and Autonomous Systems Special Interest Group went live in 2012:

tinyurl.com/tsbrassig



Images courtesy of Harper Adams



ROBO BEE



Insects possess a variety of robust, yet sensitive sensory systems. As such, they adapt themselves well to the science of biomimetics, the study of the structure and function of biological systems as models for the design and engineering of materials and machines. Biomimetics, many believe, has a secure place in the future of farming.

Defined as the 'abstraction of good design from nature,' biomimetics is at the heart of a recent Harvard study to engineer a robot honey bee.

Designing something so small, made the task extremely difficult, as it's a challenge to build something of this scale to act intelligently. However, after 12 years of work, researchers at the Harvard School of Engineering and Applied Sciences succeeded in creating a fly-like robot.

This 80-milligram, quarter-sized device is certainly one of the smallest robots ever built and the design process enabled the engineers to examine the ways in which the mechanical strain and airflow sensors found in nature can be used as the basis for new sensing technologies.

PRECISION SENSING IN AGRICULTURE: WHAT CAN IT DO?

- • • New sensor techniques can show crop nutrient levels, presence of disease or weeds, and water supply.
- • • Sensors and biosensors can monitor the health and welfare of livestock.
- • • Crop and system models can provide early warning of risks.
- • • Crop management can maximise productivity and minimise wastage.
- • • Quality sensing can allow harvest time to be optimised and maximise the value of perishable products.
- • • Robotic systems for handling and management of animals can improve productivity and welfare.
- • • Environmental control can reduce emissions and energy use.

