SLIDE 1 INTRO

Will Precision Farming Change The Face of UK Agriculture?

What is Precision Farming?

Ladies and Gentlemen. It is with great pleasure, and I have to admit a few nerves, that I accepted this invitation to present to you this morning. This is my first visit to the Oxford Farming Conference and depending on how well the next 25 minutes go, it could be my last!

I manage Overbury Farms, a LEAF – or Linking Environment and Farming - Demonstration Farm with combinable crops, sheep, Higher Level Stewardship, and some land let on annual arrangements for field scale vegetable production. Don't worry, though, I'm not going to talk for 25 minutes on

(SLIDE2 Sheep Tags) sheep electronic identification!

It's impossible to cover all aspects of this subject, with its numerous strands and diverse features depending on which farming sector you are involved in. Today I'm going to focus on precision farming in the arable sector - although some of the techniques can be easily replicated in many field scale operations.

I began by asking myself a few questions. First, what exactly is precision farming ?

SLIDE 3 Definition

Second, what are the benefits of using its techniques?

SLIDE 4 Benefits

Third, where is it relevant, and what are the range of applications available?

SLIDE 5 Applications

I also want to give you three examples of precision farming being put into practice.

SLIDE 6 Case studies

And finally

SLIDE 7 Next Steps

Where do we go from here - what is the next step for the UK arable farmer?

SLIDE 8 Definition

According to HGCA, precision farming is 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"

Wikipedia says it's about whole farm management with the goal of optimizing returns on inputs while preserving resources.

My own definition is that it aims to optimize field level management with regard to crop science, environmental protection and economics.

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 tramlines to mark out the same wheel tracks for subsequent operations when spraying grassland or pre emergence herbicides.

(**SLIDE 9 – Definition /Tramline**)

We might have used flags, sticks or small children to provide a pathway of where you have travelled, or where you intend to go next.

Another is rabbit netting:

(**SLIDE 10 - Definition/Rabbit Netting**)

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.

(**SLIDE 11 –Definiton/1945 Map**).

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. But to my mind, precision farming techniques allow us to manage ‘fields within fields’.

If these are early examples, where are we in the 21st Century? What advantage is a modern farmer looking to gain in upgrading his systems?

SLIDE 12 Signpost - Benefits

Precision farming offers three main benefits. First and foremost is cost saving. The savings come from accurate field operations, resulting in reduced diesel, man-hours and wearing parts to complete each field operation.

SLIDE 13 Benefits/Map 1945 and Soil Map

Take another look at the field I showed you. Different levels of fertility are evident in different areas of the field (in this case phosphate). Before precision farming, we had to make do with a blanket approach to inputs. Using variable rate fertiliser applications on this field alone we have saved 4.8T of TSP a reduction in cost of over £1,400, in 6 years.

SLIDE 14 Benefits/Tractor

Another example of cost saving would be pulling a 4m cultivator with a 6% overlap - only 23cm. That reduces output from 3.2 Ha/Hr to 3 Ha/Hr and increases the cost from £33.06/Ha to £34.57/Ha. It doesn’t sound a lot, but if you have 1,000 Ha to cultivate, that’s a saving of £1,500 for one pass. If you can use that equipment for every cultivation, the savings really add up.

SLIDE 15 Benefits/Sprayer

The second benefit is to the environment. Nitrogen fertiliser, for example, has a huge carbon footprint. The emissions from 1Kg of unabated ammonium nitrate are equivalent to driving a 2 litre diesel car 27Km.

Using techniques like satellite imagery to monitor crop canopy development, we can be more accurate in our fertiliser timing, and the amount we apply. Apart from optimising the use of a very expensive crop input, greater accuracy lowers the risk of nitrogen leaching from the soil due to excessive application. The use of this technology reduces our environmental impact. And six years of SOYLsense trials show a yield benefit of between 3 and 8%.

SLIDE 16 Benefits/Customers

The third benefit is marketing. It is a consequence of the others. Modern farmers using the best equipment are likely to be the most efficient, be more environmentally friendly, have better traceability, produce better quality and be more profitable - and therefore financially sound. These attributes appeal to our customers, helps build trust and strategic business alliances. For example in the LEAF Marque audit, the use of precision farming techniques helps to demonstrate compliance in crop protection standards. Being LEAF-Marqued has secured a premium for our oilseed rape for the next 5 years.

SLIDE 17 Signpost - Applications

I think every sector of our great industry has the opportunity to embrace the benefits of precision farming. For the arable farmer, the applications include:

SLIDE 18 – Applications/Yield map

Yield mapping and monitoring. Enabling you to know what is being produced from where within the field; and which areas are not delivering, having had the same level of investment.

Variable rate seeding of the fields – soils are the biggest variable

Variable rate fertiliser applications – a financial and environmental benefit

Weed Mapping and scouting

Variable rate spraying

Boundary mapping and Topography Mapping, (maybe erosion mapping in the future?)

Guidance

Recording and analysis – using it to make decisions

SLIDE 19 - Applications/Apps

For as little as £1.99 from the itunes store you can download apps that help measure leaf area indices for rape and wheat, allowing better assessment of retained nitrogen. They can assist in the forecasting of disease risk, or even allow fertiliser calculations to be generated out in the field.

And it's not just arable farmers who can benefit. For example, dairy farms are increasingly looking towards robotic milking,

SLIDE 20 - Applications/Lely Feeder

automated feeding and remote monitoring to assess individual cow performance.

Our indoor intensive pig and poultry units have been monitoring temperature, humidity, water use, energy consumption, growth rates, mortality and health issues for a number of years now, with better performance as a result. If you can't measure it, how can you manage it?

Electronic identification within the national sheep flocks and beef herds is enabling more information to be gained on the performance of individual animals. Over time this will increase performance, improve animal health and reduce the carbon footprint of the livestock industry.

Grassland based farming can also benefit from less expensive light bar guidance systems that can still deliver substantial savings when applying fertiliser or pesticides where there are no tramlines. A cheap light-bar setup can cost as little as £800. At that price it is accessible to every farmer, and shows that size doesn't always matter.

SLIDE 21 - Signpost/Case studies

So I would now like to look at three specific examples of precision farming applied in practice.

SLIDE 22 – Case study 1: 1500 Ha arable farm

The first is from Overbury, where I am the farm manager. Our objective is to optimize yield from varying soil types across the farm.

The day a seed is planted is the most important in its life and can have the greatest effect on its potential to deliver. Get the crop canopy too thin, with not enough seed, and the crop isn't intercepting enough sunlight or can't compete with weeds. Too thick, and the plants are competing for precious resources like fertilizer, moisture, sunlight and have a higher lodging risk.

SLIDE 23 – Case study 1/soil types

The soils are Overbury are very varied, from the Cotswold Brash on Bredon Hill to the reclaimed sand and gravel land. You only have to walk 40 yards within a field to find a different soil type.

SLIDE 23 – Case study 1/ soils fly in

Our initial attempts at variable rate seeding involved a manual system, pressing a button in the cab to raise or lower the seed rate depending on soil type. It had its limitations: for instance, you were relying on the operator to decide where the field variability starts and stops.

SLIDE 24 Case study 1/Soyl man on Quad

For automated variable seed rate technology to work, an additional investment is required: soil conductivity testing and soil type interpretation. This involves passing a magnetic beam over the soil and monitoring the returning signal. From this data, soil types across the field can be mapped. This is a one off cost in the region of £15/Ha. When we know the soil types, we can draw up a map of the expected seed germination rate.

SLIDE 25 - Case study 1/Evesham Rd Conductivity and Seed Rate

Communication between hardware and software is essential. If the information isn't inputted correctly in the office, the tractor can't read the data, and it's therefore useless! This can be very frustrating when you're in the field, the hopper is full of seed, it's about to rain and nothing works!

This is how it looks from the drivers seat:

Slide 26 - Video: Variable seed rate in action

Variable rate seeding enables us to be more accurate in how much seed we use and where we plant it. It's the first step in Integrated Crop Management. It means that all of the plants are at the same growth stage when it comes to precise fungicide timings and we also have reduced lodging in more fertile areas of the field. In fact we don't save money on seed, we just put the resource where it can deliver most effectively. The equipment can also record the actual seed rate applied for future monitoring and final yield comparison.

SLIDE 27 – Case study 1/Seed rate plan/actual

I believe there should also be scope with this system to reduce soil runoff down tramlines by placing bands of seed in the tramlines at specific intervals. These seeding bands would act to intercept water and soil, carrying fertilizer and pesticides as it flows down the tramlines through the winter. The drill could even use the altitude information from the tractor to work out the spacings between bands. The steeper the angle, the larger the bands of seed or the more frequently they appear. As yet I am the only one asking for this so the manufacturers don't see the need!

SLIDE 28 – Signpost/Case studies

To summarize the variable rate seeding benefit at Overbury: the initial cost of £15/Ha can be written down over 5 years. The seed rate maps are 50 pence/Ha. The annual cost therefore is £3.50/Ha. Assuming the total seed use stays the same, at £150/t we only need an increase of 23Kg/ha/Year to break even.

SLIDE 29 - Case study 2: Single operator farm

My second case study is a 360Ha arable farm, growing all combinable crops. The full time manager effectively does everything on the farm himself. In 2007 the farm changed its cultivation strategy to reduce costs in labour and machinery, purchasing a 3m one pass cultivation and drilling system. With a narrow machine there were lots of passes across the field, so accuracy drove the decision making process. The change coincided with the purchase of a new tractor with automated steering (autotrac). The net set up cost of this equipment was £7,500 for the receiver, screen and license.

SLIDE 30 – Case study 2/SF2 Kit, controller etc

This purchase in itself was the stepping stone to full integration into precision farming. The following year a trailed John Deere 28m sprayer was purchased with sectional and auto height control - all fully automated.

This brought a whole new level of sophistication to the spraying operation - something you only appreciate when you can't use it! After an upgrade failed to work, the operator went spraying manually. A block that, with guidance, sprayed out at 102 Ha turned out to be 107Ha. That is a 5% overspray - and he's a skilled operator, and been spraying the fields for years. You can very quickly see where savings can be made, especially in smaller fields.

If you treat a wheat crop 9 times through the season with pesticides you would have sprayed an extra 45Ha! If the pesticides cost you £300/Ha the net overspend due to overlap alone is £1,500. In addition there is the environmental cost of double dosing, potentially exceeding the maximum residue level for pesticides and upsetting the customer.

Over the rotation on this farm, the pesticide saving alone equates to just over £5,100/year. The added cost of the equipment is paid back in less than one and a half years.

Slide 31 - Case study 2/fertiliser spreader

Also in 2008 the fertilizer spreader was changed to a weigh cell model, allowing on-the-move calculations of applied rates - meaning very accurate application. Rates accurate to within 1-2Kg/ha are often achieved. This, coupled with swathing control of the spread pattern, reduce fertilizer overlap to a minimum, saving time and money. Quality is also increased by not having laid crops on the overlaps, which can contaminate the sample with reduced hagberg or chitted grains.

Getting the tractor, to communicate with the drill, sprayer and fertilizer spreader, means the system is quick, effective, simple and controlled from just one display unit, reducing the purchase cost of additional controllers.

In 2012 further investment in a RTK (or Real Time Kinetmatic, which uses a fixed land site to correct satellite drift) has increased the pass to pass accuracy to 2cm, generating further efficiencies and savings which have yet to be fully calculated. The investment in RTK means that the tramlines are always in the same place, again helping to increase infield speed and accuracy.

The improved signal accuracy has helped speed up operations over the old Star Fire 2 signal. There is no waiting on headlands to pick up satellites or loosing signal under a tree. One of the biggest issues is deciphering all the data, and working out what is important and what can help in making informed decisions. That's the real skill of the person behind the machine.

The main risk is the reliance on one system of satellite controls. What happens if it goes down? Currently the skills on this farm would enable farming operations to continue. But would the next generation, brought up on RTK, still be able to drive the tractors in a straight line, or operate this machinery manually?

The key benefit on this single operator farm is: increased application accuracy, saving a substantial amount of money - over £5,000 per year on expensive inputs. And let's face it these costs are only going to increase.

A word of caution, however: no matter how much you invest in technology and equipment, if the weather is against you there is absolutely nothing you can do!

SLIDE 32 - Case study 2/Tractor Stuck

My final case study is located on many different sites and focuses on quality fresh produce to major supermarkets.

SLIDE 33 - Case study 3: Large scale niche grower

Growing 1260 acres of asparagus, Cobrey Farms has a marketing edge and has employed many aspects of precision farming to cut costs, increase product quality and reduce environmental impact.

Growing 60 acres under plastic, the farm produces asparagus almost six weeks earlier than field scale practices and have a season that can last until October, reducing import substitution. The use of technology was key from day one. RTK was used to place the asparagus rows within 2cm of the desired location within the tunnel, but it didn't stop there.

SLIDE 34 - Case study 3/ Polytunnels

The rows were angled up the slope so that rainwater could be collected between the tunnels in purpose built lined channels and used to feed an irrigation reservoir in the corner of the field.

This water is used to irrigate the asparagus fern through the later part of the season, after the spears have been harvested. Borehole water is available in case the harvested rainwater runs short. Not a problem last year. The water is fed to the plants with trickle irrigation, located just under the asparagus crowns at a rate of 5mm/hr. But how do you decide when to water?

Until last season someone was employed half time for 5 months through the irrigation season to moisture probe the soil in the polytunnels to work out the moisture deficit. This resulted in information coming back to the office to be deciphered and entered into a spreadsheet the following morning and instructions given on what needed to be irrigated. This carried a cost of about £8,000.

SLIDE 35 - Case study 3/ Soil Moisture Deficit

With the purchase of nine remote moisture probes, soil moisture can be monitored and the results graphically demonstrated more accurately and frequently. The information is taken from four known depths every 15 minutes instead of once a day. The system cost £20,000 to install and will have a 2.5 year payback on sampling labour alone. This does not take into account the effect that more accurate information has on increasing the productivity of the tunnels.

This information is posted on the internet - so wherever you are in the world, you can check in to monitor the performance.

SLIDE 36 – Case study 3/ Cranfield map

When planting fields with asparagus, the field topography is walked at five meter intervals across the slope and mapped. The layout of the beds is shown in purple. The bright green verticle line is the grass strip forming the spine of the field. During periods of heavy rainfall the water runs towards the grass strip where soil particles are trapped. This retains the soil particles, fertilizer and pesticide within the field. The water is slowed by the grass margin and can then percolate through the soil profile. This method of infield margin establishment is costly. But it will be in place for at least 10 years – helping the farm to keep customers over the long term.

Neither of these systems of production have been in place for very long but the benefits are clear to see: lower cost, reduced labour, less environmental impact: and retention of the farm's biggest asset - the soil - in the field. This is particularly important in the light of the Water Framework Directive and the powers of the Environment Agency.

SLIDE 37 – Signpost: Next Steps

Preparing this presentation has made me think afresh about where we at Overbury and where should be heading along the precision farming road - and indeed how far we have already travelled. Our next step is to look at investing in RTK to increase the efficiencies we are already delivering.

Coupled with this investment, I want to explore the possibility of developing a controlled traffic farming system. This system requires all the field operations to follow the same pathways, keeping compaction to a dedicated route and leaving at least 80% of the field untrafficked. In time this will reduce soil compaction, increase soil organic matter, tie up more carbon in the soil and produce greater yields and more profit.

What are the next steps for those of you thinking of investing in precision farming for the first time? Firstly, I would look at the HGCA's precision farming calculator.

SLIDE 38 – Next steps/HGCA Calculator

This will help gauge what savings you could achieve - they vary depending on farm size and cropping. My second case study demonstrated how a 5% saving in sprays can easily save £1,500 over 100Ha's of wheat.

SLIDE 39 Signpost: Next Steps

Secondly you will need a clear vision of where you want to end up. Do you just want a tractor that steers itself so you can spend time checking your twitter account, or do you want to be fully integrated with seed, fertilizer, sprays and yield mapping? The latter will allow you to build modules that communicate with each other and avoid wasting money on systems that are not compatible. Can the hardware in the cab be moved around from vehicle to vehicle? There is no point in a system sitting in the combine when you could be drilling with it.

Thirdly, can the information you gather be used to make better decisions? This is very evident from case Study 3 where more detailed information allows better timing of inputs. Another example is harvest yield data can be converted into nutrient off-take maps for fertiliser applications the following year. Do not however, underestimate the amount of time you need to set up the systems or organise the data into a useable format.

Finally, identify the training needs of the people who are going to be using this machinery. Driving a tractor can be very different from using a USB stick to change the rate of fertiliser on the move.

But precision farming has a long way further to go. Looking further into the future could we see robots in arable or vegetable fields, planting seeds, recording where they were planted, returning two weeks later to check on germination and if necessary replant?

SLIDE 40 – Next steps/Robot

Robots are already capable of identifying weeds with cameras and micro-dot spraying a choice of selective herbicides, reducing total herbicide use by 99.9%. Others are using lasers to remove the need for herbicides at all. We could see smart drains that have nano-barriers to keep fertilizer and pesticides in the soil where the plants need them. They would have the ability to shut themselves off during the summer to retain moisture in the soil and open again to release clean water during the winter months.

Ladies and Gentlemen, in summary and to answer the question I was asked: if we are to move forward in food production - be more efficient, use less inputs, have less of an environmental impact - then I see no other way than through precision farming technologies.

Thank you.

Slide 41 – closing slide – walk off!