

THE ONLY WAY IS UP: WHY HILL FARMING IS EMBRACING TECHNOLOGY

AS WE BECOME INCREASINGLY CONCERNED ABOUT USING THE WORLD'S RESOURCES MORE EFFICIENTLY, THE AGRICULTURE INDUSTRY'S ATTENTION IS TURNING TO THE UPLANDS. PROFESSOR DAVY MCCRACKEN OF SCOTLAND'S RURAL COLLEGE IS FOCUSING ON INTEGRATED LAND MANAGEMENT, TO ENSURE THAT THE HILLS AND MOUNTAINS OF SCOTLAND ARE MANAGED IN AS SUSTAINABLE A WAY AS POSSIBLE

IMAGINE THIS

A shepherd strides over a hill in Scotland, accompanied by three sheepdogs and a drone. An electronic tag in one of his sheep's ear has alerted him that a sheep has become separated from the flock, that it hasn't moved for several hours, and that the rest of the flock are now a kilometre away. By using the location coordinates in tandem with the drone's infrared camera, he spots it stuck in a gully, and manages to haul it out and reunite it with the flock.

The next day, the shepherd and his dogs herd the flock to the farmhouse to measure their weight and assess other health factors. The database informs him that the sheep that had been stuck is losing weight, and on closer inspection he sees it is suffering from a disease. He closely monitors it for the next few weeks, feeding it a special diet as well as a course of tailored antibiotics. When it has fully recovered, it returns to the flock.

Imagine innovating and developing more technologies like these to help farmers manage their land sustainably and profitably.

QUICK FACTS

UPLAND FARMING – Also known as hill farming. Upland farms generally produce livestock such as sheep, cattle and goats, which graze on vegetation that cannot otherwise be used by humans.

PRECISION FARMING – Also known as precision agriculture. Precision farming uses specialised equipment, software and IT to ensure that crops and livestock receive everything they need for optimum health and productivity.

INTEGRATED LAND MANAGEMENT – A system that enables farmers to manage all aspects of their land sustainably and profitably, especially by producing more than one type of product for the market.



Upland farming has historically been overlooked by agricultural science compared to higher-output, more profitable lowland farming. This has meant that technological innovations and other precision measures have, until recently, been underused in such areas. However, as we move into an age focused on sustainability and efficiency, it is probable that upland farms will come to represent a much greater proportion of animal agriculture. It is therefore very important that they are managed as effectively as possible.

Professor Davy McCracken, Head of Integrated Land Management and Head of the Hill & Mountain Research Centre at Scotland's Rural College (SRUC), has spent several decades working on this issue. Scotland is one of the world's leading areas for sheep farming; in fact, the UK is the sixth largest producer of sheep meat (lamb and mutton) in the world. Now, integrated management techniques are helping to ensure that these areas are managed as productively and sustainably as possible.

WHY THE FOCUS ON THESE UPLAND SYSTEMS?

Around 70% of Scotland's land is mountainous or has mountainous characteristics (i.e. a similar climate or soil type), and there are limited agricultural uses to which this land can be put. "Poor soil condition combined with high rainfall means that Scotland's mountainous areas are unsuitable for ploughing or growing crops,"



says Davy. “Farming in these areas therefore focuses on livestock – in particular sheep and cattle in Scotland, and goats elsewhere in the world – that can convert the vegetation that grows there into protein sources suitable for humans, such as meat or milk.” This is not a solely Scottish situation: many other areas around the world, from the Italian Alps to the Tibetan Plateau, have similar characteristics. Davy’s research has the potential to be used to improve management in any of these areas.

WHAT ARE THE CHALLENGES THAT UPLAND SYSTEMS FACE?

These areas do not lend themselves to productivity. “When compared to livestock systems in lowland areas, upland systems are unable to produce the same number of young animals or rear them as quickly,” says Davy. There are several reasons for this: the plants that grow there are of low nutritional value, and the animals are also exposed to high levels of rainfall and very cold winters. Add into this the risk of attack from predators and the amount of energy the animals use to navigate the uneven terrain, productivity can be significantly affected.

This limited productivity has meant that technological advances in agriculture have often passed upland systems by. “When technological innovation was first introduced in the UK, it was primarily aimed at the more productive farming systems in the lowlands,

where farmers were more able to afford to invest in the technology,” explains Davy. “This rapidly became a vicious circle.” Upland systems were left behind as innovation made lowland systems increasingly productive, and therefore more tempting for investors – but this is now changing. Davy believes that the value of upland systems from an environmental as much as an agricultural perspective, and the importance of managing them as effectively and sustainably as possible, is now being recognised.

HOW IS SCOTLAND’S RURAL COLLEGE IMPROVING MATTERS?

SRUC rents two neighbouring upland farms, Kirkton and Auchtertyre, from the Scottish Government to use as a research base. Experimenting with different management techniques is not a risk that most upland farms can take, since the farmers’ livelihoods depend on being reliably profitable every year. This is where funded scientific research can step in. Despite misconceptions of scientific study being consigned to the laboratory, it is on these hillsides where Davy’s work is focused. “We are aiming to gain a better understanding of how best to manage the sheep flock and the land they graze upon,” he says. It takes practical experimentation, as well as learning first-hand from the farmers who know the areas intimately, to yield meaningful results. The management techniques the team is developing and testing are varied, but one



PROFESSOR DAVY MCCRACKEN

Head of Integrated Land Management and Head of Hill & Mountain Research Centre Scotland’s Rural College (SRUC)

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FIELD OF RESEARCH

Integrated Land Management

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RESEARCH PROJECT

The SRUC’s Hill & Mountain Research Centre focuses on driving innovation to increase the economic, environmental and social viability of hill farming and crofting in Scotland and beyond.

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FUNDERS

The Scottish Government’s Rural & Environment Science & Analytical Services Division through their Strategic Research Programmes; The European Commission’s H2020 Research & Innovation Programme; Defra’s ERA-NET Sustainable Animal Production programme; Global Food Security’s Resilience of the UK Food System Programme, with support from BBSRC, ESRC, NERC and the Scottish Government; Innovate UK

innovation stands out to Davy. “We have established a weighing crate on our farms that can identify individual sheep from their ear tags, and measure and store their weight automatically in a database.” Along with an array of other measurements, such as age, sex or breed, this means the animals can be sorted according to their characteristics. For instance, these measurements can help identify underweight animals, which can then be separated from the flock and fed a special diet. By tailoring techniques down to the individual animal, farming becomes a lot more precise – earning such efforts the title of precision livestock farming.

ABOUT INTEGRATED LAND MANAGEMENT

Integrated land management is about combining conventional farming techniques with countryside management and the latest innovations in science and technology, as well as considering factors such as biodiversity and sustainability. This knowledge, together with the capacity to collect and interpret increasing quantities of data, gives a much broader understanding of what can be done to make farms more profitable, more sustainable and more efficient.

By understanding the factors that affect upland systems, it is easier to modify these factors in a meaningful way. The right data can help decipher the best diet for a flock, the optimum number of animals an area can support, or how to ensure positive interactions between farming and conservation measures.

WHAT ARE SOME EXAMPLES OF THE RESEARCH TAKING PLACE?

Since integrated upland management is concerned with accounting for all the players in the system, it is natural that SRUC's Hill & Mountain Research Centre has a very broad array of projects, drawing on several scientific disciplines. As well as developing precision livestock techniques, they also research bio-economic modelling (using biology and economics to model optimal land management practices), how to

integrate trees and woodlands into upland farming, and how best to mitigate upland farming's contributions to climate change – and these are just the tip of the iceberg! This dispels the myth of scientific research being narrow-focused; the SRUC's goal is to see the big picture.

WHAT IS THE ROLE OF THE ENVIRONMENT IN INTEGRATED LAND MANAGEMENT?

"In upland areas, it is impossible to separate agricultural issues from environmental issues," says Davy. Uplands contain diverse ecosystems, from peatlands to native woodlands, which are home to many species of high conservation value. In the past, environmentalists have largely condemned animal agriculture for degrading and destroying natural habitat, and while that remains the case in many areas, Davy believes there is clear evidence that grazing livestock in the uplands can have strong environmental benefits. "Appropriate active management can have a positive impact on many environmental issues, such as stopping or reversing declines in biodiversity, or reducing the risk of flooding in the lowlands," he says. "Nowadays, upland livestock systems are seen as having an important role to play in addressing the ongoing climate and biodiversity emergencies."

WHAT SORT OF PERSON WOULD SUIT A CAREER IN THE AREA?

Many people carry a preconception of agriculture as an industry dominated by practically minded, non-academic people, but Davy thinks that this idea is out of date. "The technological solutions being put in place mean that there are more and more opportunities for people interested in understanding a wide range of agricultural, biological and ecological processes through the collection and interpretation of data."

The environmental aspect of land management is also increasingly recognised. Scientists and land managers are needed to help restore peatlands, establish woodland cover and make land management overall more conservation minded. "In uplands areas at least, the focus will shift from opportunities solely in either agriculture or countryside management, towards a situation where integrated land management is the norm," says Davy.

Check out this video of Davy highlighting the range of career opportunities to secondary school pupils and their teachers: <https://www.youtube.com/watch?v=lp8WhJbQi7c>

OPPORTUNITIES IN LAND MANAGEMENT

- Several UK universities and colleges run courses in rural land management or related areas. Examples include the Royal Agricultural University, Scotland's Rural College (SRUC) and Newcastle University.
- A number of other courses can open up a career in land management. Davy recommends animal biology courses if livestock genetics interests you, ecology for understanding soil and vegetation, or engineering to get involved in technical innovations such as drones.
- SRUC hosts a wide variety of courses at college and university level, with subjects ranging from countryside management to sustainability. In many instances they offer funding to assist with student loans and other forms of hardship.
- SRUC also offers Skills Development Scotland Modern Apprenticeship programmes, which allow apprentices to gain hands-on industry experience through work-based learning.

ASK PROFESSOR DAVY MCCRACKEN

WHAT DID YOU WANT TO BE WHEN YOU WERE YOUNGER?

My dad was a shepherd on an upland farm in southern Scotland. We didn't own it, so I knew I was not going to get into farming by inheriting the farm - but I did know I wanted to do something with a farming focus. If I'm honest, however, it wasn't until after I had completed my PhD that my focus became clear.

YOU HAVE A BSC HONS IN AGRICULTURAL ZOOLOGY AND A PHD IN AGRICULTURAL ECOLOGY. WHAT DREW YOU TO THESE SUBJECTS?

I didn't study biology at secondary school until my final year, when I chose a crash course in higher biology. I loved it! And it was the combination of biology and farming that drew me to agricultural zoology, which largely focused on pests and parasites in crops and livestock. My PhD sought to understand which insects were important in the diet of a rare farmland bird (the red-billed cough), and how farm management ensured those

insects were available for the bird throughout the year. Again, it was the merging of farming and wildlife, coupled with a practical, applied outcome, that drew me in.

WHAT DO YOU ENJOY MOST ABOUT THE WORK YOU DO?

This has changed throughout my career. Initially, it was all about gaining a better understanding of the interactions between farming and the wildlife on farms. I still enjoy this aspect, but over the last 20 years I have been more involved in helping to translate the findings of research into actions that farmers and land managers can undertake in the real world. Seeing these results is very fulfilling.

HOW OPTIMISTIC ARE YOU ABOUT THE ABILITY OF UPLAND LIVESTOCK SYSTEMS TO OVERCOME THE CHALLENGES THEY FACE?

I am confident that there is a future for upland livestock systems, but I believe that only those that practise a range of land management techniques and consider environmental benefits on par with

agricultural products will thrive. This is why I created a Department of Integrated Land Management at the start of 2019.

FINALLY, WHY DO FARMING COMMUNITIES NEED PEOPLE LIKE YOU TO WORK WITH THEM?

I come from a farming background but have also worked for nature conservation agencies and on agricultural and environmental policy. My background not only allows me to see the wider opportunities for farmers to increase the resilience of their farming systems, but also helps me speak to them on their own terms.

DAVY'S TOP TIPS

- 01** Don't rely solely on the advice of your parents and teachers - there is a widespread lack of awareness of the opportunities that agriculture and countryside management can offer.
- 02** Build an understanding of the importance of collecting, analysing and interpreting data.
- 03** Do your research. Seek out colleges and universities offering courses in areas such as agricultural biology, ecology or other topics that interest you, and ask what career paths these courses might open up for you.

