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Department of Geography, Environment and Earth Sciences

Robotic and Information Technologies in UK Dairy Farming



Robotic and Information Technologies in UK Dairy Farming: Project Overview

Robotic milking technologies are becoming increasingly important in UK dairy farming, as well as elsewhere in Europe and in North America. Robotic milking machines milk cows automatically at any time, without the need for a human worker to be present. Cows choose when to be milked, enter the robot, are milked and then return to the herd.

The robot records detailed data during this process, which can be accessed via computer. It is claimed by manufacturers that the system can potentially raise milk yields, and also produces benefits in terms of animal health and welfare and for the working conditions of the farmer. Scientists and companies working on the development of automatic milking systems (AMS) have had to engage with a range of issues surrounding the deployment of the technology; these concern, for instance, the

maintenance of hygiene, the way the robot can 'learn about' and adapt to cows (and udders) of different shapes and sizes, the management of herds so that all cows attend the robot a sufficient number of times per day, and the implications of robotic milking for the health status of cows.

As well as being associated with a set of technical issues, however, the development of robotic technologies in agriculture raises many questions of interest to social scientists. This project, which was funded by the Economic and Social Research Council and involved collaboration between researchers at the University of Hull and Cardiff University, investigated how the introduction of AMS may change the ways dairy farmers manage their farms and businesses, and might affect the farmer-cow relationship.



The research focused on three central themes, each raising a series of specific questions:

1. How technologies change farm practices

- How does the use of AMS change farming routines and activities? How does it change the way people and cows are expected to behave? How do AMS change the relationships between farmers and their cows?

2. How farmers learn and make decisions

- How do farmers decide whether to adopt robotic milking technologies on their farms? How do farmers learn to use the information generated by robotic milking systems?

3. Health, welfare and agricultural ethics

- What ethical questions are raised by the use of robotic milking technologies? What positive and negative effects on animal welfare are associated with robotic milking, and what are the implications of these for the public image of dairy farming?

The research involved detailed interviews with dairy farmers and dairy farm workers, staff on the research farms of agricultural colleges, agricultural scientists and researchers involved in developing robotic milking technologies, the companies marketing robotic milking equipment and representatives of a wide range of organisations including veterinary practices, those concerned with animal welfare, and specialist dairy feed and management companies. It involved periods of research on three case study farms, during which the routines and behaviours of both cows and humans were observed. The case studies included the college farm at Askham Bryan College, a farm with a well established robotic dairy, and a farm in the process of converting from conventional to robotic milking.



Robotics on Dairy Farms: Manufacturer perspectives

Manufacturers outlined five key benefits of AMS for farmers and cows:

1. Economic benefits

Labour costs are reduced as labour demands are minimised whilst yields should increase.

2. Management benefits

Management of the herd can be made more efficient, although this is dependent on farmers making use of the additional data provided by AMS and changing their approach to management accordingly. Manufacturers were clear that adopting robots meant adopting a whole new farming system, a whole new farming routine, and a whole new attitude to dairy farming, as shown by their comments during interviews for this research:

“For a farmer who’s never managed his cows properly the robot computer will force him to do so. It tells him about blood in the milk, conductivity, yield per quarter. If a cow’s possibly lame it can indicate that, it tells him how many times a cow has been fed every day. There’s heaps of information that they’ve never ever had before and if they don’t take account of that things can quickly go wrong. Farmers sometimes put robots in thinking that it’s all automatic, it’s like, you know, the cows will feed themselves automatically, and milk themselves automatically. But it doesn’t work like that. And those are the things that we’ve got to make sure the farmer understands”.

“I think with robotics you’re looking at managing by exception. The data you can pull off the cows i.e. yield, activity, and start collating that information it allows you to manage and fine tune the animals you know accordingly which then brings the efficiencies into play of the feed. And it’s keeping that balance and that efficiency so, I think, it gives you the tools to manage by exception; it gives you all the information to actually manage the animals accordingly. I would say that’s one of the sorts of core strengths of the system.”

3. Cow health and welfare benefits

For example, benefits resulting from quarter-by-quarter milking, which can help to reduce udder infections.

4. Cow ‘quality of life’ benefits

Cows milked by AMS are said to be quieter and less stressed; their quality of life is claimed to improve as a result of increased choice about when to be milked.

5. Farmer ‘quality of life’ benefits

AMS are promoted as freeing farmers from rigid twice-a-day milking routines, allowing them to spend more time with their families or pursue farm business diversification. One manufacturer said:

“We want to recognise, we do say this to people, if you’re looking to save six hours a day you won’t. What robotic milking brings is it will free up a lot of time that you can then invest into herd management, looking after the environment, other jobs on the farm, fine. It will save you some time but not six hours a day. It might be one hour a day, it depends on the particular circumstances. What it does do is it gives the farmer the opportunity to actually go around the shed, look at what’s going on, look at the feeding, look at the other things, and that’s where a lot of the mastitis, the health improvements, even the milk from the feeding, it’s having that management capability to stand back and look at the business and not spend six hours a day milking cows.”

AMS in a European context

Manufacturers compared AMS use in the UK to mainland Europe where they have been used commercially since 1992. The reasons given for their increased use are varied but as one manufacturer commented this may in part be due to a different ‘mentality’ that is inherent in UK dairying:

“I would say we’re lagging behind Holland continuously. So if we went back to Holland like this year for instance, of all the systems sold, i.e. a new milking system, there will be over 50% of them are actually robotics. And I think Germany you’re maybe looking at 30-35% of all systems sold will be robotic. So what we’re seeing is a lot of the European countries are embracing the technology, but I think also the herd sizes suit those countries as well. In the UK we’re looking about a hundred and five cows being the average herd size. Well that is too much for one robot, maybe not enough for two, it’s that middle of the ground, whereas a lot of the Dutch market you’re maybe fifty cows. I’m not sure specifically but that will influence the market reception to the machine. But I think also the culture, the mentality, and I think one of the European sort of mentalities really is more of a family environment, i.e. you know the husband may go out to work and they may have a few cows, and it’s more the home life, the family life, the farming life. So I think there’s a cultural reason why.”



Understanding and Using Robots: Farmer Perspectives

1. Learning about and adopting robots

Key reasons given for adopting robots were:

Lifestyle Farmers would no longer be tied to a traditional dairy farming lifestyle. Some adopted AMS with the intention of prolonging their working life or enabling them to have an ‘easier’ working day as they grew older.

Flexibility Farmers were drawn to AMS by the potential of not being bound by the clock and having more time to have a social life. A key attraction was the possibility of carrying out other work on the farm without the absolute need to get back to milk.

Labour (cost and availability) Whilst the initial outlay on AMS is expensive, many farmers set this against the cost of the labour which it replaces. Others highlighted the difficulty in attracting experienced and reliable labour and viewed AMS as a potential solution to this.

Interest to younger generations Some farmers invested in robotic technology as a way of maintaining their dairy herd for their children, who did not want to follow the same working routine as their parents.

Second-hand market Tenant farmers especially found that investing in a robot made more sense economically than updating their original parlour. Should they move they could take the equipment with them or it could be sold on if no longer required.

Increased productivity Farmers spoke of AMS’s potential to increase milk yields through more frequent milkings; this could produce greater returns from high-yielding cows in particular.

2. Robots, farm routines and information use

Farming routines Following the adoption of AMS, many farmers found that their daily routines changed. Most research participants experienced increased flexibility in their daily routines and spent more time on herd management. As these farmers commented:

“It’s given me flexibility to do the jobs and the things that I want to do when I want to do them. When you’re milking in a parlour, you can’t do that.”

“I walk around them more than I used to do, I’ve got more time. I spend more time managing the cows than I used to do because I don’t have to prat around milking.”

In spite of this, farmers also highlighted new constraints on their time and freedom, especially resulting from the ability of AMS to send alerts and alarms to their mobile phones at any time. Other farmers contrasted the everyday flexibility provided by AMS with new-found difficulties in going on holiday or staying away from the farm for longer periods unless another person was trained to use the AMS computer.

Information use Beyond the automation of milking itself, AMS also impacts on farming routines through the data it provides about milk yields and cow health. Manufacturers encourage farmers to check this data regularly and use this to direct them to particular cows, which might be displaying irregular patterns of behaviour or have conductivity readings (a measure used to indicate the presence of infection) that are suggestive of mastitis. Some farmers follow this approach:

“I look at the computer at what cows need milking: fresh calvers, or lame cows, or sick cows, lazy cows, whatever that need milking. I write a list out and I get them in the pens and put them through the robot.”

Others, though, preferred to be guided by their visual and tactile engagement with cows, before using the AMS data to clarify issues they had identified.

While all of the AMS farmers in the study found data from the robots useful – especially in relation to milk yield, milking frequency and conductivity – most also spoke of their inability to make use of the majority of data produced. For instance:

“We could spend hours sat there, but we’ve too much on, we’re too busy to trawl through pages and pages of different types of information. You just head for the first two or three pages that are pertinent to you – i.e. who’s late, who’s got a higher conductivity – those are the cows you’re checking out.”

There may be a need for systems to enable farmers to better use the information generated by AMS. In part this may come from more training being available for farmers before, during and after starting robotic milking, in part from higher continuing levels of support from manufacturers, in part from systems allowing data sharing and comparisons between farms, and in part from specialist consultants able to analyse and interpret data for farmers.



AMS Impacts on Cow Health and Welfare: Farmer Perspectives

The role of the stock person While AMS farmers were enthusiastic about the benefits of robotic milking, they were keen to emphasise that AMS could only advance cow health and welfare if the farmer remained cow-focused. The introduction of AMS did not reduce the need for good stockmanship:

“Robots will never take over from a good cowman but they provide you with a lot of information that you can make your decisions on without necessarily having to be the greatest cowman in the world.”

Cow ‘freedom’ Beyond this, AMS farmers generally commented on reduced levels of mastitis (although these levels sometimes rose in the early stages of their AMS use), the calmness of cows and changes in the herd structure. In discussing these issues, they often focused on the ‘freedom’ cows have in AMS to choose when to be milked:

“It’s maybe just they’re happier because they do seem genuinely happy, they’re free range cows as opposed to they’ve been managed and driven around.”

Farmers referred to AMS cows as ‘happy’, ‘chilled out’ and ‘relaxed’. In a related issue, most farmers also discussed the impact of AMS on herd hierarchies, with ‘bully cows’ becoming less dominant.

Farmer-cow relationships The research highlighted how AMS changed ways of identifying cow health and welfare issues. In particular, the time farmers spent with their cows changed, as did their contact with the animals:

“The advantage of the parlour system is the cows are presented to you twice or three times a day, and if you’ve got a lame cow you can shed her off and see to her in the herringbone. In the robots all you notice is ‘oh she’s late to milk’ and you go and get her up out of the cubicle, and it’s the last job at night. ‘I’ll see to her in the morning’, and in the morning you’re off calving a cow, or you’re doing something else and she’s left for two or three days when you maybe should have dealt with it. By that time she has lost condition and you could have dealt with it.”

AMS, therefore, is not a panacea. Good stockmanship is still crucial, but a new approach to cow health and welfare is necessitated, involving new forms of interaction between farmer and cow, mediated by the data provided by AMS.





Case study farms

The following section provides a brief overview of the three case study farms that formed part of the study, giving a description and some of the reasons why AMS was used, or were about to be installed.

Our first case study farm, located in the East Riding of Yorkshire, combines around 600 acres of arable land with around 100 dairy cows. A family farm for three generations, the current owner has been there since 1998. The dairy unit was converted to a robotic milking system in November 2006.

Why convert to AMS? The main reasons for converting this farm to a robotic system were to address difficulties in attracting and retaining reliable labour, while also reducing overall labour costs. Cows are housed indoors throughout the year and do not go out to graze. Housed in a 'cubicle' barn, they are free to move around the shed and also have access to a cow-operated brush.

Our second case study farm is at Askham Bryan College, located to the south of York. Askham Bryan has a robotically-milked dairy herd of approximately 40 cows, situated alongside a herd of about 160 cows milked using a conventional milking parlour. The robotically-milked herd is kept inside all year, while some of the conventionally-milked herd goes out to graze for part of the year.

Why use two systems? The college farm, Westfield Farm is run as a commercial enterprise as well as providing opportunities for students to take part in practical learning. This was one of the reasons the College invested in an AMS so providing the opportunity for students to see two alternative milking systems working thus complementing the classroom elements of their studies.

Our third case study is a farm in North Yorkshire that converted to robotic milking during the project. Previously the farm used an 'abreast' parlour to milk 170 cows twice a day, which was very labour intensive. They purchased four robotic milking machines, built extensions to their existing buildings and changed the layout of the cow shed to accommodate the new machines. Herd management shifted from grazing to year-round housing.

Why convert to AMS? The family, who have been there for thirty years, hope that investing in robots will provide a viable future as the older generation begin to think about retirement and as a way of encouraging the younger generations to stay in dairy farming. AMS will also give more free time to spend on other parts of the farm, when they are freed from the daily milking routine.

More detail on the case study farms is available at:

<http://www2.hull.ac.uk/science/geography-1/research/livestockrobotics/casestudies.aspx>

AMS on Dairy Farms: Specialist Perspectives

Veterinary and dietary specialists were interviewed as part of the research. Four key areas were identified where AMS contrasted with conventional milking parlours.

Use of AMS as a feeding station Previous research has demonstrated that given a choice cows will select milking randomly and that udder fill, or the time since their last milking, has no effect on the choice to attend the AMS. Thus the most reliable motivating factor for a cow is feed rather than being milked and if given a choice cows will rarely visit a milking system. It is important therefore to get the nutritional balance right and use the robot as a way of feeding cows correctly:

“[An AMS is] a feeding station that happens to milk the cows. They don’t go there really to get milked, they go there because they know there’s some nice tasty concentrates. And it is a mistake to feed Total Mixed Ration at the barrier, if you over feed the cows here they’re not hungry to necessarily go to the milking station. Whether it’s feed first or free cow traffic they’ll just stand around and will not move around the system if you fill her up with nice tasty TMR. They just sit there or stand there and don’t move anywhere. So the feeding is really an extremely key element to a robotic system. But she will always have food available, if she’s got milking permission as we call it she will have food available. That’s the way the system is calculated.”

AMS and improving welfare It was felt that cows were quieter and less stressed when milked through an AMS. They experienced greater freedom and were happier:

“I personally think AMS are a very positive thing. Having spent my entire life working with cows I would say cows seem far more, I hate to use the word but happy and content, far more content being milked robotically than

they would be being crowded together in a collecting yard and then pushed into a parlour and so on and so forth. So I think that is a very positive thing and clearly there are also the benefits of choice in that an animal chooses when to be milked as opposed to being forced in twice a day.”

AMS and a consistent milking process Cows were not subjected to the changing vagaries of the farmer’s mood and behaviour at milking times. Instead, they can develop their own milking routine and experience a milking process which is always predictable and consistent:

“The robot never comes in in the morning tired and grumpy, or hung-over! Which you know, undoubtedly happens in the conventional system. So you get that repeatability. And that’s what cows want, they’re creatures of habit and they want everything to be the same and of course that’s absolutely what you get from a robot.”

AMS and grazing Getting cows to come in and be milked when turned out was something that farmers found was one of the drawbacks with AMS coupled with the fact that AMS lends itself to zero grazing. This was seen as an area where research and development was needed so that AMS could be combined with grazing regimes. The positive public image of dairy farming is related to the sight of cows in fields so it is important to be able to maintain that system:

“The biggest downside is the current requirement of 365 day housing in the robotic system. The majority of robotic systems are 365 day housed and whilst pasture based robotic systems are being developed and are in their infancy the system largely required 365 day housing which I think is the significant downside to them as far as the animal is concerned.”



Key Points:

- Individual farms and farmers use robots in unique ways relating to their personalities and specific characteristics of their farms. This means *technology adoption and use is complex* because the technology has to fit into all sorts of existing circumstances and relationships. Robots are not simply adopted. Decisions to adopt robots can be complicated; farmers have to take a wide range of factors into account, including farm layout, individual and family preferences, economic circumstances and cow health and welfare. Also, getting a robot doesn't just mean having a new machine – the robot implies adopting other things as well, both systemically on the farm, and in terms of having to adopt a new philosophy of dairy farming.
- Automatic milking systems don't just fit in to existing circumstances and relationships. They *change the circumstances and relationships*. The robot affects what the farmer is expected to know and do on his/her farm; it affects farm layout, system and routine and it affects the farmer's behaviour and his/her relationships with their dairy cows. However, AMS do not replace traditional skills of stockmanship. AMS change farmer-cow relationships significantly, creating new possibilities for how cows are seen and known by the farmer. But it is stressed that it is up to the farmer to make the most of the opportunities created by the robot. For many AMS users, robotic milking demands even higher levels of stockmanship, commitment and discipline than conventional milking:

“I think you must be really sharp up on dealing with cows. It is a personal thing, you really must be extremely hard on yourself and disciplined. The robot is not an easy option”
- Farmers using AMS consistently *experiment and tinker* with the robots and with the farm system they are part of. This is a process of trying to get the technology to work as well as possible in unique circumstances. It involves both trying to get the robot to fit the farm and the farm to fit the robot. It involves trying to make sense of the robot and what it can/cannot do, and trying to overcome some of the limits of the technology.
- Farmers using AMS have to *learn to make use of the data* produced by the robot, and to build their work routines around data analysis and rapid responses to what the data tells them. However, many feel overwhelmed and admit to using only a fraction of the data available. Alternative ways of ensuring better use of the data could usefully be explored by manufacturers.

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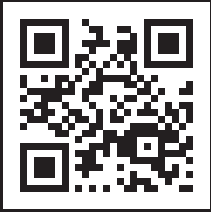
For further information go to the project website address:

http://www2.hull.ac.uk/science/geography/research/livestock_robotics.aspx

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