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UK agricultural students' perceptions of future technology use on-farm

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Abstract

Agricultural systems are currently experiencing a wave of new technological developments, which could lead to large and possibly disruptive changes in agricultural systems. So far, the adoption rates of new technologies have been highly variable, and attempts have been made to estimate adoption rates based on specific attributes of the technology and how it will be used, which can be difficult with new and emerging technology. An alternative approach is the Theory of Reasoned Action, published by Fishbein and Ajzen in 1975, which aims to explain how individuals will behave based on their existing attitudes and behavioural intentions and could be useful for examining the factors influencing adoption of future technologies. Current agricultural students are the farmers, researchers and rural professionals of the future. Their attitudes and beliefs towards technology will influence its integration into farming systems and how ethical concerns will have to be addressed. 300 current UK agricultural students participated in in an online survey; their perceptions around current and future agricultural technology developments were analysed using quantitative and qualitative methods. Results showed efficiency gains and improved management as the major perceived benefits of technology, while potential malfunction of and overreliance on technology were the main perceived risks.

Keywords

Theory of reasoned action, agricultural technology, on-farm, students' perception, farm management, technology use

Presenters Profile

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Dr Victoria Westbrooke undertakes research area in farm systems, linking biophysical science and human/social research. In particular, ways of sharing knowledge and information within agricultural systems, future technology and farm scale. To date Dr Westbrooke has been a dairy farm consultant in both NZ and the UK and have also worked in agricultural research. Currently she is based at Lincoln University in Canterbury, NZ where she teaches farm management at both undergraduate and post graduate levels.

Introduction

Agricultural systems are currently experiencing a wave of new technological developments, which could lead to large and possibly disruptive changes in agricultural systems (Small, 2017). To date, adoption rates of new technologies have been highly variable (Miller, Griffin, Ciampitti, & Sharda, 2018). They are influenced, amongst others, by associated investment needs (capital, learning), existing infrastructure, farm size, perceived risks, and the type of technology (level of complexity) (Finger, Swinton, El Benni, & Walter, 2019), and depend also on farmers characteristics, such as beliefs, risk aversion, age, education (Pannell et al., 2006). While adoption rates can be estimated based on specific attributes of the technology and how it will be used (Kuehne et al., 2017), it is difficult to estimate this for new and emerging technology. An alternative approach is the Theory of Reasoned Action (Fishbein & Ajzen, 1975), which aims to explain how individuals will behave based on their existing attitudes and behavioural intentions and could be useful for examining the factors influencing adoption of future technologies.

Workforces are changing and increasingly diverse with preference for variety, flexibility, and ongoing upskilling; recently there are initiatives trying to build on this, such as DairyNZ's New Workplace Design project (DairyNZ, undated). Agricultural students are the workforce of the future and their attitudes and beliefs towards technology will influence its adoption on farm. The aim of this study was to explore future agriculturalists views on the role of technology in farming systems, by investigating the following research objectives;

1. Identify and describe students' previous experience with agricultural technology.
2. Identify areas or tasks that students' value on farm (high job preference) and assess the beliefs and attitudes associated with them. Explore areas and tasks that students identify for technology to take over (low job preference). Focus on job satisfaction.

The research focussed on technology used in the operation and management of farms that is 'inside the farm gate' in the United Kingdom, with the potential to include other countries in future studies. Four types of technology were analysed: 1. Mobile phone applications (recording, collating and sharing of data), 2. Weeding robots and / or drones (autonomous weed control in pasture and crops), 3. Sensors which capture and analyse data (such as livestock collars, or sensors in combines), 4. Swarm robotics taking over farm operations (farmers role mainly to maintain robots and deal with non-standard problems).

Methods

An online survey was undertaken between 4th and 26th November 2019. Students studying agriculture and related topics at Harper Adams University were invited to participate. The survey gathered information on the students' background (age, gender, exposure to farming) and future plans (preferred job, subject area and sector). Students' views on four different types of agricultural technology (mobile apps, drone/robot, smart sensor and swarm robotics) were explored by asking the students' overall view of the technology, their level of knowledge of the technology and how they believed the technology would impact on different aspects of the farming system. The questions were either short answer or statements; the respondent was asked to rate the degree of agreement with a statement based on their experience or view. A Likert style scale from 1 (a great deal) to 5 (not at all) with word anchors at each point was used, based on trial students' rating preferences. The questionnaire was designed to take between 10-15 minutes. The project was approved by the Harper Adams Human Ethics committee, 15 October 2019. The data was analysed using SPSS (Statistical Programme for

Social Science, IBM) and Nvivo (qualitative data analysis software, QSR International, version 12). The qualitative data from the short answer questions is reported in this paper.

Results

In total 301 students completed the online questionnaire, with 300 usable surveys obtained. The majority, 95%, of the respondents were between 18 and 21 years old, with a minority aged over 22 years. There was a slightly higher proportion of male (53%) compared to female (46%) respondents to the survey. Overall, respondents had a high level of experience on farms with the majority of respondents (70%) brought up on a farm. The majority of the participants (73%) had worked on one to three farms for more than a month, and 14% had worked on more than five farms. Less than 2% had not worked on farms. The majority (83%) of respondents plan to complete a bachelors level qualification (BSc Hons), after which almost half (47%) would prefer an on-farm role, with just under a fifth (19%) planning to work as a rural professional, and very few preferring research or public sector roles.

Of the usable surveys, the short answer questions obtained 103 to 261 responses each (61% average response rate). Main topics identified by coding of open-ended questions identified four key topics: Efficiency, work environment and skills, perceived risks, and employment.

Efficiency was the biggest perceived benefit of technology with 264 references. Important subcategories were time effectiveness, better recording of data, communication / sharing of information, and productivity increase, with 51, 36, 26, and 23 references respectively. **Work environment and skills** were mentioned in 202 references, with making jobs easier (40) and management (36) references making up the majority of remarks. In terms of management, references focussed on 'improved, better, easier' management, often through reduced time in monitoring, but also mentioned the need for "different style of management for most businesses" and a general "shift towards more management positions or duties". Improved decision making (19), the need for different skills or knowledge (24), and tasks becoming more technical (22) were also frequently mentioned. 128 references were attributed to **perceived risks**. Views here were more widely spread, and are reflected in a higher number in sub-categories with fewer individual references, compared to previously identified topics. Above all, there seems to be a high concern for potential malfunction (28), followed by a feared overreliance on technology (18). A range of statements received between 11 and 5 references: less human interaction, the farmer seen as no longer farming, overcomplication, time consumption, increased loneliness, crime, lost skills, distraction, a disconnection of farmers to their work, and the fear of AI taking over. A reduction of standards, data privacy issues, noise, and a disconnection of consumers to farming received between 4 and 2 references each. In terms of **employment**, an interesting aspect was the clear distinction between labour reduction and unemployment, with some participants clearly expecting technology to cause unemployment (30 references), while the majority used the more neutral term of labour reduction (53 references), including a reduction in stress and workload, or freeing up hours to spend elsewhere on farm. 22 references were made to structural change, saying the new technology would "leave the older generation behind", and "pushing the older generation and poorer farmers out of the market". On the positive side, several references were made towards "attracting younger people" to agriculture with the increased use of technology.

Sentiment, costs and environmental aspects were also reported. Autocoding of the dataset suggested a relatively even spread of **sentiments**, with 144 positive (49 very positive and 95 moderately positive) and 141 negative (with 45 very negative and 96 moderately negative)

statements. Individual coding revealed following concerns: Emotional concerns (8 references) were raised about the lack of direct relationship to the animals, and changing farmers' traditional lifestyles: "Slowly we are getting replaced by machines like in many other working environments." Students mentioned specific concerns of trust (4 references) towards automated equipment: "I'd trust a labourer to do the work more than a machine depending on the task." **Cost** related aspects were mentioned 58 times. While 27 references assumed a reduction in costs – 12 of those through a reduction in labour cost – another 27 expected an increase of costs, mainly through direct investment cost, but 4 references specifying increased training costs. In contrast, improved financials via increased profitability and competitiveness were only mentioned 8 times. There were 37 references on **environmental aspects**, which focussed largely on soil compaction, although reduced emissions and inputs were also mentioned.

Discussion

An initial challenge was the categorisation of technology into four distinct types, and to explain these with enough detail to clarify each type, while being open enough to allow for individual experience and association.

Survey results showed efficiency gains and improved management as the major perceived benefits of technology, acknowledging the need for additional training and a different style of management as well as a changed skillset for it to work. A wide range of potential risks were identified, with malfunction of and overreliance on technology being the main concerns. In terms of its impact on employment, participants' views ranged from a reduction of stress and freeing up time for other activities, to a more negative view of causing unemployment. While acknowledging the attraction of younger people into agriculture with increased technology use, concerns were raised about leaving the older generation behind and pushing them out of the market. The results confirm previous findings of ethical concerns (Eastwood, Klerkx, Ayre, & Dela Rue, 2017) and the need for more training for agricultural students (Eastwood, Klerkx, & Nettle, 2017). It is notable that environmental impact references were almost exclusively made with respect to cropping, not the livestock sector, where comments focussed on health and welfare aspects. This raises the question if there is less awareness of the environmental impact of livestock, or on how technology can improve it.

The perceived risks should be viewed in light of their emotional aspect, such as less human interaction, increased loneliness, AI taking over and increased disconnection. These concerns represent fears which will likely influence the adoption of technology in the future. They can also provide constructive input for both technology providers and the education sector to address accordingly.

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