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Decision support tools for agriculture: Towards effective design and delivery

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ABSTRACT

Decision support tools, usually considered to be software-based, may be an important part of the quest for evidence-based decision-making in agriculture to improve productivity and environmental outputs. These tools can lead users through clear steps and suggest optimal decision paths or may act more as information sources to improve the evidence base for decisions. Yet, despite their availability in a wide range of formats, studies in several countries have shown uptake to be disappointingly low. This paper uses a mixed methods approach to investigate the factors affecting the uptake and use of decision support tools by farmers and advisers in the UK. Through a combination of qualitative interviews and quantitative surveys, we found that fifteen factors are influential in convincing farmers and advisers to use decision support tools, which include usability, cost-effectiveness, performance, relevance to user, and compatibility with compliance demands. This study finds a plethora of agricultural decision support tools in operation in the UK, yet, like other studies, shows that their uptake is low. A better understanding of the fifteen factors identified should lead to more effective design and delivery of tools in the future.

1. Introduction

Decision support tools (DST) are designed to help users make more effective decisions by leading them through clear decision stages and presenting the likelihood of various outcomes resulting from different options (Dicks et al., 2014; Parker, 2004). These can be dynamic software tools, whose recommendations vary according to the user's inputs, and they may suggest an optimal decision path. For farmers, and their advisers, software tools can facilitate effective farm management by recording data efficiently, analysing it, and generating a series of evidence-based recommendations (Rossi et al., 2014). Other DST may not be dynamic but act more as information sources. However, despite their apparent value the uptake of DST by farmers and advisers in the UK, and elsewhere, has been limited (Alvarez and Nuthall, 2006; Gent et al., 2013; McCown, 2002; Parker et al., 1997). There has been relatively little investigation into decision support uptake by farmers in the UK, but studies elsewhere (e.g. Australia, Belgium, Italy) have developed a number of important characteristics that determine use (Hochman and Carberry, 2011; Kerr, 2004; Kerselaers et al., 2015; McCown, 2012; Rossi et al., 2014). Research into appealing characteristics has also been undertaken in different disciplines, especially medicine; this work provides useful insights for an agricultural audience (Shibl et al., 2013; Venkatesh et al., 2012). Yet despite sustained interest from inter-disciplinary researchers, uptake is still low. This is especially problematic since projects to design DST are often expensive.

In this paper, we do not seek to argue that farmers and advisers should use multiple DST, since the quality and effectiveness of tools is more important than the quantity used. Rather, we note that there are already a number of high-quality DST available, with many more in the conception and design phase. Therefore, to assist the delivery of existing tools, and the design of future tools, we identify a number of key characteristics affecting the use of DST by farmers and advisers in the UK. We identify fifteen factors that should be considered in the design and delivery of successful DST. Many of these are relevant to software-based, app-based, or paper-based tools, and also to tools

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developed outside of the UK. If the designers of DST can be encouraged to apply the findings from this study as a checklist against which to measure the quality of new tools, then the likelihood of a tool's uptake in on-farm decision making will be increased.

2. Methods

2.1. Expert-collated list

Based on a broad definition of a decision support tool, which includes bespoke or generic software, email/text alerts, online calculators or guidance, phone apps, and paper-based guidance, an initial list was created of tools that could contribute to a farming decision (including business decisions) in the UK. As a consequence, decision support tools (DST) relating to many aspects of farm management were eligible for the list, including business and accounting tools and general information sources. The list does not include 'human-based' decision support tools, such as advisers or peers. Full search terms, criteria for inclusion, details of experts, and the resulting list can be found in Appendix 1.

2.1.1. Compiling initial list

Firstly, a review of literature on DST identified a number of tools available for use in the UK. Secondly, an online search was undertaken through Google, in combination with the websites of large companies, levy boards and research organisations connected to the arable and livestock enterprises. Thirdly, a non-exhaustive list of apps was compiled by searching on both the Android and IoS app stores. The original list comprised 129 tools.

2.1.2. Adding to the list

The list was supplemented by agricultural experts, who were given the same definition of a decision support tool and the same criteria for inclusion. This list was sent to known experts, who were also encouraged to send it to colleagues. A designated space was left for respondents to add further DST to the list and these additions were checked on return. Experts returned 24 lists of tools within one month, with many of these including contributions from a number of different individuals. Of the 24 returned lists, five respondents across at least two enterprises could not make any further additions, and the list was closed upon the fifth non-addition. This list was then supplemented by a wider consultation of the IoS and Android app stores (see Appendix 1).

2.2. Survey

A survey of farmers was undertaken in seven study areas across England and Wales (Fig. 1). These areas were chosen to represent some of the key agricultural land use types and geographies across England and Wales as part of Defra's Sustainable Intensification Platform (SIP). A sample of farmers was drawn from Defra from the June Agricultural Survey Register (2013), which groups similar farms by type to allow comparison. Six different robust farm types were surveyed: 'Arable', 'Dairy, 'Lowland Grazing', 'LFA Grazing', 'Mixed', and 'General Cropping', which account for the vast majority of agricultural land cover (National Statistics, 2016).

The sample of farms in each survey area, provided by Defra/Welsh Government, was stratified to reflect the main farm types in each area. Any robust farm types accounting for less than 10% of the case study area population were excluded. Farms were selected to give good geographical coverage of each area. In addition, to be included in the sample each holding had to meet the criteria of being a 'commercial holding' as well as farming a minimum of 20 ha. Registered holders were sent an opt out letter giving five working days to opt out of being telephoned to be invited to take part in an interview. 220 farmers (approximately 14% of the original sample) chose to opt out and a further 611 (38%) were uncontactable (including those who never answered the phone or where contact details were incorrect), leaving an effective sample of 782. 244 of these responded positively when contacted and telephone and were then interviewed face-to-face.

The survey asked a range of questions relevant to on-farm decision-making (Appendix 2), but two questions in particular related to use of DST. Farmers were asked whether they used software, apps, or paper-based guidance to inform their decisions and asked to name up to three that they found most useful. A list of the most commonly used tools was generated and categorised by mode of delivery (Appendix 1).

The survey was quantitatively analysed to generate overall usage data, and to look for significant associations between the use of DST and other factors. Generalised linear models assuming a binomial

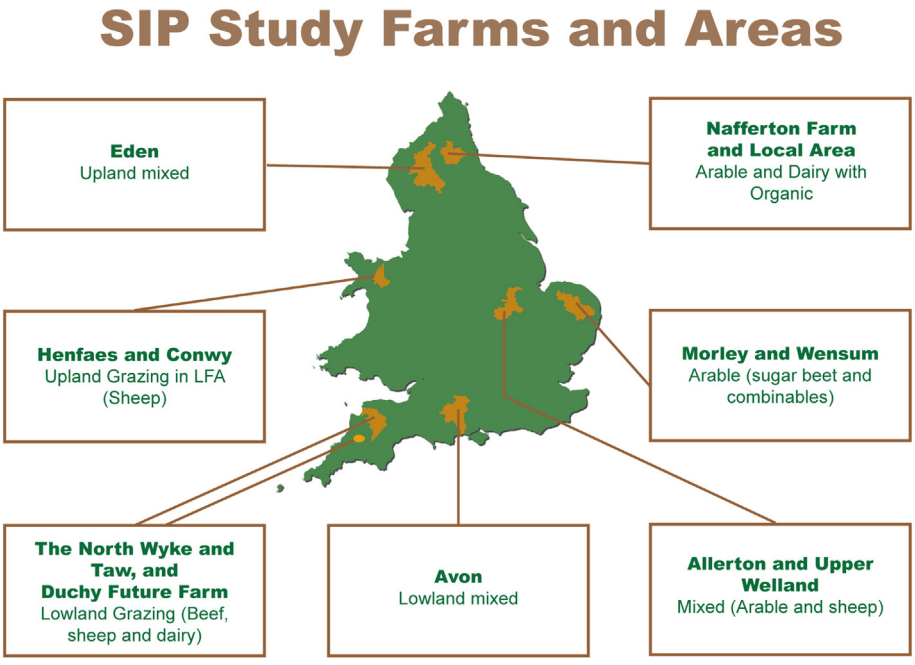

Fig. 1. Study areas for survey.