Article:
Little, R.A., Wheeler, K. and Edge, S. (2017) Developing a risk-based trading scheme for cattle in England: farmer perspectives on managing trading risk for bovine tuberculosis. Veterinary Record, 180 (6). p. 148. ISSN: 0042-4900

https://doi.org/10.1136/vr.103522

Developing a risk-based trading scheme for cattle in England: farmer perspectives on managing trading risk for bovine tuberculosis

Ruth Little BA (Hons), MRes, PhD[1]*

Karen Wheeler BSc (Hons)[2]

Stephen Edge BSc (Hons)[3]

[1] Department of Geography, The University of Sheffield, Sheffield, S10 2TN

Tel: 0114 222 7983 Email: ruth.little@sheffield.ac.uk

[2] ADAS UK Ltd, Pendeford House, Pendeford Business Park, Wobaston Rd, Wolverhampton, WV9 5AP

[3] ADAS UK Ltd, Pendeford House, Pendeford Business Park, Wobaston Rd, Wolverhampton, WV9 5AP

Developing a risk-based trading scheme for cattle in England: farmer perspectives on managing trading risk for bovine tuberculosis

Abstract

This paper examines farmer attitudes towards the development of a voluntary risk-based trading scheme for cattle in England as a risk mitigation measure for bovine tuberculosis (bTB). The research reported here was commissioned to gather evidence on the type of scheme that would have a good chance of success in improving the information farmers receive about the bTB risk of cattle they buy. Telephone interviews were conducted with a stratified random sample of 203 cattle farmers in England, splitting the interviews equally between respondents in the high risk area and low risk area for bTB. Supplementary interviews and focus groups with farmers were also carried out across the risk areas. Results suggest a greater enthusiasm for a risk-based trading scheme in low risk areas compared to high risk areas and amongst members of breed societies and cattle health schemes. Third party certification of herds by private vets or the Animal and Plant Health Agency were regarded as the most credible source, with farmer self-certification being favoured by sellers, but being regarded as least credible by buyers. Understanding farmers' attitudes towards voluntary risk-based trading is important to gauge likely uptake, understand preferences for information provision and to assist in monitoring, evaluating and refining the scheme once established.

Introduction

Bovine tuberculosis (bTB) is an infectious disease of cattle that can also affect humans and other species of domestic and wild animals (Godfray and others 2013). Disease incidence in cattle in England has continued to increase over the past three decades, with large parts of the South West and West of England now being categorised as endemic. The disease and the measures applied to control it have significant social and economic consequences for the farmers affected, resulting from movement restrictions, increased testing requirements and mandatory slaughter of animals (Department for Environment, Food and Rural Affairs 2014). Transmission routes for the disease remain poorly understood, but cattle movements are widely acknowledged as one of the primary drivers of infection (Godfray and others 2013). In areas where bTB is not endemic, animal movements account for the majority of herd incidents, principally through the movement of undetected infected cattle.

Risk-based trading has been proposed as a voluntary initiative designed to encourage cattle sellers to provide information on the bTB history of their herds and for buyers to routinely request information prior to making a purchase (Gibbons 2013). The aim is to help farmers to understand and manage the risks associated with introducing cattle into their herds. Similar attempts to manage epidemiological risk through trade have already been established in Australia (Cousins 2001, Adkin and others 2016), New Zealand (Enticott 2016) and the US (Horan and others 2015). Enticott (2016) characterises this as a trend as a move towards more neoliberal modes of governing animal disease, using market instruments to promote and influence disease management practices amongst farmers. For this more market-based approach to work, farmer confidence and participation is key (Adkin and others 2016).

In 2012, the Department for Environment, Food and Rural Affairs (Defra) established an advisory group, comprising industry stakeholders, to develop a set of recommendations for Government Ministers on the development of a risk-based trading scheme in England. This work was commissioned to provide data on the viability and potential uptake of the scheme. Separate epidemiological analysis and modelling of possible risk-based trading schemes was also prepared (Adkin and others 2016). To date, social scientific studies on risk-based trading in England have been lacking, but previous research on cattle control measures, such as the introduction of pre-movement testing in England and Wales (Christley and others 2010, 2011), underline the importance of investigating farmer attitudes and the potential impacts on cattle trading behaviours.

This research aimed to provide empirical evidence to help design and establish a risk-based trading scheme for cattle in England. Animal Health is a devolved issue in the UK so the proposals for a risk-based trading scheme apply to England only. The primary focus of the work was to gain insight into farmer enthusiasm for the scheme, likely uptake and views on practical implementation, including how farmers would prefer to receive bTB risk information and how it might be used in their cattle purchasing decisions. The specific objectives were to investigate the views of buyers and sellers of cattle that are moving between herds rather than to slaughter. This includes cattle that will become replacement breeding stock in the purchasing herd (either dairy or suckler), cattle that will be finished for beef and any other intermediate stages.

The research was conducted in late 2012. In the intervening period, additional cattle measures have been introduced including compulsory post-movement testing in the Low Risk Area (Defra 2016a) and a more robust approach for resolving TB breakdowns in the high risk area requiring two consecutive short interval herd tests with negative results, read under ‘severe’ interpretation, before restrictions are lifted (Defra 2016b). Whilst the policy environment has moved on, risk-based trading

remains a voluntary initiative. This research provides important baseline data against which to evaluate the scheme as it develops in the future.

Materials and methods

The research included a combination of qualitative and quantitative research activities, including a series of semi-structured interviews with farmers, veterinarians, auctioneers and other relevant organisations; three focus groups with cattle farmers in different bTB risk areas; and a telephone survey of 203 cattle farmers. The results of the telephone survey are the main focus of this paper, but illustrative quotes are drawn from the focus groups and the semi-structured interviews with 21 farmers conducted at auction marts in different bTB risk areas. The qualitative results are indicative rather than representative and are designed to supplement the quantitative findings. Full details of the quantitative and qualitative phases can be found in the final report submitted to the Bovine TB Risk-Based Trading Group (Defra 2016c).

The telephone survey was conducted between 29th October and 16th November 2012. It comprised a randomly selected stratified sample, designed to be representative of herd type, herd size, and cattle trading practices in England. The sample criteria stated that all eligible farms needed to have had a current herd size (January 2012) of more than 10, at least 5 batch movements (not to slaughter) in one of the last 3 years (2009 – 2011) of which at least two must have been an "on" movement.

A total of 1200 contacts that met the above criteria were selected at random by the Animal and Plant Health Agency (APHA) from the Cattle Trading System (CTS) database with the aim of conducting 100 interviews with farms on annual or 2 year whole herd testing (representing high and edge of risk bTB areas) and 100 with farms with a 3 or 4-yearly testing interval (low bTB risk). A total of 600 contacts were selected for each risk area and then the sample was further structured to ensure a representative sample of farms in terms of geographic spread, dairy versus beef holdings, herd size, history of bTB restricted movements, farm to farm and farm to market movements. The split by herd type achieved 30% dairy and 70% beef against a target of 33% dairy and 67% beef (reflecting the breakdown of herd types in England); a marginal under sampling of dairy herds (due in part to some dairy farms having ceased dairy farming and switching to beef production). The research was carried out during the transition from Parish Testing Intervals (PTIs) to the classification of 'high' 'edge' and 'low' risk areas. Table 1 provides a summary of the survey sample. As the number of farms drawn from the newly created 'edge' area was relatively small, the results will

predominately refer to 'high' and 'low' risk areas only. Attempts to contact farmers ceased once the threshold of 100 farms per area had been achieved.

The questionnaire was designed to cover details on trading cattle from both the buyer and seller perspective. Section one asked a generic set of questions on the type and number of cattle kept on farm, concluding with a question asking if any cattle had been brought onto the holding in the last 12 months (bought or hired in). Farmers answering 'yes' to this question then moved on to section 2 to answer a set of questions about their trading patterns for bringing in cattle; factors considered when bringing in cattle; if and how bTB risk was assessed and managed in making these decisions; and the perceived usefulness of a voluntary scheme for farmers bringing cattle onto their holding(s). Section 3 focused on farmers selling cattle, with questions on trading patterns for those moving cattle off holdings; current level of information provided for cattle when moved; and willingness of sellers to participate in a voluntary scheme.

Farmer responses were recorded, collated and analysed using SNAP software (dedicated survey software). Cross tabulation analysis was carried out for each question to enable differences between sub-groups to be explored. Specifically cross breaks were tabulated for the key sub-groups of TB risk area, herd type (dairy vs beef) and herd size. The differences between sub-groups were compared and tested for statistical significance using simple tests e.g t-test (to compare the means of two groups) or z-tests (to compare two percentage scores).

Results

Farm characteristics

Interviews were completed with 203 farmers covering a range of cattle enterprises. Of the 203 farmers interviewed, 59% had a suckler herd, 35% had a grower/finisher unit, 33% were involved with calf rearing, 28% reared heifers, 24% had a dairy herd and 2% were classed as 'other' (e.g. an exempt finishing unit). Table 2 provides a detailed breakdown of cattle enterprises by bTB risk area, herd type and herd size (based on the Animal and Plant Health Agency's record of cattle numbers in January 2012). The range of cattle enterprises reported was broadly similar across the different bTB risk areas with the exception of grower/finisher units that tended to be reported more often in high bTB risk areas.

Overall the majority of respondents (84%) stated that all their cattle were kept on one holding. The proportion tended to be higher in the low bTB risk areas (89%) compared with high risk areas (78%) and in small and medium sized herds (average 91%) compared with large herds (65%). Where

respondents reported more than one holding (n=33) 39% stated that they were in different bTB risk areas.

Trading patterns and purchasing rationales of farmers bringing in cattle

The majority of respondents (70%) reported that they had brought cattle onto their holding(s) in the previous 12 month period. Movements onto the holding(s) were unaffected by herd type or bTB risk area but there was a trend for larger herds to be more likely to have brought cattle in (76%) compared with small herds (63%). Respondents in high bTB risk areas were significantly more likely ($p<0.05$) to have brought in cattle for finishing than those in low bTB risk areas and significantly less likely ($p<0.05$) to have brought in cattle for further rearing (i.e. to be sold as stores or for breeding rather than to slaughter). Those in low bTB risk areas and with small herds reported bringing cattle in on fewer occasions than those in high bTB risk areas or with medium/large herds. Respondents with beef herds were more likely to report bringing in cattle on more than 10 occasions.

Markets were the most frequently mentioned source of cattle (55%), followed by direct movements from another farm (45%). Dealers or buying groups were only used by 8% of respondents and 5% reported other sources, including imports from other European countries or the return of their own stock from a rearing site. The source of stock varied according to the intended use of the animals. Animals intended for finishing were significantly more likely to be sourced from livestock markets or dealers/buying groups than direct from other farmers (Table 3).

Respondents were asked how much consideration they gave to a number of pre-defined factors when selecting animals. They were asked to provide a score based on a scale of 1 to 4, with 1 being 'not at all' and 4 being 'a great deal'. The quality of animals was ranked highest (3.60) by respondents irrespective of bTB risk area, herd type or herd size. Overall, the risk of bringing in bTB was ranked third (3.11) but for farmers in low bTB risk areas it was considered to be significantly ($p<0.05$) more important and was ranked as the second most important factor (3.35) compared with 4th choice for those in high bTB risk areas (2.88) (Table 4). These findings were echoed in the face-to-face farmer interviews and focus groups. Overall, choosing a healthy looking animal at the right price and right age to meet their farming needs was key (e.g. appropriate age for breeding).

Assessing and managing the bTB risk of cattle brought on to holdings

The majority of respondents felt that they were provided with sufficient information to adequately assess both the general health status (78%) and specifically the bTB status (77%) of animals they were bringing in. However differences between bTB risk areas were observed with respondents from

low bTB risk areas more likely to consider they had sufficient information to assess bTB status of cattle (87%) than those in high bTB risk areas (68%). Overall 16% of respondents (22% in high bTB risk areas) considered that they were not provided with sufficient information to assess the bTB status of animals they were bringing in and a small number (n=10, 7%) stated that they did not consider the bTB risk at all when bringing cattle onto their holdings. Seven of these were in a high risk area and three a low risk area. Respondents that moved cattle direct from another farmer were more likely to state that they had received sufficient information (84%) than those that had sourced cattle through a dealer or buying group (55%). Trust and familiarity with the seller were mentioned as key factors by face-toface interviewees and focus group participants, as demonstrated in the following quote:

> *"I still think trust plays a big part in it, because you mention about buying cattle from the same place, well you obviously trust that guy so you go back to that place….. We always ask their history, what they've had." (Focus group, low risk area)*

Of those that sourced cattle through markets 72% considered that they had received sufficient information to assess the bTB risk.

Respondents were asked what they currently do to minimise the risk of spreading bTB to their herd by bringing in animals from a high risk area. Differences were observed between respondents from low and high bTB risk areas. Of the 141 responses recorded 73% of farmers said they do not bring cattle in from high risk areas - the vast majority of these respondents (90%) farming in low bTB risk areas compared with 57% in high bTB risk areas. This finding was echoed in the qualitative results, with most interviewees in the low risk area stating that they would not buy animals from the high risk area. These interviews were carried out at an auction mart with close trading links into Scotland and respondents stated that maintaining this trade was a primary reason for their reluctance to purchase animals from areas on annual testing. Of the 21% of respondents that indicated they currently check that animals had been pre-movement tested, a significant majority farmed in high risk areas. Only 8% said they currently isolate and post movement test with a further 7% saying they implement 'other measures'. These other measures included trusting in the market to check necessary tests had been completed, avoiding older cattle and isolating cattle brought in for a period of time (without subsequent post-movement testing). Only 1% of respondents reported that they did nothing.

Respondents were asked about the potential usefulness of a range of information that could be provided to assist with assessing the bTB status of cattle brought onto their holdings. These

responses were graded on a scale of 1 – 4 where 1 was 'not at all' and 4 was 'very useful'. Overall, all sources were considered to be useful but the current herd bTB status (score 3.22) and the date of last bTB restriction (3.06) were scored most highly. In all cases respondents from low bTB risk areas tended to score the information more highly than those in high bTB risk areas (3.42 vs. 2.77). Respondents with dairy herds also tended to score all sources of information higher than those with beef herds (3.66 vs. 2.96). Information relating to animals moving from herds with a 4-yearly testing interval was considered particularly useful by respondents in low risk areas or with dairy herds (3.79 and 3.42 respectively).

Respondents were questioned about the credibility of bTB status information and the responses were graded in a similar way to before with a score of 1 being 'not at all credible' to 4 being 'fully credible'. Across all respondents, certification from the (private practice) vet was deemed to be marginally more credible than an official APHA letter (3.3 vs. 3.23) and both were rated as being more credible than self-certification by the farmer (2.54). This pattern was consistent across all respondents, irrespective of bTB risk area, herd type or herd size.

Perceived usefulness of a voluntary scheme for farmers bringing cattle onto holdings

Respondents who had brought cattle onto their holding(s) in the previous 12 months were asked whether a voluntary scheme in which sellers declared their herd's bTB status in a standardised format would be valuable to them. Overall 53% of respondents stated they would find a scheme valuable, 28% would not and 18% were not sure. Those in a low bTB risk area tended to be more likely to state they would find a scheme valuable (59%) than those in a high bTB risk area (47%). Herd size and herd type did not appear to affect the likelihood of a scheme being considered valuable to respondents. In face-to-face interviews with farmers in the high risk area, questions were raised on the value of a scheme focusing on cattle movements because the risk of disease spreading from neighbouring herds or wildlife was perceived to be constant. There was an appreciation that moving cattle from high risk to low risk areas may spread TB, but pre-movement testing was considered to be an adequate safeguard.

The influence of other factors that might affect respondents' views on a voluntary scheme were explored including age group, bTB restriction history and membership of other schemes (e.g. farm assurance schemes). Age of respondent affected the view of a voluntary scheme with those in the 56-65 and over 65 age groups significantly less likely (average 42%) to consider it valuable than those in the 46-55 age group (67%). Respondents whose herds had been under bTB restrictions in the previous

two years were also significantly less likely to consider the scheme valuable (6 out of 21, 29%) than those that had not experienced restrictions (69 out of 119, 58%).

Membership of other schemes also affected respondents' views on the value of a voluntary scheme with those that were members of a cattle health scheme or breed society more likely (69% and 65% respectively) to view a voluntary scheme as something they would find of value than those that were not members of any scheme (42%).

Trading patterns for those moving cattle off holdings

Overall 155 respondents (76%) reported that they had moved cattle off their holding(s) (other than to slaughter) in the previous 12 months. Movements off holding(s) were unaffected by herd size or bTB risk area but there was a tendency ($0.05<p<0.1$) for dairy herds to be more likely to have moved cattle than beef herds (85% vs. 73%). Those with small herds moved cattle on significantly fewer occasions than medium or large herds (90% reported moving cattle off on 1 -5 occasions vs. 48% for medium-sized herds and 52% for large herds) and beef herds were also more likely to report moving cattle off on fewer occasions than dairy herds (1-5 occasions 72% vs. 45%).

Markets were the most common sale route for cattle (72%) followed by movements direct to another farm (36%). Dealers or buying groups were used by 4% of respondents (particularly by large and dairy herds) and 5% reported other routes including movements to shows, isolation/finishing units or movements to temporary grazing.

Current level of information provided for cattle when moved

Respondents were asked about the information they provided when moving cattle off their holdings. Overall, they were most likely to provide information on pre-movement testing (60%), herd bTB status (56%) and whether the cattle were home-bred (56%). With the exception of information relating to bTB, the information provided was common across bTB risk areas, herd type and herd size. Those in high bTB risk areas were significantly more likely to provide information on herd bTB status (65% vs. 47%) and pre-movement tests (88% vs. 32%) than those in low risk areas. It should be remembered, however, that pre-movement tests are not required in low risk areas and so very few would have this information to share. Information relating to other disease status, vaccination or other details was less frequently given. A small number stated that they did not provide any information (7%). Where respondents had provided other information this was most likely to be information on pedigree/breeding (n=9), general husbandry (such as calving dates, castration etc.) and worming (n=11) or farm assurance details (n=7).

Respondents were asked how useful they thought a range of channels would be for providing information to buyers about bTB status. The mean scores (on a 1 – 4 scoring system) are in close agreement with the scores given by farmers bringing cattle onto their holdings (and in many cases respondents may be both buyers and sellers). The auctioneer and the sale catalogue were considered the most useful channels to provide information (2.93 and 2.91 respectively) whilst a separate bTB document or online system was considered least useful (2.40 and 2.37 respectively).

Respondents were asked how willing they would be to provide information on their herd's TB status through self-certification, an official APHA letter or veterinary certification. The vast majority (86%) stated they would be willing to provide information through self-certification. Overall, 74% would be willing to provide a veterinary certificate and 69% an official APHA letter. In the last two cases, respondents in high bTB risk areas were significantly more willing to provide information than those in low risk areas. This may reflect the fact that animals moving from herds in high risk areas will have been pre-movement tested, and the farmer provided with a copy of the Tuberculin Test Certificate to verify this. In low risk areas, animals are not required to be pre-movement tested and hence farmers would need to actively seek additional certification. Respondents who were willing to provide vet/APHA information were, however, cautious (irrespective of risk area) about additional costs and paperwork associated with these. These sentiments were echoed in the face-to face interviews and focus groups, with one participant providing the summary that, *"you don't want all this paperwork; you want something simple to tell you it's a clear healthy animal to buy"* (Focus group, low risk area).

Where respondents had stated that they were not willing to provide information through the above routes, the reasons given included: their trade may be adversely affected; additional paperwork and/or costs; adequacy of the existing system; and questions over the trustworthiness of self-certified information. These themes were also addressed in the face-to-face interviews and focus groups, with particular emphasis given to the potential negative implications of the scheme for sellers recently under restriction or with a history of TB breakdowns. The potential negative impact on sales was highlighted in the high risk area:

> *"We've got to talk from a seller's point of view and I don't think it's a good idea at all, I'm happy to provide the date of the last test but I wouldn't want to provide my TB status… I don't want them to know how many times I've had TB in the last 10 years."* (Focus group, high risk area)

There was also general concern that if farmers were required to give information about when they were last under TB restrictions, it would stigmatise those who have recently had TB on their farms.

Willingness of sellers to participate in a voluntary scheme

Overall 65% of respondents that had moved cattle off their holdings in the previous 12 months (n=100 out of 155) indicated that they would be willing to participate in a voluntary scheme in which sellers would declare their bTB status in a standardised format. Although there was slightly more interest amongst those from high bTB risk areas differences were not significant. A fifth of respondents (20%) stated that they would not be willing to participate and the remaining 16% were unsure.

Many of the respondents provided additional comments to qualify their response. Those that were willing to participate (n=39 that commented out of 100) stated that sharing information would be helpful in tackling the bTB problem (n=21). Other noted that they were either already employing the principles of risk-based trading or that they had no objections to the scheme because they had nothing to hide. Those unwilling to take part (n=28 that commented out of 31) thought that they we already providing enough information (n=8) or didn't want any additional paperwork, complications or costs (n=8) that may result from the new scheme. Those that were unsure (n=16, that commented out of 24) also had concerns about increased paperwork and cost burdens, had questions about the value or relevance of the scheme, or wanted more information before making a decision.

Discussion

To date, there has been limited empirical research on farmers' attitudes to a risk-based trading scheme for cattle in England. Critical determinants for its relative success are farmers' enthusiasm for and willingness to take part in the scheme, underpinned by the perceived relevance of bTB risk to their herds; the types of information required by buyers and the willingness of sellers to provide it; and the practical mechanics of how the scheme should function, including the mode by which information should be conveyed and how the scheme should be certified. As the current scheme is voluntary, an understanding of farmer attitudes and their rationale is critical, as has been evidenced by recent work on the Badger Vaccine Deployment Programme (Enticott and others 2012; Maye and others 2013) and on the risk-based trading scheme currently operating in New Zealand (Enticott 2016). As Enticott (2016) concludes, the relative success of market instruments such as risk-based

trading are closely tied to farmers' existing values, attitudes and practices. It is, therefore, important to appreciate the factors that may limit or promote uptake of the scheme.

The survey results point to a number of factors particularly relevant to those tasked with promoting and implementing risk-based trading.

First, the perceived value of the scheme was mixed. Approximately half (53%) of farmers who had brought cattle onto their holding thought that a scheme providing information on bTB status in a standard format would be valuable. This figure could have been influenced by the relatively high percentage of respondents reporting that they already received sufficient information on bTB when purchasing cattle direct from other farmers, or through markets. Second, there was spatial variation in farmers' enthusiasm for the scheme and in the consideration given to bTB risk when purchasing cattle into the herd. Farmers in low risk areas displayed greater interest in asking for information on bTB status and ranked bTB risk as a more prominent factor influencing their decision-making. Reasons for this spatial difference in receptivity to the scheme could be linked to the fatalism (Enticott 2008, Enticott and Vanclay 2011), perceived lack of control over the disease situation (Naylor and Courtney 2014) and generally low level of confidence in bTB control measures (Bennett and Cooke 2005, Enticott, et al. 2011) reported by farmers in previous studies in the high risk area. Third, younger respondents (particularly in the 46-55 age cohorts) were significantly more likely to state that they would find such a scheme valuable. And finally, memberships of breed societies and cattle health schemes were also associated with a greater degree of interest in risk-based trading.

When assessing options for the practical implementation of risk-based trading, the survey provides insight into the types of information and preferred modes of information provision requested by farmers. The most useful information was considered to be current herd bTB status and date of last bTB restriction. The vast majority of respondents moving cattle off their holding stated that they would agree to providing information via self-certification, closely followed by provision of veterinary certificate and an official APHA letter. However, from the buyers' perspective, self-certification was rated as the least credible source. Trust and confidence have been identified as important factors in determining farmers' acceptance of new bTB control measures (Enticott and others 2012), indicating that the buyers' perception of what is credible is arguably as important as taking into account what the seller is willing to provide. In line with previous research (Enticott and Vanclay 2011, Fisher 2013) the private practice vet was considered to be the most credible source to provide certification.

Finally, like any new intervention in animal disease control, there is a need to closely monitor the development of risk-based trading over time and evaluate the impact that it has on trading patterns and disease risk once it has become fully established. The results presented here provide important baseline data on farmers' enthusiasm (as an indicator for likely uptake) for the scheme and preferences for practical implementation. Further research will be required to understand if, how and why farmers apply the principles of risk-based trading in mitigating the risk of bTB entering their herd. Such data would assist in evaluating the relative success of this voluntary scheme and inform future decisions as to whether a regulatory approach would be required.

Tables

Table 1: Summary of the survey sample (percentage)

		TB risk area				Herd type	
		Low risk 101 (49.8%)		High risk 102 (50.2%)		Dairy	Beef
	Total	PTI4	PTI3	PTI2	PTI1		
Number of farms (%)	**203**	97 (48%)	4 (2%)	19 (9%)	83 (41%)	60 (30%)	143 (70%)

Table 2: Cattle enterprises reported by respondents by TB risk area, herd type and herd size – number reported (percentage)

	Total	TB risk area		Herd type		Herd size*		
		Low	High	Dairy	Beef	Small	Medium	Large
Base	**203**	101	102	60	143	68	81	54
Dairy herd	**49 (24%)**	23 (23%)	26 (26%)	48 (80%)	1 (1%)	3 (4%)	16 (20%)	30 (56%)
Suckler herd	**120 (59%)**	63 (62%)	57 (56%)	11 (18%)	109 (76%)	51 (75%)	48 (59%)	21 (39%)
Grower/finisher unit	**70 (35%)**	28 (28%)	42 (41%)	14 (23%)	56 (39%)	16 (24%)	33 (41%)	21 (39%)
Calf rearing	**66 (33%)**	32 (32%)	34 (33%)	34 (57%)	32 (22%)	16 (24%)	23 (28%)	27 (50%)
Heifer rearing	**57 (28%)**	30 (30%)	27 (27%)	34 (57%)	23 (16%)	12 (18%)	22 (27%)	23 (43%)

Exempt finishing unit, approved finishing unit, approved quarantine unit	**4 (2%)**	2 (2%)	2 (2%)	2 3%)	2 (1%)	1 (2%)	2 (3%)	1 (3%)

* Herd size: Small – up to 50 cattle, Medium 51 to 150, large >150.

Base: all respondents

Table 3: Sources of cattle brought onto holding(s) by TB risk area, herd type and herd size – number reported (percentage)

	Total	TB risk area		Herd type		Herd size*		
		Low	High	Dairy	Beef	Small	Medium	Large
Base	**141**	69	72	41	100	43	57	41
Market	**78 (55%)**	36 (52%)	42 (58%)	20 (49%)	58 (58%)	25 (58%)	33 (58%)	20 (49%)
Direct from another farmer	**64 (45%)**	29 (42%)	35 (49%)	18 (44%)	46 (46%)	16 (37%)	28 (49%)	20 (49%)
Dealer/buying group	**11 (8%)**	6 (9%)	5 (7%)	0 (0%)	11 (11%)	2 (5%)	7 (12%)	2 (5%)
Other source	**7 (5%)**	5 (7%)	2 (3%)	5 (12%)	2 (2%)	1 (2%)	2 (4%)	4 (10%)

* Herd size: Small – up to 50 cattle, Medium 51 to 150, large >150.

Base: 141 respondents that had brought cattle on in the last 12 months

Table 4: Consideration given to a range of factors when bringing cattle onto holding(s) by TB risk area and herd type and herd size – mean score (on a scale of 1-4 where 1 = not considered at all and 4 = considered a great deal)

	Total	TB risk area		Herd type		Herd size*		
		Low	High	Dairy	Beef	Small	Medium	Large
Base (number)	**141**	69	72	41	100	43	57	41
Quality of the animal	**3.60**	3.63	3.57	3.54	3.62	3.60	3.46	3.78
Price of the animal	**3.28**	3.23	3.33	3.08	3.36	3.50	3.31	3.03
Risk of bringing in TB	**3.11**	3.35	2.88	3.29	3.03	3.20	2.95	3.22
Risk of bringing in other diseases	**3.07**	3.07	3.07	3.20	3.02	2.98	3.07	3.17
Being able to source them from a dealer or 3rd party	**2.20**	2.26	2.16	2.11	2.24	1.86	2.14	2.36

* Herd size: Small – up to 50 cattle, Medium 51 to 150, large >150.

Base: 141 respondents that had brought cattle on in the last 12 months

Funding

This research was funded by the Department for Environment, Food and Rural Affairs, project code SE3048. The funder provided comments on the research design, data collection, analysis and results. The decision to submit the paper for publication was taken by the authors.

References

ADKIN, A., BROUWER, A., SIMONS, R. R. L., SMITH, R. P., ARNOLD, M. E., BROUGHAN, J., KOSMIDER, R. & DOWNS, S. H. (2016). Development of risk-based trading farm scoring system to assist with the control of bovine tuberculosis in cattle in England and Wales. Preventive veterinary medicine, 123, 32-38

CHRISTLEY, R. M., ROBINSON, S. E., MOORE, B., SETZKORN, C., & DONALD, I. (2011). Responses of farmers to introduction in England and Wales of pre-movement testing for bovine tuberculosis. Preventive veterinary medicine, 100(2), 126-133

COUSINS, D. V. (2001). Mycobacterium bovis infection and control in domestic livestock. Revue scientifique et technique (International Office of Epizootics), 20(1), 71-85

BENNETT, R., & COOKE, R. (2005). Control of bovine TB: preferences of farmers who have suffered a TB breakdown. Veterinary Record, 156(5), 143-145

DEFRA (2013) Bovine TB Risk-Based Trading: Empowering Farmers to Manage TB Trading Risks. London, Defra

DEFRA (2014) The Strategy for Achieving Officially Bovine Tuberculosis Free Status for England. London, Defra

DEFRA (2016a) Bovine TB Information Note 01/16: Compulsory post-movement testing in the Low Risk Area. London, Defra

DEFRA (2016b) Bovine TB Information Note 02/16: A more robust approach for resolving TB breakdowns in the High Risk Area of England. London, Defra

DEFRA (2016c) Farmer attitudes to risk based trading scheme for cattle in England. Project code: SE3048

ENTICOTT, G. (2008). The ecological paradox: social and natural consequences of the geographies of animal health promotion. Transactions of the Institute of British geographers, 33(4), 433-446

ENTICOTT, G. (2016). Market instruments, biosecurity and place-based understandings of animal disease. Journal of Rural Studies, 45, 312-319

ENTICOTT, G., & VANCLAY, F. (2011). Scripts, animal health and biosecurity: The moral accountability of farmers' talk about animal health risks. Health, Risk & Society, 13(4), 293-309

ENTICOTT, G. P., MAYE, D., ILBERY, B., FISHER, R., & KIRWAN, J. (2012). Farmers' confidence in vaccinating badgers against bovine tuberculosis. Veterinary Record, 170(8)

FISHER, R. (2013). 'A gentleman's handshake': The role of social capital and trust in transforming information into usable knowledge. Journal of Rural studies, 31, 13-22.

GIBBENS N (2013) Bovine TB: Implementing risk-based trading. Veterinary Record 173:22 557-558

GODFRAY H. C., DONNELLY C. A., KAO R. R., MACDONALD D. W., MCDONALD R. A., PETROKOFSKY G., WOOD J. L., WOODROFFE R., YOUNG D. B. & MCLEAN A. R. (2013) A restatement of the natural science evidence base relevant to the control of bovine tuberculosis in Great Britain. Proceedings of the Royal Society B: Biological Sciences 280, 20131634

HORAN, R. D., FENICHEL, E. P., FINNOFF, D., & WOLF, C. A. (2015). Managing dynamic epidemiological risks through trade. Journal of Economic Dynamics and Control, 53, 192-207

MAYE, D., ENTICOTT, G., ILBERY, B., FISHER, R., & KIRWAN, J. (2013). Assessing farmer confidence in badger vaccination: some findings from a survey of cattle farmers in England. Journal of Rural and Community Development, 8(3), 49-64

NAYLOR, R., & COURTNEY, P. (2014). Exploring the social context of risk perception and behaviour: Farmers' response to bovine tuberculosis. Geoforum, 57, 48-56