Farming on the Edge: Farmer Attitudes to Bovine Tuberculosis in Newly Endemic Areas

Enticott, G. [1 *]
Maye, D. [3]
Carmody, P. [6]
Naylor, R. [4]
Ward, K. [1]
Hinchliffe, S. [5]
Wint, W. [7]
Alexander, N. [7]
Eglin, R. [2]
Ashton, A. [2]
Upton, P. [2]
Nicholson, R[2]
Goodchild, A.V. [2]
Brunton, L. [2]
Broughan, J.B. [2]

* Corresponding author (Enticottg@cardiff.ac.uk)
[1] School of Planning and Geography, Cardiff University, UK.
[2] Department of Epidemiological Sciences, Animal and Plant Health Agency, Weybridge, UK.
[3] Countryside and Community Research Institute, Gloucester University, UK
[4] Royal Agricultural University, Cirencester, UK.
[5] Department of Geography, Exeter University, UK.
[6] Agile Information, London, UK.
[7] ERGO, Oxford University

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Abstract

Defra's recent strategy to eradicate bovine tuberculosis (bTB) establishes three spatial zones: High and Low Risk Areas (HRA and LRA), and an area referred to as 'the Edge', which marks the areas where infection is spreading outwards from the HRA. Little is known about farmers in the Edge area, their attitudes towards bTB and their farming practices. This paper examines farmers' practices and attitudes towards bTB in standardized epidemiologically defined areas. A survey was developed to collect data on farmer attitudes, behaviours, practices and environmental conditions as part of an interdisciplinary analysis of bTB risk factors. Survey items were developed from a literature review and focus groups with vets and farmers in different locations within the Edge area. A case-control sampling framework was adopted with farms sampled from areas identified as recently endemic for bTB. 347 farmers participated in the survey including 117 with bTB, representing a 70% response rate. Results show that farmers believe they are unable to do anything about bTB but are keen for the Government intervention to help control the spread of bTB.

1. Introduction

The spread of bovine tuberculosis (bTB) from southwest and west England is of concern to policy makers, vets and cattle farmers. In response, Defra's (2014) strategy to achieve officially TB free status for England divides the country into three distinct spatial units in an attempt to stem the eastwards and northwards spread of bTB. The High and Low Risk Areas (abbreviated to HRA and LRA) are separated by an area called the Edge Area (abbreviated 'the Edge'). According to Defra's strategy, the Edge marks areas defined as endemic of at high risk of endemicity as a result of spread from the HRA. Within the Edge, Defra has since 2013 strengthened the routine surveillance testing regimen and the TB incident control policy in cattle herds, supported voluntary vaccination of badgers against TB and funded specific research in order to contain and reverse the spread of bTB.

The creation of the Edge area focuses attention on those areas and farms that have recently become endemic for bTB. However, little is known about the attitudes and farming practices of farmers that live and work in such areas that may affect the spread of bTB. Recently, it has been recognized that social research is important in animal disease policy: understanding farmers' behaviours and understanding of bTB can help

develop better bTB policy (Enticott 2008; Enticott and others 2012; Warren and others 2013). Existing social research tends to apply to farmers in high-risk bTB areas, although few studies provide clear definitions of what constitutes a high-risk area. This is important because preventive disease attitudes and behaviour are informed by actual or perceived disease incidence (Champion and Skinner, 2008).

Knowledge of farming practices and farmers' attitudes towards bTB in areas that have recently become endemic for bTB may prove valuable for policy makers attempting to design effective bTB interventions. The aim of this paper is therefore to provide a descriptive account of farmers' behaviours, attitudes and farm management practices that could influence the spread of bTB, stratified by the farmer's disease experience. To do this, the paper draws on a new method of epidemiologically defining the bTB status of areas of England and Wales to identify and collect data from farmers in areas that have recently become endemic for bTB. The paper represents the first attempt to organize social research of bTB around detailed epidemiological mapping of bTB.

2. Materials and Methods

Farmer Survey

A survey was developed as part of an interdisciplinary study to investigate the factors that affect the spread of endemic bTB. It is increasingly recognized that solutions to complex policy problems such as bTB require input from a range of disciplines across the natural and social sciences (Kristensen and Jakobsen 2011; Wentholt and others 2012). Interdisciplinary approaches can contribute to the acceptance of scientific knowledge where they involve stakeholders in the shared production of scientific knowledge by developing trust and 'scientific citizenship' amongst social groups such as farmers and vets (Irwin 1995). Previous studies have highlighted how lack of trust in science and/or the institutions related to scientific knowledge is an important limitation to bTB policy (Enticott, 2008).

In order to investigate the spread of endemic bTB, the study combined approaches from epidemiology, spatial modeling and social research. A survey instrument was developed

to generate data on farmer attitudes, behaviours, practices and environmental conditions. Survey items were developed, firstly, from a large-scale review of the existing scientific literature and expert opinion, and secondly from nine focus groups with vets and farmers in different locations within the Edge area (including, Cheshire, Leicestershire and Nottinghamshire). The role of the focus groups was to identify environmental and behavioural risk factors for bTB that farmers and vets felt were important. Participants discussed the nature of bTB spread in their areas before identifying and rating those risk factors they felt were most important in a deliberative consensus exercise.

Risk factors identified by these methods for which secondary data were not already available were included in the survey. These included: farm management information; biosecurity activities; farm fragmentation; concurrent disease; within-farm cattle movements; flooding history; and presence of maize. Behavioural risk factors were informed by the focus groups but also reflected conceptual models of preventive health behaviour, specifically the health belief model (Champion and Skinner 2008). The survey included items on farmers' own perceptions of bTB risks and threats; their locus of control, including self-efficacy (i.e. their perceived ability to control disease) and the influence of others to reduce bTB (such as other farmers and vets); their connectedness to others (e.g. farmers and vets) who could help and advise at times of crisis; and their openness to new ideas and initiatives to control bTB (specifically the disclosure of bTB status to all farmers).

Survey items required responses to categorical options or along a scale. Data on farmers' perceptions were collected on a five point likert scale ranging from strongly disagree (1) to strongly agree (5). One item on the perceived speed of bTB spread in farmers' own area required a response along a ten point scale (1 = not at all, 10 = rapidly).

Sampling

The Edge Area was created from existing institutional (County) boundaries and local veterinary epidemiological knowledge, and therefore contains areas with different incidence of bTB. Using Defra's Edge areas as a sampling framework may therefore incur

ecological fallacies (Openshaw 1984). In addition, the Edge area only covers England, yet areas of Wales are also vulnerable to the spread of endemic bTB. Instead, a sampling procedure was derived from the objective definition and mapping of bTB spread. A mathematical definition of endemicity was developed using bTB surveillance data from which the expansion of the area affected by endemic bTB through time was mapped (Brunton and others 2015). Hexagonal cells were overlaid on a map of England and Wales and gained endemic status based on the distance to the third nearest bTB breakdown on a two yearly basis between 2002 and 2011. Analysis focussed only on herds classified as Officially Tuberculosis Free Status Withdrawn (OTF-W) following detection of skin test reactors with typical lesions of TB at post-mortem examination or animals with bacteriological test results positive for *Mycobacterium bovis*. The rate of spread of endemic bTB across these cells was calculated for the year in which the spread occurred (see Brunton and others 2015 for more details). Farms in cells that gained their endemic status from 2006 onwards were considered to be "recently endemic" and formed the survey population. The sampling framework therefore permits meaningful comparisons to be drawn between farmers' in different areas based on a precise epidemiological calculation of bTB endemicity and spread. The calculation of recently endemic areas identifies farms in both Edge and HRA risk areas enabling comparisons to be made between these areas which could be useful for policy makers given that different management interventions are planned for each.

The wider interdisciplinary project aimed to investigate the role of different risk factors in the spread of bTB. For this reason, a case-control research design was adopted. Potential participants were sampled from the Animal and Plant Health Agency's (APHA) SAM bTB database (see table 1). The sampling criteria provided 284 eligible case herds (i.e farms that had had a bTB OTF-W breakdown) and 2,369 control herds (i.e farms with no history of a bTB OTF-W breakdown) and so were potential controls. Cases were matched to up to five selected controls to improve the probability of attaining a 1:2 ratio of cases to controls. Farms were also matched for herd type, high or low rates of bTB spread and location to within 25km. A target of 40 dairy herds was set to ensure sufficient statistical in an analysis stratified by herd type. Control farms were randomly selected from among those that met the matching criteria. Randomisation was

conducted using an MS Access VBA script interrogating the APHA SAM database. A herd could not be a control for more than one case.

Piloting

Ethical approval for the survey was received from the Research Ethics Committee at Cardiff University and received approval from Defra. The survey was piloted with 5 farmers prior to use, leading to some changes in wording to survey items. Following the pilot, the survey was conducted between April – May 2014 by eight interviewers. All interviewers attended a training day to ensure that each adopted the same approach during the survey. The survey was delivered via telephone and was approximately 20 minutes duration.

Analysis

Survey responses were entered directly into an Access database during the telephone survey. These data were converted to SPSS format for analysis. Data were summarized according to characteristics of farmers. For this paper, separate descriptive analyses are presented for cases (recently bTB infected farms) and controls (bTB free farms) in relation to farmers' behaviours and perceptions of bTB. Median responses are reported in the analysis and full descriptive statistics in supplementary evidence. Chi square tests and independent samples t-tests were used to detect for statistically significant differences between farms in the Edge and HRA. The level of statistical significance was set at $p<0.05$. Future analyses will explore the relationship between bTB status and environmental and social risk factors.

3. Results

i. Survey Response

A total of 347 farmers agreed to participate in the survey, whilst 146 refused to participate. The most common reasons for refusing to participate in the survey were: not having enough time (20), not being interested in the research (24), and not wanting

to talk about bTB (24). Eleven potential respondents could not be contacted and were replaced with a matching farm from the control or case samples. In all cases, at least five attempts were made to contact respondents before substituting an alternative farm. This was particularly important given the limited number of case farms and the need for accurate matching. Data cleansing reduced the sample to 346: one control farm was discovered to have had a bTB breakdown after the sample was constructed. Most respondents were male (80%) and aged over 55 (52%). Few respondents were aged under 40 (8%). Of the 346 farms surveyed, 160 were in the Edge area as defined by Defra with the remainder in the HRA.

Table 2 describes the herd characteristics of survey respondents. Of the 346 farms surveyed, 117 had experienced an OTF-W bTB breakdown between 2010 and 2013, whilst 229 had no history of bTB. A large proportion (45%) of farms also had sheep on their farm, but few had farmed deer (n=1) or alpacas (n=2). More beef farmers (n=213) than dairy farmers (n=133) were surveyed. Of those with a recent breakdown, 46 were dairy farms and 71 beef farms, and 32 were under bTB restrictions at the time of the survey (15 dairy and 17 beef). Of those with no history of disease, 87 farms were dairy farms and 142 beef.

ii. bTB Free Farms

Biosecurity Practices

Farms with no experience of bTB in recently endemic areas were largely self-contained (63%). Of those with field parcels away from the main enterprise, half of these were within 3.2km. A third reported nose-to-nose contact was possible with cattle on neighbouring farms. Half of these farms had 70 animals or fewer and were 56.6 hectares or less.

Almost two-thirds (62%) of these farmers purchased animals in the past year. Levels of cattle purchasing biosecurity were moderately high. More than half (59%) of farmers who had purchased cattle said they avoided buying from herds in areas considered high risk or enquired as to the bTB history of the herd (50%). Nevertheless only 27% isolated purchased cattle for >60 days. The implementation of badger biosecurity measures was

less popular. Measures to stop badgers from entering cattle housing or to stop badgers accessing feed stores or silage clamps were implemented by 12% and 24% of farmers. Just 10% used fencing to prevent cattle accessing badger setts or latrines whilst 31% raised feed and water troughs. Only 19% reported altering grazing strategies to avoid fields that posed a high bTB risk. 74% of these farmers reported badger activity on their farm.

Perceptions of bTB Spread and Endemicity

Farmers with no history of bTB perceived it's spread to be occurring at a relatively fast rate with half of them scoring 6 (on a scale of 1 = not at all, 10 = rapidly) but were undecided on whether their local parish was endemic (median 3 on a scale of 1 (strongly disagree) to 5 (strongly agree)). They agreed to feeling under threat from bTB (median 4), and were more likely to attribute that threat to badgers (median 4) than neighbouring cattle (median 3), even if only half of them thought that bTB was endemic in the local badger population (median 3).

Farmers' Views of bTB

Despite no experience of bTB, control farmers expressed low levels of self-efficacy in relation to bTB. Farmers disagreed that they could control whether their herd became infected with bTB (median 2) and agreed that it was just a matter of luck (median 4). They were undecided whether anyone could help them avoid bTB, whether that assistance came from their vet, other farmers or government advice (medians all 3). In terms of social connectivity, farmers agreed that their neighbours would help them out in the event of a problem and regularly talked to them about bTB (medians 4). Most farmers thought they were able to get advice about bTB if they needed it, and agreed that their vet or vets in APHA could provide that information (medians 4), but were less likely to search the internet for advice. Reflecting their low levels of self-efficacy, farmers were not worried what other farmers thought of them if they had a bTB outbreak (median 2). Nevertheless, they agreed that farmers who get bTB should tell their neighbours and that vets or APHA should be allowed to inform farmers who has bTB locally (medians 4). Moreover, farmers supported the idea that Defra should regularly publish the locations of all bTB breakdowns (median 4).

iii. Case Farms

Biosecurity Practices

Farms with a history of bTB had a range of farm structures but over half (57%) had at least one additional block of land set apart from the main farm. Of those with field parcels away from the main enterprise, the median distance was 6.43km. A third reported nose-to-nose contact was possible on their fields. Median herd size was 200 and median farm size was 116.7 hectares.

Nearly three quarters (74%) of farmers with a bTB history purchased animals in the last year. Of these, 67% avoided buying from herds in areas considered high risk or enquired as to the bTB history of the herd (58%) and 29% isolated purchased cattle for >60 days. The implementation of badger biosecurity measures was less popular with 34% of these farmers reporting implementing measures to stop badgers from entering cattle housing, and 39% implementing measures to stop badgers accessing feed stores or silage clamps. 23% used fencing to prevent cattle accessing badger setts or latrines whilst half raised feed and water troughs. 22% reported altering grazing strategies to avoid fields that posed a high bTB risk. 77% of these farmers reported badger activity on their farm.

Perceptions of bTB Spread and Endemicity

Farms with a recent history of bTB believed the disease was spreading at a faster rate than control farms. On the 1-10 scale, half placed the speed of spread at 7 and they agreed that bTB was endemic in their parish (median 4 on a 1-5 scale). As might be expected from their bTB history, these farmers also felt under threat from bTB (median 4.5). They were more likely to suggest their herds were susceptible because of infected badgers (median 4) than cattle (median 2) and believed that the local badger population had endemic bTB (median 3.5).

Farmers' Views of bTB

Just like those who have not had bTB, farmers with herds recently infected with bTB felt they had no control over the disease (median 2) and thought infection was a matter of luck (median 4). These farmers felt that neither their vet (median 3), government advice

(median 2.5) or local farmers (median 2) could help them avoid bTB. Nevertheless, these farmers do have strong connections with other local farmers, suggesting that their neighbours would help them out if they had a problem and that they regularly talk to them about bTB (medians 4). They agreed that they could get advice about bTB if needed (median 4), either from their vet or APHA vets (median 4), but were less keen on using the internet as a source of bTB information (median 3). Farmers were not worried about what others thought of their bTB status (median 2), supported the idea that Defra should publish the locations of bTB breakdowns (median 4) and agreed that vets, APHA or farmers themselves should inform farmers of local bTB breakdowns (medians 4).

iii. Differences between areas and farm characteristics

The calculation of newly endemic bTB areas identifies areas within Defra's HRA and Edge zones. Differences between respondents' farming practices in these areas were explored through separate analysis of controls and cases in the HRA and Edge. Few statistically significant differences were found. Farmers' reported biosecurity practices were no different in the HRA or Edge areas amongst controls or cases, except in relation to actions taken to prevent badgers entering cattle housing. Case farms in the Edge area (44%) were more likely to have implemented these measures than in the HRA (26%, χ_2 4.196, p.0.041).

4. Discussion

These results raise a number of points relating to the management of bTB, and Defra's Edge policy.

Firstly, the results provide an opportunity to explore attitudes to bTB and farm practices between farmers in standardized epidemiological zones and in groups of farmers with different disease experience. Whilst other farmer bTB surveys may claim to have targeted hot-spot or high-risk areas, none controls for the local variations in bTB endemicity meaning that randomly selected respondents are likely to represent a range

of different epidemiological statuses. This survey, however, is the first to sample farms from clearly defined estimates of disease spread and endemicity. In areas that are recently endemic for bTB, theoretical models of farmer behaviour would suggest that exposure to disease should play an important role in shaping farmers' attitudes and behaviour (Ellis-Iversen and others 2010). In relation to bTB, there is currently only limited and contradictory evidence for this. For example, farmers' confidence in badger vaccination appears unrelated to disease history (Enticott and others 2012). The data presented here, however, suggests that farmers tend to share the same characteristics whether or not they have recently had bTB.

In general, regardless of their disease experience, farmers in these areas displayed low levels of self-efficacy, with most believing that bTB was a matter of luck. These findings resonate with other recent social research: 79% of farmers in Devon, Gloucestershire and Cheshire viewed bTB as a matter of luck (see Enticott and others 2012). The high level of fatalism could be viewed as surprising given that these areas have only recently become endemic for bTB and that it also existed in farmers that have no direct experience of bTB. It may be, however, that fatalism towards bTB is connected to the wider socio-political context of bTB policy. For example, previous studies have suggested, farmers' views of bTB solutions are mediated by their perception of the disease as a political problem which results in a lack of trust in Government and science (Enticott 2008). Similarly, in this survey, only a third of all farmers in this survey agreed that following government advice would help them avoid bTB in future – whether they had recently been infected with bTB or not. However, their faith in others to help them resolve bTB was also low and comparable to other surveys, again, whether they had experience a bTB incident, or not. The high levels of fatalism found in this survey may therefore reflect differences between the way farmers understand the spread and extent of bTB compared with epidemiological calculations. Indeed, in focus groups prior to the survey, some farmers in the Edge area reported feeling like they were already in a high-risk area. Further research is required to compare the extent to which farmers' perceptions of bTB spread reflect epidemiological calculations. This is important because a lack of correspondence between farmers and policy makers definitions of bTB spread and endemicity is likely to impact upon the success of, for example, attempts to encourage farmers take more biosecurity precautions.

It is also possible that the high levels of fatalism are informed by farmers' sense of being part of a national farming community and that their views reflect some sort of solidarity or support for farmers in areas with higher bTB incidence. Heffernan and others (2008) argue that this sense of solidarity also justifies farmers' calls for Government intervention. Whilst farmers may see themselves as all in the same boat, they appear not to trust each other to collectively fight disease: 'bad apples' will undo the work of the 'good' farmers. In this survey, farmers reported speaking to fellow farmers regularly about bTB and seeking information from their private vet. However, farmers with both direct disease experience, and those that have been bTB free, did express some support for Government, suggesting that they could get information on bTB from APHA if they needed it. Support for the Government to regulate bTB may also explain these farmers' enthusiasm to disclose information about farmers' bTB status. The disclosure of bTB breakdowns by Government was, until recently, restricted by data protection concerns. The survey suggests support for Government action in this respect, but also provides guidance on how this might occur. A large majority of farmers supported both the APHA informing neighbouring farmers and Defra publishing bTB breakdown information, and this was broadly similar, regardless of their disease experience, but they were less keen on private vets adopting this role. In telephone surveys, farmers explained that they would be concerned about commercial confidentiality if vets had that role and preferred Government to take responsibility for disseminating this information. The extent to which farmers would use this information to guide their cattle purchasing decisions, however, is not clear particularly if this information lags behind or is qualitatively different to farmers' understandings of bTB spread.

5. Conclusion

This paper represents the first attempt to explore farmers' practices and attitudes towards bTB in standardized epidemiologically defined areas. From this descriptive analysis, there are indications that, farmers in areas defined as recently endemic for bTB share many of the same characteristics, attitudes and behaviours, whether they are bTB free or not. Most farmers in areas recently endemic for bTB, whether or not they have

had a TB incident, believe they are unable to do anything about bTB or believe anybody can help them avoid bTB. However, these farmers, even some who have no bTB experience, have implemented some biosecurity measures and are keen for Government intervention to help control the spread of bTB by, for example, disclosing the locations of farms with bTB breakdowns. Further multivariable analysis is being undertaken to assess the relationship between bTB status, farm management and farmer attitudes and perceptions, and how these characteristics might influence a farmer's risk of infection in recently endemic areas. In addition, there appears to be no statistically significant differences between farmers' views and practices in Defra's Edge area and the HRA which raises questions around how policy makers should organize their engagement and communication with farmers in different epidemiological policy zones.

Tables

Table 1 Comparison of Farm Characteristics in Survey sample and Total Population								
	Survey Data				Population Data*			
Herd Size	HRA		Edge		HRA		Edge	
	Beef (%)	Dairy (%)	Beef (%)	Dairy (%)	Beef (%)	Dairy (%)	Beef (%)	Dairy (%)
zero	2.7%	1.4%	2.0%	0.0%	n/a	n/a	n/a	n/a
1-10	19.5%	2.7%	18.0%	1.7%	22.0%	4.8%	26.6%	6.6%
11-50	32.7%	9.6%	31.0%	0.0%	33.8%	7.7%	34.4%	6.3%
51-100	24.8%	12.3%	14.0%	15.0%	19.1%	11.6%	16.6%	10.2%
101-200	11.5%	31.5%	16.0%	33.3%	15.7%	24.2%	13.6%	26.5%
201-300	5.3%	15.1%	7.0%	10.0%	5.3%	20.0%	4.3%	21.8%
>300	3.5%	27.4%	12.0%	40.0%	4.1%	31.7%	4.5%	28.6%

* Data derived from AHVLA. (2012)

Table 2 Characteristics of Survey Respondents						
	Controls (n)			Cases (n)		
	Beef	Dairy	Total	Beef	Dairy	Total
Zero/no data	3	1	4	2	0	2
1-10	34	3	37	6	0	6
11-50	55	7	62	13	0	13
51-100	26	16	42	16	2	18
101-200	17	33	50	12	10	22
201-300	3	10	13	10	7	17
301+	4	17	21	12	27	39
TOTAL	142	87	229	71	46	117

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