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Assessing Farmer Confidence in Badger Vaccination: Some Findings from a Survey of Cattle Farmers in England

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Abstract

Bovine tuberculosis (bTB) is a complex animal disease affecting farmed cattle and badgers in England and Wales. In England, vaccination of either cattle and/or wildlife is seen as an important long-term policy to help reduce the impact of bTB. This paper provides an assessment of cattle farmer attitudes towards badger vaccination, captured via a baseline telephone survey of farmers in five areas where rates of bTB in cattle are high, including one area in Gloucestershire where, since 2010, badgers have been vaccinated as part of the Government's Badger Vaccine Deployment Project (BVDP). The uptake of badger vaccination is likely to be dependent on farmers' trust and confidence in the vaccine and those who promote it. The paper argues that measuring trust in institutions is a good way to assess farmer confidence in badger vaccination. Using a series of statements from previous research that has examined institutional trust, the paper shows how farmers surveyed were cautious about the role of badger vaccination to control bTB in cattle. Levels of vaccine acceptability or trust in the Government were not high. Further work is needed to unpack the relationship between trust and confidence in badger vaccination.

Keywords: Bovine TB; badger vaccination; trust; confidence; England

1.0 The Changing Policy Context of Bovine Tuberculosis

Bovine Tuberculosis (bTB) is a complex animal disease that affects farmed cattle and badgers in England and Wales. It is a significant cost burden to the state, with over £60 million spent every year in compensation (Defra, 2010a).¹ Tens of thousands of cattle are slaughtered as a result of the disease. In 2010, almost five per cent of cattle farms in England were under bTB restriction; 60% of those cases were concentrated in the south west of England (see Fisher et al., 2012 for details). The stress of TB testing and control requirements also has significant economic and emotional impacts on livestock farming households. The current policy measures for bTB control focus on a compulsory national ‘test and slaughter’ policy whereby herds are routinely tested for bTB (every one to four years depending on the prevalence of bTB in the area) and cattle that test positive are slaughtered. If reactors (cattle testing positive) are found in a herd, cattle movement restrictions are put in place until all animals test negative.

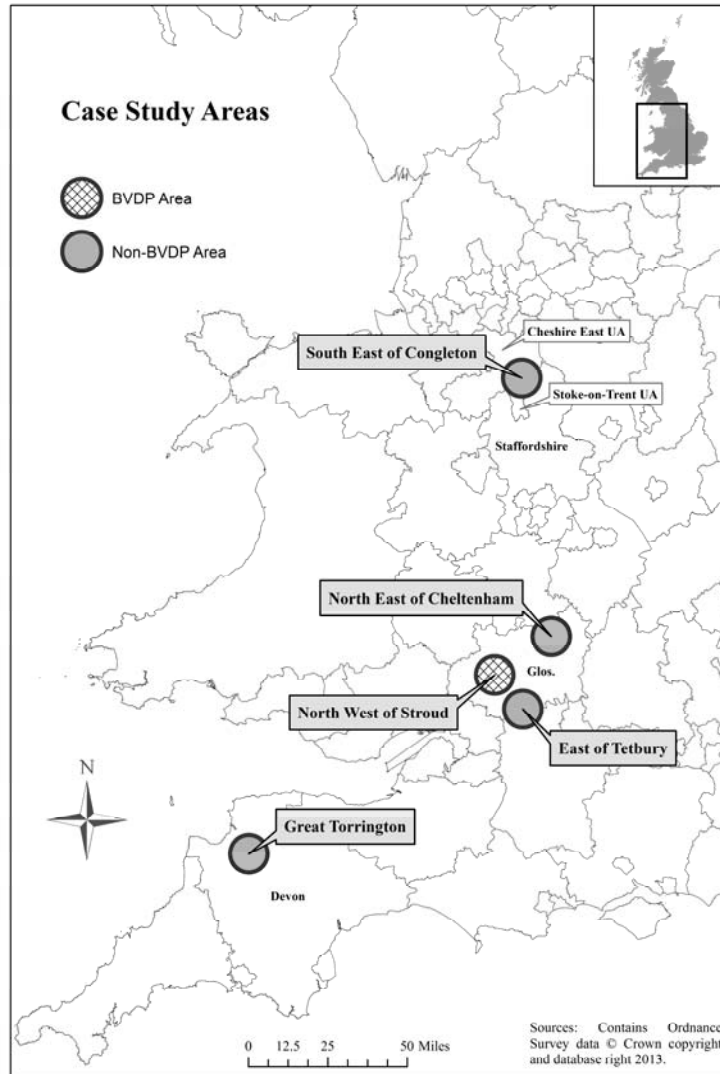
Various measures have been developed to control the disease, including tighter controls on cattle movements, as well as better use of diagnostic methods, enhanced on-farm biosecurity and badger and cattle vaccination (Enticott, 2008a/b). Widespread badger culling was initially undertaken to control the disease in the early 1970s, when a connection between bTB and badgers was first confirmed in a dead badger found on a Gloucestershire farm. However, towards the end of the 1990s cases of bTB in cattle began to increase, bringing into question the role of the badger in spreading the disease and with it the ethics of badger culling. In 1997, Lord Krebs was commissioned to review the evidence on bTB and the resulting report concluded that there was “compelling” evidence that badgers were involved in transmitting the disease to cattle (Krebs et al., 1997). Nevertheless, the report also suggested that the development of appropriate badger control strategies was difficult due to the lack of quantifiable data to prove the effectiveness of badger culling. As recommended by the Krebs report (1997), a Randomised Badger Culling Trial (RBCT) was commissioned in 1997 which monitored the impacts of badger culling. The trial, run by the Independent Scientific Review Group between 1998 and 2005, concluded that badger culling was not a meaningful way forward for cattle TB control (ISG, 2007).

The current coalition Government is reviewing badger control policy and is considering the need for a badger cull in TB hot spot areas in a bid to establish “affordable options for a carefully managed and science-led policy of badger control in areas with high and persistent levels of bTB” (Defra, 2010b, p. 4). In 2012, the government put forward its plans to allow a cull of 70% of the badger population in two pilot areas in Gloucestershire and Somerset. Following delays to the start of the cull throughout the summer of 2012, the proposed October start date was postponed because of concerns by the National Farmers Union about the ability to cull the required number of badgers during the specified time frame. The pilot badger cull started in the summer of 2013, with a decision on the viability of the method and possible further roll-out to other areas due in 2014.

¹ The total cost in 2009/10 was £87 million, which includes research and development to try and control the disease. Compensation payments in this period amounted to £63 million (Defra, 2010a).

Set against this context, vaccination of either cattle and/or wildlife is viewed as an important long-term policy to help reduce the impact of bTB in England. Previous research has suggested that farmers have a low level of support for badger vaccination (Bennett & Cooke, 2005). However, their work was undertaken before a badger vaccine was available. A badger vaccine was licensed in 2010. It was due to be administered in England through the Badger Vaccine Deployment Programme (BVDP). The BVDP was established to assess the practicalities of badger vaccination in six areas of England. Farmers in each area would be recruited until 100 km² were covered out of a 300 km² area. However, before the trial began, its scale was reduced to just one area in the south-west of England (Stroud), with a neighbouring area (Cheltenham) acting only as a training area (see Figure 1). Despite this smaller-scale intervention, the current coalition Government has noted that vaccination will have a role to play in the future management of the disease, especially close to areas where farmers could be licensed to conduct badger culling (Defra, 2010b).

Figure 1: Location of study areas.



This article examines farmers' levels of confidence in vaccinating badgers against bTB and their trust in the Government's ability to deal with the disease (see also Enticott et al., 2012). It complements work on bTB and other cattle diseases carried out by geographers and others (Enticott 2008a/b; see also Convery et al., 2005; Ellis-Iversen et al., 2010; Grant, 2009; Palmer et al., 2009), some of which includes the adoption or rejection of new agricultural technologies amongst farmers in relation to the management of animal disease. It links also to a wider body of work on biosecurity that has examined the practices and regulatory regimes designed to control disease spread (for reviews see Bingham et al., 2008; Mather & Marshall, 2010 and Maye et al., 2012). This article also contributes to a long-standing area of work in agricultural geography in terms of understanding factors that influence decision-making and behaviour change in farmers and, more generally, research on environmental and controversial policy decisions (Poortinga & Pidgeon, 2003). The rest of the article is structured as follows. The next section reviews existing social science work on vaccination for farmed animals and outlines the theoretical framework developed to assess farmer confidence in vaccinating badgers. This is followed by a section outlining the methodology developed for the study. An analysis of the survey findings is then presented, including a preliminary assessment of farmer confidence in badger vaccination.

2.0 Vaccination, Confidence and Institutional Trust

Research on farmer confidence in vaccines for farmed animals is limited. However, work on the uptake of human vaccines and the perceptions of environmental and agricultural risks and trust in environmental institutions and regulation is more developed and provides useful conceptual insights. Research on vaccines for human illnesses includes studies which have examined intentions amongst parents to vaccinate their children for diseases. Research by Keene et al. (2005) is notable here, using the Health Belief Model to assess parent acceptability of vaccines. Such studies are relevant to farmer behaviour work because they invoke caring relationships for others, rather than merely self-interest. Other work on the acceptability of controversial vaccines, principally the measles-mumps-rubella (MMR) vaccination (see Raithatha et al., 2003), is also instructive. The MMR controversy and related studies reinforce research findings from environmental controversies, which highlight the importance of trust, social identity and local knowledge practices in resisting scientific advice (Wynne, 1992, 1996).

Only a small number of studies of farmer confidence in vaccines for farmed animals exist, most related to the uptake of new vaccines. This includes research by Elbers et al. (2010) and Cross et al (2009) on the bluetongue (BTV) vaccine in Holland and Wales respectively. Elbers et al. (2010) asked commercial and hobby farmers about their attitudes towards bluetongue vaccination. Cross et al. (2009) compared responses from farmers and vets to possible control strategies for BTV. Their study used adaptive conjoint analysis² to test preferences for individual control strategies; paired control strategies; and bundles of different control strategies. Heffernan et al. (2008) meanwhile provide a more nuanced understanding of the uptake of vaccination for foot and mouth disease (FMD) in Bolivia. They showed how uptake and resistance reflected local health beliefs. Uptake of vaccination was not due to scientific or economic arguments. Vaccination discourses were 'reinvented' to fit in with local beliefs. As they explained, "farmers were not vaccinating

² Conjoint analysis is a statistical technique used to quantify an individual's perceived values with respect to a given product.

against the disease threat itself, but rather the imbalances of hot and cold [with an assumption that FMD was caused by heat] underlying the disease process” (Heffernan et al., p. 13). It is worth noting that a cattle vaccine for bTB is often favoured by farmers (Bennett & Cooke, 2005); however, it is currently unavailable due to licensing issues and the inability to distinguish between an infected and inoculated animal under the current testing regime.

Studies on the use of other preventive measures are also relevant. Ellis-Iversen et al.’s (2010) analysis of farm-based measures to control E-Coli is particularly notable, analysing the influences and barriers to disease control. Ellis-Iversen et al. develop a ‘pathways to disease control’ approach. This step-change model ranges from no intent and intent to implemented control and sustained control. Meanwhile qualitative research by Enticott (2008a) on bTB suggests there is reluctance amongst farmers to implement forms of preventive strategies for the disease. Issues of practicality and affordability are noted, but Enticott also highlights how attitudes towards bTB are dominated by fatalism, and these attitudes are inadvertently encouraged by the promotion of biosecurity solutions.

The literature on vaccination, agricultural risks and bTB suggests that confidence in vaccination is likely to be related to *institutional trust*. Trust and confidence are separate but related items. Research has already sought to analyse the relationship between trust and confidence. Various authors have attempted to identify the multidimensionality to these constructs, but on the whole find that trust is related to just two core factors: general trust and general competence (confidence). For example, Metlay’s (1999) analysis of institutional trust explores trust and confidence in relation to the following dimensions: openness, reliability, integrity, credibility, fairness, care and competence. Principal Components Analysis showed that only two components figure in Metlay’s study: the first relates to affective elements of trust (reliability, integrity, credibility, fairness and care); and the second relates to institutional competence.

Poortinga and Pidgeon (2003) find similar results with their analysis of a range of different environmental risks in the UK (including climate change, mobile phones, radioactive waste, GM food and genetic testing). Similar to Metlay (1999), they identify two key components. The first they label *general trust*, which consisted of items relating to competence, care, fairness and openness. The second consisted of items relating to credibility, reliability and integrity; Poortinga and Pidgeon label this second dimension *scepticism*. General trust tends to apply to an institution as a whole, but Poortinga and Pidgeon suggest that there are different levels to trust which may lead to more differentiated perceptions. These studies of institutional trust and their related dimensions are useful for this study of farmer confidence in vaccination, which is conceptualised as a study of farmer confidence and trust in government and its ability to control bTB.

3.0 Methodology

Farmers’ views of, and confidence and trust in, badger vaccination were obtained using a telephone survey. This method was preferred over a postal questionnaire-type survey as it allows the researcher to engage in a verbal dialogue with each farmer. The relative impersonality of telephone interviews when compared with face-to-face interviews was also deemed advantageous (Sturges & Hanrahan, 2004), given the sensitive nature of bTB. Farmers were surveyed in five different locations of 100km² in the west and south-west of England (see Figure 1). The locations were chosen as examples of areas with

high bTB incidence and therefore as areas where badger vaccination may be used in future. Commonality between areas in terms of disease pressure was important, although the prevalence of bTB is less pronounced, but still significant, for Congleton. In one area (Stroud), vaccination is already occurring as part of the BVDP. Another of the areas (Cheltenham) was also due to be part of the original BVDP plans.

Surveyed farmers were identified using a stratified random sample of cattle farms. The sample was drawn up using data from the Animal Health and Veterinary Laboratory Agency's Vetnet database to be representative of the number of beef and dairy livestock farms in each area. These data were provided at County Parish Holding (CPH) scale for all farms in each area, including the number of farms, farm size and herd type. This was to ensure that the sample could be weighted to reflect the total population of cattle farms in the study areas. To ensure valid comparisons between farm types were possible, additional dairy farms were added to the sample. This oversampling of dairy did not significantly distort the final set of responses. Following the survey, the representativeness of the survey responses was compared to the total population for each of the study areas. The representative structure was largely maintained with just over 27% of all farms in the 5 study areas completing a survey, although this figure varied by region (see Table 1). The highest survey rate was in Cheltenham (42.2%) and the lowest in Congleton (18%). Analysis of survey responses shows that 31% came from dairy farms (the total population accounted for 28%) and 58% from beef farms (59% in the total population).

Table 1: *Summary data of farm characteristics*

Area	Total No. Farms	No. Farms Surveyed	% Total Farms Surveyed	Surveyed Farms: (%)		Mean farm size (hectares)	Mean herd size	No. Farms under bTB restrictions	Since January 2003: (mean)	
				Dairy Farms	Beef Farms				No. days under bTB restrictions	No. reactors per farm
North East of Cheltenham	116	49	42.2%	20.8%	73%	123.0	127.3	8	630.5	30.8
North West of Stroud	294	79	26.9%	35.4%	49.4%	118.4	192.6	17	484.4	14.9
East of Tetbury	149	61	40.9%	23%	60.7%	97.6	138.7	9	341.3	11.3
South East of Congleton	417	75	18%	46.7%	44%	64.1	113.5	6	155.4	6.1
Great Torrington	275	75	27.3%	24%	68%	104.3	184.9	21	528.0	17.0
All Areas	1251	339	27.1%	31.1%	57.7%	100.3	154.3	61	416.6	15.1

Taking place in autumn 2010, the survey collected 339 usable responses. The response rate was 80%. On average, the telephone survey lasted 20 minutes during which farmers were asked about their bTB status, their confidence in vaccination, and their levels of trust in the Government's TB policy. Data from

the telephone survey were supplemented with data relating to each farm's bTB history dating back to January 2003. Data were accessed from the Vetnet database and matched to survey data using CPH codes.

The main part of the telephone survey asked each respondent to rate 31 attitudinal statements relating to confidence and trust along a 1 (strongly disagree) to 5 (strongly agree) scale. The statements were organised into three rounds, which started by asking farmers to score statements about the severity and susceptibility of bTB, farmers perceived control of bTB and risks and benefits associated with badger vaccines. The second round of statements asked farmers further questions relating to their confidence in badger vaccination, including questions on perceptions of effectiveness and practicality. Farmers were also asked to indicate how they *felt* about badger vaccination. The third round of statements asked farmers to score a series of questions relating to trust in Government and bTB policy. These questions were based around the previous studies of trust reviewed earlier (Metlay, 1999; Poortinga & Pidgeon, 2003), but were tailored in this case to reflect bTB policy.

A series of general questions about the farm's bTB status and management practices were also included in the survey. These related to biosecurity practices; the presence of badger setts on farm land; and sightings of badgers in and around farm buildings. Respondents were also given the opportunity at the end of the telephone survey to make any additional comments about bTB and badger vaccination in particular. This was an opportunity for farmers to provide more open ended comments. The majority of respondents (74%) provided some additional comments. Whilst not always consistent or related to one particular issue, these comments help to shed light on some of the quantitative findings presented in this article.

The telephone survey was piloted by two members of the research team with a sample of cattle farmers in Devon and Gloucestershire (6 farms were piloted in total, 3 in each area and included beef, dairy and mixed farm types). The piloting exercise was designed to help refine the survey to ensure it yielded the correct level of information. It was also used to check that wording was such that farmers would not be deterred from responding to the survey and that any ambiguities were removed. The piloting exercise was valuable in one important respect. It indicated an inconsistency regarding reference to Defra and the Government and a lack of clarification in the statements when reference was made to Defra. A decision was taken that all statements in the revised survey should refer to the Government (rather than Defra, the civil service delivering the Government's bTB policy).

Data were inputted into an Access database during the telephone survey using a predesigned form. These data were then converted to SPSS format for statistical analyses. Data have been analysed in SPSS using various statistical techniques. Principal Components Analysis with a rotated varimax solution was used to search for commonalities between question responses and reduce data into separate components. The qualitative comments recorded at the end of the telephone survey were read and frequent themes were noted. The data were then downloaded into NVivo 9.0 (a qualitative software package) and coded.

4.0 Assessing Farmer Confidence in Badger Vaccination

4.1 Farm Survey Characteristics and General Attitudes Towards bTB

Before examining farmer attitudes towards badger vaccination, it is necessary to outline some general characteristics of the farm sample, including the bTB status of surveyed farms and general attitudes towards bTB. The majority of

respondents (57.7%) are beef farmers, followed by dairy and mixed (see Table 1). There is no major difference between study areas in terms of farm size, although Congleton has the largest proportion of smaller farms, with just over half of the farms 50 hectares or less. The vast majority of farms (93.7%) are less than 250 hectares. Overall, dairy farms are the largest farms within the sample, with almost half between 100 and 250 hectares. Beef farms within the sample are relatively small, with 60.0% less than 50 hectares. Cattle farms in Congleton tend to be smaller in terms of cattle numbers (with an average cattle size of 117 in the farm sample, even though dairy farms in the sample have larger numbers), which accords with area differences in terms of farm size. The Stroud sample has the largest average cattle herd size and the smallest number of farms who reported having between 1-50 cattle.

Farmers were asked whether they were currently under a cattle movement (TB2) restriction. At the time of the survey, 61 farmers (18.0% of the total) were under TB movement restrictions (see Table 1). There are some area differences, with over a quarter of farms surveyed in Great Torrington (Devon) under restriction compared to just 8.0% of surveyed farms in Congleton (Cheshire). Almost one third of dairy farms in the sample were currently under restriction, compared to one sixth of beef and mixed farms respectively. For the survey period, the number of reactors per farm ranged from 0 to 304 with a mean of 15, whilst the number of days under bTB restrictions ranged from 0 to 2593 (7.1 years) with a mean of 417 days. 68.0% of farmers reported badger setts on their farm land, whilst 24% had seen signs of badger activity around their farm buildings.

Bovine TB is considered to be a major risk by cattle farmers in the five case study areas. 86.0% of respondents feel that going under bTB restriction is a big problem for their business. There is no significant difference between the case study areas in relation to this feeling. The vast majority (75.7%) of survey participants agree that badgers are responsible for spreading the disease. A similar number (74.0%) feel that there is nothing they can do to prevent their herd from going down with bTB. The overall feeling among farmers is thus one of pessimism when it comes to avoiding bTB restrictions: 79.0% said it was simply a matter of luck if they went down with bTB. Building on work carried out elsewhere (Bennett & Cooke, 2005), farmers were asked whether or not they had implemented recommended biosecurity measures. Self-reported biosecurity activities were higher for some practices than others. In particular, the extent of badger proofing feed stores/silage clamps and raising water troughs appears to be double that of previous estimates, but fencing off latrines and badger setts has remained largely unchanged. This may reflect Government attempts to communicate the benefits of these practices.

4.2 Confidence in Badger Vaccination

Despite the above noted pessimism regarding bTB restrictions, support for badger vaccination was mixed. Statements in the telephone survey which examined farmers' general views about badger vaccination, including whether they think it is an acceptable preventative measure, and their confidence in its efficacy to control bTB, thus revealed some support (see Table 2). For example, when asked whether badger vaccination is an acceptable way of dealing with bTB, 41.2% of the sample agreed with this statement. That said, just under 40% disagreed with it, revealing a split of opinion amongst surveyed farmers. Almost half of the respondents agree or strongly agree that badger vaccination is a good thing to do, compared with one third who disagree with the statement. This supports the finding about farmers not being generally

resistant to badger vaccination per se. Just over 40% of farmers thought vaccination would increase their confidence about avoiding TB restrictions in the future, but 48.4% did not feel it would prevent the spread of the disease.

Table 2: *Farmers' Confidence in Badger Vaccination*

Concept	Question	Response (%)		
		Strongly Disagree/Disagree	Strongly Agree/Agree	Neither Agree-Disagree/Don't Know
Vaccine Acceptability	Badger vaccination is an acceptable way of dealing with bTB	39.9	41.2	19.2
	Vaccinating badgers is better than culling badgers to control bTB	60.8	20.7	18.3
	Paying for badger vaccination should not be the Government's responsibility	89.3	2.7	6.5
General Affective Evaluation	I think vaccinating badgers is a good thing to do	31.6	48.4	19.5
	Badger vaccination will help me feel more confident about avoiding TB restrictions	39.6	41.0	18.6
	I am confident that badger vaccination will help prevent the spread of bTB	48.4	26.6	24.8
Risks and Benefits	Badger vaccination will decrease levels of bTB in badgers	9.1	38.1	51.3
	Vaccinating badgers is practical	61.0	17.1	20.9
	Badger vaccination will reduce the chances of my herd going under bTB restrictions	24.7	44.9	28.6

During the telephone interviews, many farmers identified the need for an approach that encompassed a range of measures, including culling. Badger vaccination was deemed acceptable as part of a wider control strategy. As can be seen from Table 2, 60.8% of farmers felt culling was more effective than vaccination. Some of the qualitative statements helped to explain this position further. Farmers who provided comments on this issue were not necessarily against badger vaccination per se, but could not see how the bTB problem could be controlled without a targeted cull in hot spot areas. For example, a dairy farmer from the East of Tetbury area (*n*463) commented that "...vaccination is acceptable with other measures. Culling and vaccination should be used together". Another farmer argued that "Culling in hot spot areas should be done first, then vaccinate all badgers in other areas" (*Dairy farmer, North West of Stroud, n*350).

When farmers were asked to score statements about perceived risks and benefits of badger vaccines, the survey revealed that a majority of farmers (61.0%) were concerned about the practicality of vaccination. The impracticality of badger vaccination was one of the main themes which arose from the analysis of qualitative statements made by farmers. Fifty three respondents made some comment regarding practicalities, most of whom expressed doubts about how a vaccine can be administered in a way that ensures all badgers in a sett are vaccinated. There was also a general assumption among respondents that it is necessary to vaccinate the entire badger population for vaccination to be effective. That said, only 9.1% felt vaccination would increase TB in badgers by encouraging perturbation. For this statement, and to a lesser extent the other two risk/benefit statements (see Table 2), some farmers were unsure how to respond, indicating a lack of knowledge about badger vaccination. Nevertheless, 44.9% felt it would reduce the chances of their herd going under bTB restrictions. Overall, the survey suggests that farmers were cautious about badger vaccination: they appeared to be neither overly confident nor unconfident in it.

4.3 Trust and Confidence in Government

A series of statements were designed to help establish levels of farmer trust in government, as a proxy measure of confidence in vaccination. They covered seven different components of trust. A summary of the responses to these statements is provided in Table 3. Overall, responses suggest farmers do not trust the Government to manage bTB policy or vaccination, although a high percentage of farmers were also unsure how to respond to some of these statements, reflecting the fact that the coalition Government at the time of survey was only recently in power and their views on badger vaccination and culling were still to be established. Nevertheless, 52.2% of farmers did not think the Government was doing a good job in relation to bTB policy. Most (59.3%) did not know whether they could manage vaccination competently. Farmers also disagreed with the credibility of the scientific case for badger vaccination; again, a number were unsure on this.

Statements on integrity are equally distrusting of government in relation to badger vaccination. Four out of every five respondents feel the Government is too influenced by public opinion regarding badger vaccination and less than one third agree the government acknowledges the mistakes it has made about bTB. The following comments from farmers give an indication of this view: "if the government doesn't do anything, farmers will be forced to take matters into their own hands" (*Dairy farmer, North West of Stroud, n*334); "the sooner they get on with it the better" (*Beef farmer, South East of Congleton, n*513);

Table 3: *Farmers' Trust in Badger Vaccination and bTB Policy*

Aspect of Trust	Survey Question	Response (%)		
		Strongly Disagree / Disagree	Strongly Agree / Agree	Neither Agree/Disagree / Don't Know
Competence	The Government is doing a good job in relation to bTB	52.2	21.5	25.7
	The Government is organising badger vaccination competently	23.6	16.5	59.3
	The Government has the necessary skilled people to manage badger vaccination	24.1	23	51.9
Credibility	The Government does not distort the facts about bTB to make its case for badger vaccination	33.4	27.4	36.9
	The Government ignores the views of scientists who disagree with them about badger vaccination	15.6	37.7	45.1
Integrity	The Government is not too influenced by public opinion regarding badger vaccination	80.0	9.7	9.4
	The Government acknowledges mistakes it has made about bTB	43.0	29.2	26.3
Reliability	The Government takes its commitments to reducing bTB seriously	30.9	51.4	17.1
	We can rely on the Government to ensure that badger vaccination is carried out properly	38.4	26.3	34.8
Openness	The Government is open and honest about badger vaccination	29.8	35.4	33.0
Care	The Government is interested in what farmers think about badger vaccination	29.5	57.8	12.1
	The Government cares about reducing bTB	14.4	77.3	7.7
Fairness	The Government considers all arguments for and against badger vaccination	18.0	57.8	22.7
	Decisions made by the Government about bTB are fair and just	45.7	21.5	30.4

it should never have been allowed to get to this point” (*Beef farmer, North East of Cheltenham*, n258); and “the government could do a lot more, and they should do [more]. Agriculture was generally ignored by the last government” (*Beef farmer, East of Tetbury*, n401). For other aspects of trust, associated with reliability, openness, care and fairness, the responses suggest some modest support for the Government. In terms of reliability, there would appear to be some consensus that the government does take its commitment to reducing bTB seriously, although a not insignificant 30.9% disagree with this statement. The data relating to care suggest that respondents do feel the government cares about reducing bTB and is interested in what farmers think about badger vaccination. Farmers also feel the government considers all arguments for and against badger vaccination. There is less consensus regarding whether the government is open and honest about badger vaccination, with a fairly even split between those who disagree, those who agree and those who neither agree/disagree/don’t know. Only a few farmers feel that decisions made by the government are fair and just (statement 31). This implies a distinction between the way farmers consider the government’s general attitude towards bTB, which tends to be positive, and statements that focus on how the government translates that general attitude into policy to deal with the TB problem, which to their mind is not always fair or just.

These results indicate a general lack of trust in Government. A good number of farmers surveyed were reluctant to offer a view either way. This may be due to a general lack of knowledge about badger vaccination and/or reflect wider changes and uncertainties surrounding bTB policy. Farmers are reserving judgement on vaccination and the Government. These views are likely to change as wider bTB policy evolves.

4.4 Multivariate Analysis of Confidence Statements

To further disaggregate these data a Principal Components Analysis (PCA) was run based on the 31 survey statements. The PCA reduced the large number of variables to a smaller number of components to identify commonalities across the sample. This yielded nine significant components and accounted for 63% of the total variance in the dataset. The first two components, explaining the most variance in the data, form the focus of this analysis. They account for approximately one-third of the total variance (32.2%). The first is a *vaccination acceptability* component and accounts for approximately one-fifth of the variance in the dataset, with an Eigenvalue of 6.518. The component is dominated by the two general affective evaluation statements relating to badger vaccination (vaccination will help me feel more confident about avoiding bTB restrictions; I think badger vaccination is a good thing to do) and a statement about badger vaccination reducing the chances of a farmer’s herd going under bTB restrictions (all three statements have a loading score of 0.832).

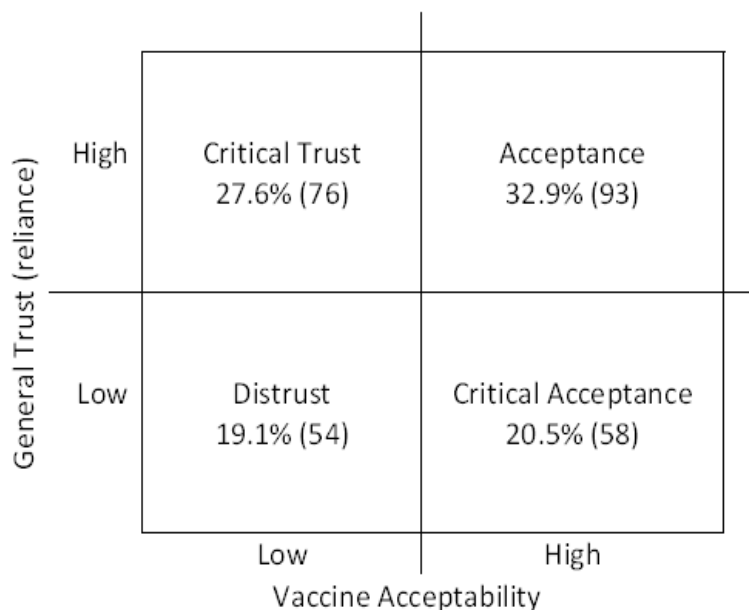
The second component had an Eigenvalue of 3.64 and explained 11.17% of the variance in the data. All significant loadings in this component relate to statements about trust and confidence in the government. Statements with the highest loadings related to care, fairness and reliability: the Government cares about reducing bTB (0.756); the Government is interested in what farmers think about badger vaccination (0.743); and the Government considers all arguments for and against badger vaccination (0.733). This second component is a *general trust* component.

Analysis of the two components reveals that neither confidence in badger vaccination nor general trust appears to vary greatly between different farm types, locations or farmers. No significant differences were detected between

dairy and beef farmers. There were no differences in levels of confidence or trust between farms that were under bTB restrictions at the time of the survey and those that were not. Neither were there any differences between farms with historically high levels of bTB.

The two components (vaccine acceptability and trust) have been used to classify farmers according to their confidence in badger vaccination and trust in Government. Farmers' views can be placed along these two different axes. The first axis represents the acceptability of vaccination – that is confidence that it works. The second axis represents trust – that is a belief in the reliability of the government to implement vaccination properly. Component scores for each farmer can be plotted along these two axes. Four views of vaccination can be identified (see Figure 2). The most frequently populated category in the matrix, accounting for a third of all farmers surveyed, reflected those farmers who accepted badger vaccination. That is, they had both high levels of trust in government and believed that vaccination would work. By contrast, the least populated category – distrust (or rejection) – accounted for just 19.1% of farmers who neither trusted the government nor believed vaccination could work. There is thus some support for badger vaccination amongst farmers but these figures need to be interpreted with caution because of: a) the distribution of scores close to the mid-point (see below); and b) the qualitative comments that farmers made which indicated acceptance the vaccine would work on individual badgers but skepticism it would work at a population level due to practical concerns.

Figure 2: Farmers' confidence in badger vaccination and trust in Government.



Note: based on component scores

The remaining categories reflect positions between the two extremes. Firstly, the category 'critical trust' accounted for just under 28% of farmers who trusted the government to be reliable but do not believe that vaccination will work. Secondly, 20.5% of farmers fell into the critical acceptance category. These were farmers who believed vaccination would work but who did not

trust the government to organise vaccination effectively. These farmers have a skeptical view of either vaccination or the Government. In both cases, confidence is mediated by trust. Overall, the matrix suggests that just a majority of farmers have positive views towards badger vaccination. *The actual levels of acceptability are not high and are clustered around the mid-points of each axis.* The acceptability of vaccination is thus limited and the actual proportion of each group may easily change in future.

5.0 Conclusion

In England, vaccination of either cattle and/or wildlife is seen as an important long-term policy to help reduce the impact of bTB. This article has provided a preliminary assessment into farmers' confidence in badger vaccination and their trust in Government regarding bTB policy. It has done so using a series of statements from previous research that has examined institutional trust (Poortinga and Pidgeon, 2003). The telephone survey results suggest neither strong views for or against vaccination, nor a complete lack of trust in the Government's approach to TB policy. This cautious assessment is supported by the PCA, with farmers relatively evenly distributed in each of the four categories. There is a clustering of responses around the mid-point. This suggests that the views expressed are finely balanced and relate to a political context. Future changes to TB policy may therefore contribute to a strengthening or weakening of these views, and alter the prospects of badger vaccination being used by farmers.

At the time of the survey, the new coalition Government had signalled its intention to cull badgers, although at that point the consultation was underway. Farmers appeared to be reserving judgement on vaccination and the Government until the outcomes of the consultation were known. Many farmers during the telephone interviews argued for an approach which incorporates a range of disease control measures, recognising the need for a cull in response to a perceived need to control badger numbers, which they argued were too high and were creating an imbalance in nature. The Government proposals to instigate a badger cull alongside badger vaccination and other control measures may increase acceptability of badger vaccination. However, the recent controversial postponement of the cull in 2012, at the request of the National Farmers Union because badger numbers were higher than thought, which in turn raised cost and practicality concerns, continues to create an uncertain political context. This uncertain political context helps to explain the lack of relationship between confidence and trust reported in the autumn 2010 survey. The on-going uncertainty regarding badger culling and other control options suggests that this may continue to feature as a significant background influence in future assessments of farmer confidence in badger vaccination and farmer relationships with Government going forward.

Views on badger vaccination may be mediated by different levels of trust not factored into this baseline analysis. Whilst this analysis has focused on trust between farmers and Government, different levels of trust and influence between other local farmers, family members, local institutions such as farming unions, and advisors such as vets may also mediate farmers' confidence in badger vaccination. Further analysis and research examining the relationship between these actors will help explain their relative roles and influence in shaping farmers' attitudes towards badger vaccination.

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