Farmers' Confidence in Vaccinating Badgers Against Bovine Tuberculosis

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Abstract

This paper examines farmers' levels of confidence in vaccinating badgers against bovine Tuberculosis (bTB) and their trust in the Government's ability to deal with bTB. In 2010 a badger vaccine based on the BCG vaccine was licensed following field trials and used as part of the UK Government's Badger Vaccination Deployment Project (BVDP). A stratified random sample of cattle farmers in five different locations of England were surveyed by telephone to elicit their views of badger vaccination. The survey provided a total of 341 responses with a response rate of 80%. Results suggest that farmers are cautious about badger vaccination, appearing to be neither overly confident nor unconfident in it. However, farmers did not reveal high levels of trust in the Government to manage bTB policy or badger vaccination. 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, or between farms with historically high levels of bTB. Principal components analysis suggests that 33% of farmers accepted badger vaccination, but that acceptance is dependent on the wider social and political environment.

Introduction

When it comes to making decisions about adopting or agreeing with new practices or technologies, trust and confidence are key factors. Confidence refers to the degree to which something can be relied upon. By contrast, trust refers to the faith placed in people and social institutions. This social trust influences the extent to which people have confidence in the advice and behaviour of those institutions. Previous studies have shown this to be particularly true in relation to environmental and controversial policy decisions (Poortinga and Pidgeon 2003). Moreover, studies have shown how trust is central to the adoption or rejection of new agricultural technologies amongst farmers, particularly in relation to the management of animal disease (Enticott 2008; Department for Environment Food and Rural Affairs. 2009).

Drawing on this work, this paper examines farmers' levels of confidence in vaccinating badgers against bovine Tuberculosis (bTB) and their trust in the Government's ability to deal with bTB. Previous research has suggested that farmers have a low level of support for badger vaccination (Bennett and Cooke 2005). However, this research was conducted before a badger vaccine was available. In 2010 a badger vaccine based on the BCG vaccine was licensed following field trials (Department for Environment Food and Rural Affairs. 2010). The vaccine was to be part of the UK Government's Badger Vaccination Deployment Project (BVDP). Starting in 2010, the BVDP was to investigate the practicalities of badger vaccination in six areas of England. However, before the project began, its scale was reduced to just one area (Stroud) with a neighbouring area (Cheltenham) acting only as a training area. Nevertheless, the current coalition Government have suggested that vaccination will have a role to play in future near areas where farmers could be licensed to conduct badger culling (Department for Environment Food and Rural Affairs. 2011).

Materials and Methods

The aim of the study was to assess farmers' levels of confidence and trust in badger vaccination. Farmers' views were obtained using a telephone survey. Farmers were identified using a stratified random sample of cattle farms in five different locations of 100km^2 (see figure 1). The sample was drawn up using Animal Health's Vetnet database to be representative of the number of beef and dairy livestock farms in each area. To ensure there were enough farms to allow valid comparisons, additional dairy farms were added to the sample. The locations were chosen as examples of areas with high bTB incidence and therefore as areas where badger vaccination may be used in future. 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.

The survey took place in Autumn 2010 and provided a total of 341 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 bTB policy. Respondents were asked to rate 31 attitudinal statements relating to confidence and trust along a 1 (strongly disagree) to 5 (strongly agree) scale.

The questionnaire was in three parts. Firstly, farmers were asked a series of questions relating to their confidence in badger vaccination. These included questions on their perceptions of effectiveness, practicality, risks and benefits. In addition, farmers were asked to indicate how they *felt* about badger vaccination. Such general affective beliefs are known to encapsulate more specific beliefs and help act as mental short cuts – known as the affect heuristic (Finucane and others 2000) – to help make sense of new technologies or risks (for questions see table 2).

Secondly, farmers were asked a series of questions relating to trust in Government and bTB policy. These questions were based on seven different aspects to trust identified in previous studies of trust. These aspects of trust in Government included: general competence, care, fairness, openness, credibility, reliability and integrity (for questions see table 3).

Thirdly, a series of general questions about the farm's bTB status and management practices were included in the survey. This included questions relating to biosecurity practices; the presence of badger setts on farm land; and sightings of badgers in and around farm

buildings. Data relating to each farm's bTB history (such as number of reactors, time spent under bTB restrictions) were supplemented with data accessed from the Vetnet database relating to each farm's bTB history dating back to January 2003.

Survey responses were inputted into an Access database during the telephone survey using a predesigned form. These data were matched with Vetnet data using the CPH code for each responding farm. Data were converted to SPSS format for statistical analyses. Principal components analysis with a rotated varimax solution has been used to search for commonalities between question responses and reduce data into separate components.

Results

Farm characteristics and practices

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. The remainder were classified as mixed farms). 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 five 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%).

Amongst the surveyed farms, 61 farms were under bTB restrictions at the time of the survey, whilst 203 (60%) had had been under bTB restrictions at some point since 2003. There are some important area differences, with over a quarter of farms surveyed in Great Torrington under restriction compared to just 8% of surveyed farms in South East of Congleton. Analysis of bTB restrictions since 2003 also revealed the same regional variation: the highest number of restricted farms was in Great Torrington (68%) and the lowest in Congleton (49%). The mean number of days spent under bTB restrictions for all surveyed farms was 417 with a maximum of 2593 days (7.1 years). The mean number of reactors was 15 per farm with a maximum of 304. These figures for the survey sample are broadly representative of the wider population across the five areas.

The majority (68%) of farmers reported badger setts on their farm land whilst 24% had seen signs of badger activity around their farm buildings. In terms of biosecurity practices, the most widely reported implemented measures were the securing of buildings from badgers (35.5% of all farms), badger proofing feed stores (63.6%) and raising water troughs (59.5%). Only 8% of farmers reported fencing off badger latrines and 16% said they fenced off badger setts. Dairy farmers were more likely to fence off badger setts (30%) or secure buildings from badgers than beef farmers (10.8% and 30% respectively), but levels of badger proofing feed stores and raising water troughs were similar for both farm types.

Farmers' confidence in badger vaccination

Farmers responding to the survey were pessimistic that they were able to do anything about avoiding bTB restrictions: 79% said that it was simply a matter of luck if they went down with bTB. Despite this, there was mixed support for badger vaccination. Questions that asked about general acceptability or farmers' general feelings towards vaccination revealed some support (see table 2). Whilst 61% of farmers suggested that badger culling was more effective than vaccination, almost half of the sample thought that vaccination was a good thing to do, whilst 41% said vaccination was an acceptable way of dealing with bovine tuberculosis. A similar number of farmers (41%) thought that vaccination would increase their confidence about avoiding bTB restrictions in future, but 48% did not think that it would prevent the *spread* of the disease.

Criticisms of badger vaccination have focussed on its practicality and potential to perturb badger populations resulting in an increased risk of bTB. Results from the survey revealed that a majority of farmers (61%) did have concerns about the practicality of vaccination, but only 9% thought that vaccination would increase bTB in badgers, such as by encouraging perturbation. Most farmers (51%) were unsure about the effect vaccination would have, but almost two fifths thought it would reduce bTB in badgers. Finally, the vast majority (89%) of farmers believed that it was not their responsibility to pay for vaccination.

Farmers' trust in Government

As indicated earlier, confidence in badger vaccination will often be mediated by levels of trust with other social institutions, other farmers and social contacts. This survey focused on aspects of trust between farmers and the Government in respect of bTB. Farmers did not reveal high levels of trust in the Government to manage bTB policy or badger vaccination (table 3). Criticisms of the handling of bTB policy have in the past revolved around concerns about the handling of science and its practical limitations in the field. In this study, the majority of farmers (52%) did not think the Government were doing a good job in relation to bTB policy and less than a fifth thought the Government could manage vaccination competently. Similarly, a third of farmers thought that the Government's scientific case for badger vaccination lacked credibility.

For other aspects of trust, responses revealed some modest levels of support for the Government. A majority of respondents believed that the Government cared about reducing bTB; cared about what farmers thought of badger vaccination; and had considered all arguments related to badger vaccination. However, 80% of farmers believed that bTB policy was too influenced by the general public (as opposed to veterinary or agricultural specialists) whilst 46% did not believe that bTB policy decisions in general to have been fairly made.

Components of trust and confidence

Results from a principal components analysis from 283 respondents revealed a value of 0.836 for the Kaiser-Meyer-Olkin test of adequacy and a significant ($p<0.001$) Bartlett's test of sphericity. These values indicate that the data were suitable for the analysis. Nine components with Eigenvalues over 1.0 were identified within the 31 survey questions. The remainder of this analysis focuses only on those components with Eignevalues over 3.0, that is the strongest components that explain the most variance in the data. Two strong components were revealed by the analysis. The first explained 21.027% of the variance in the dataset, with an Eigenvalue of 6.518. Questions that loaded onto this component were clearly related to confidence in vaccination and its effectiveness. Questions with the highest

loading scores (all 0.832) included: vaccination will reduce the chances of my herd going under bTB restriction; vaccination will help me feel more confident about avoiding bTB restrictions; and I think badger vaccination is a good thing to do. These questions tap into the affective element of farmers' perceptions of badger vaccination but also relate to its perceived efficacy. This component has therefore been labelled 'confidence in vaccination'.

The second component was less strong but still had an Eigenvalue of 3.464 and explained 11.174% of the variance in the data. Questions that loaded into this component were this time related to aspects of trust in the Government. Questions with the highest loading scores were: 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). These results confirm previous studies (Metlay 1999; Poortinga and Pidgeon 2003) which suggest that trust has a number of different dimensions, but in the case of badger vaccination, aspects of care, fairness and reliability appear to be the most clearly defined. This component has been labelled 'general trust'.

Differences between types of farm and survey locations

Analysis of both these components reveals that neither confidence in badger vaccination nor general trust vary greatly between different farm types, locations or farmers. No significant differences were detected between dairy and beef farmers. There were no differences in confidence in relation to farmer characteristics such as age or gender. Equally, no significant differences were recorded between the smallest and largest farms in terms of hectarage (farm size: <20ha and >100ha) or herd size (comparison between herd size: <50 cattle and >250 cattle).

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. Farms that have had many reactors since 2003 or those that have spent longest under bTB restrictions did not have significantly different views to other farmers. Similarly, farmers who reported seeing badger

activity around their farm buildings or having setts on their land did not have significantly different views than those that did not.

Classification of farmers' by trust and confidence

Results from the principal components analysis make it possible to classify farmers according to their confidence in badger vaccination and trust in Government. By plotting farmers' positions along these twin axes, it is possible to identify four potential different views of badger vaccination. The first view has been labelled 'acceptance' and refers to farmers who have both confidence in vaccination and trust the Government. These farmers are likely to volunteer to participate in vaccination schemes such as the BVDP. The second group reflects the opposite: 'rejection', which refers to those farmers who neither have confidence in the vaccine nor have trust in Government. These are farmers not likely to participate in schemes like the BVDP.

The remaining groups reflect positions between these two extremes. 'Critical trust' accounts for those farmers who have positive levels of trust in the Government but do not have confidence in badger vaccination. 'Critical acceptance' accounts for those farmers who do have confidence in vaccination but are less trusting of the Government. In both these cases, it is suggested that farmers have adopted a critical stance on the Government's approach to bTB policy. That is to say that these farmers have a questioning and sceptical view on either vaccination or the Government's commitment to bTB. This critical approach means that confidence is mediated by levels of trust, and vice-versa. This may result in beliefs about vaccination being over-ruled.

Figure 2 shows how these groups were populated by survey respondents. In total, 33% of farmers fell into the acceptance category, whilst 19% rejected vaccination outright. Of the categories between these extremes, 27.6% fell into critical trust and 20.5% within critical acceptance. However, in many cases the actual levels of acceptability are not high and cluster around the mid-points of each axis. This suggests that the acceptability of vaccination is limited and that the actual proportions of each group may easily change in future.

Analysis of the survey data also helps to confirm the validity of these categories. Table 4 shows that of those farmers that indicated a willingness to participate in the BVDP (this question was asked to eligible farmers in the Stroud and Cheltenham areas), the acceptance category accounts for 22 out of 70 farms, 17 of which had indicated willingness to participate in the BVDP. The same pattern is true for the rejection category: this category accounts for a total of 19 farmers, 16 of whom indicated that they would not be willing to participate in the badger vaccination project. The critical acceptance and critical trust categories are also confirmed by the analysis: of the 11 farmers falling into the critical acceptance category, 3 were unwilling to vaccinate.

Discussion

These results raise a number of points of empirical, theoretical and policy interest.

Firstly, the survey suggests that farmers were cautious about badger vaccination: they expressed neither strong confidence in favour or against badger vaccination. Confidence was also multi-faceted. For example, a significant proportion of farmers suggested that vaccination would help them feel more confident about avoiding bTB restrictions, but did not think that it would prevent the spread of the disease. Similarly, the results also indicated a cautious attitude towards Government amongst farmers. Overall, levels of trust were generally low, particularly for some aspects of trust. However, they were not as low as findings from previous qualitative and quantitative social science studies of bTB might suggest (Enticott 2008; Enticott and Vanclay 2011; Christley and others 2011). Without the same quantitative longitudinal measures of trust, it is difficult to precisely estimate how farmers' trust in Government has changed over time.

This cautious assessment of both badger vaccination and the government is underlined by the four-fold classification of farmers. Farmers are relatively evenly distributed in each of the four possible categories. Given that previous studies (Poortinga and Pidgeon 2003, 2005) have shown that levels of trust in government are related to the acceptance of new and controversial environmental technologies, this distribution is surprising. It indicates that when it comes to bTB, trust in government is not a significant factor in shaping farmers'

opinions. Further analyses that takes into account other factors, such as farm level characteristics and farmers' perceptions of risk, are required to help unpack the relationship between trust and confidence in badger vaccination.

Secondly, and in relation to the first finding, farmers' trust and confidence appear to be highly contingent. For many of these questions, significant proportions of farmers were reluctant to offer a view either way. This indecision reflects a lack of knowledge of farmers about the vaccination programme and suggests a potential role for education/information programmes about badger vaccination. Alternatively, the lack of strong views on badger vaccination reflects wider changes and uncertainties surrounding bTB policy. Whilst the new coalition Government has signalled a different approach to bTB policy and an intention to cull badgers, its consultation exercise was still under way when these data were collected. Many farmers appeared to be reserving judgement on vaccination and the Government until the results of the consultation were known. That is to say, confidence in badger vaccination and trust in government is dependent on bTB policy as a whole and is likely to change as policy evolves. Indeed, many farmers stated during telephone interviews that badger vaccination was acceptable so long as it was accompanied by other methods of badger control. This uncertain political context therefore helps to explain the apparent lack of relationship between confidence and trust. For policy makers, it also highlights how the acceptability and use of new animal health practices by farmers are limited by wider political processes.

Thirdly, compared to previous studies (Bennett and Cooke 2005), levels of self-reported biosecurity activities were higher. In particular, the extent of badger proofing feed stores/silage clamps and raising water troughs is double that of previous studies. By contrast, levels of fencing off latrines and badger setts have remained largely unchanged. These changes may reflect the success of efforts by the Government to communicate biosecurity best practice and encourage its uptake. Alternatively, these changes may over-report biosecurity activities due to social desirability bias: where there are expectations that certain behaviours are desirable, respondents may over-report practices to save face (Podsakoff and Organ 1986). Nevertheless, even if a gap exists between attitudes and

biosecurity behaviours, these higher values suggest farmers have become knowledgeable about the types of biosecurity activities required to reduce the risk of bTB.

Finally, this study is limited by its focus on farmers' relationship with Government. Farmers' confidence in badger vaccination is also likely to be mediated by different levels of trust not factored into this analysis. As other studies have shown for other animal health problems (Gunn and others 2008; Heffernan and others 2008a; Heffernan and others 2008b; Elbers and others 2010), other local farmers, family members, local institutions such as farming unions and advisors such as vets may shape farmers' acceptance of new practices and technologies. These people and organisations, and farmers' trust in them, will also mediate farmers' confidence in badger vaccination. This helps to explain why five farmers shown to accept badger vaccination were unwilling to participate in the vaccination project and three who rejected it nevertheless participated in it. Further 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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Figure 1: Locations of Study Areas

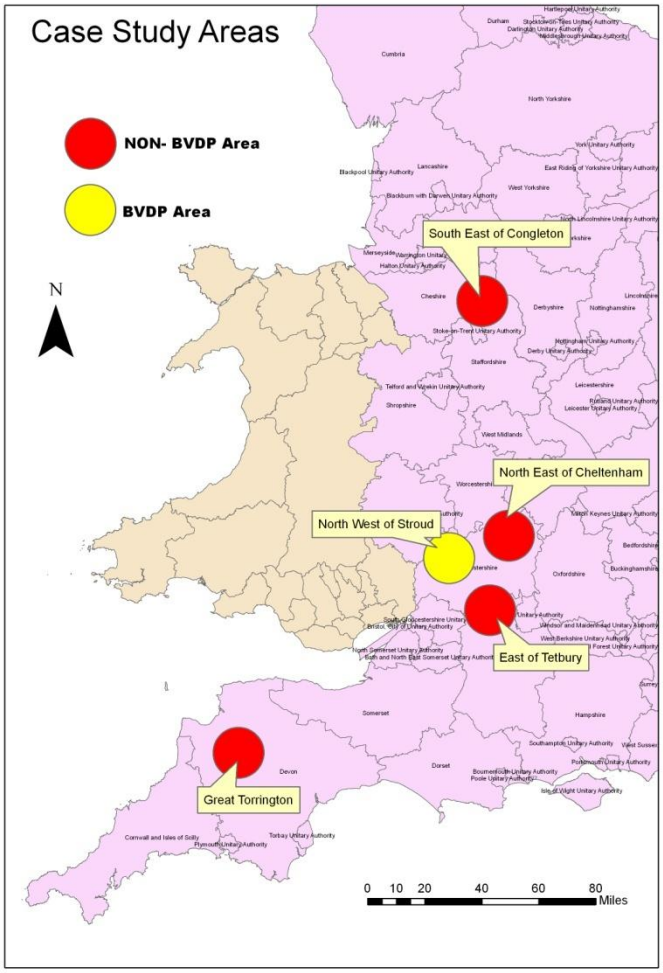


Table 1: Summary data of farm characteristics from respondents to survey of farmer confidence in badger vaccination

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)		% planning voluntary vaccination
				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	36.73
North West of Stroud	294	79	26.9%	35.4%	49.4%	118.4	192.6	17	484.4	14.9	37.84
East of Tetbury	149	61	40.9%	23%	60.7%	97.6	138.7	9	341.3	11.3	32.20
South East of Congleton	417	75	18%	46.7%	44%	64.1	113.5	6	155.4	6.1	45.95
Great Torrington	275	75	27.3%	24%	68%	104.3	184.9	21	528.0	17.0	23.53
All Areas	**1251**	**339**	**27.1%**	**31%**	**58%**	**100.3**	**154.3**	**61**	**416.6**	**15.1**	35.49

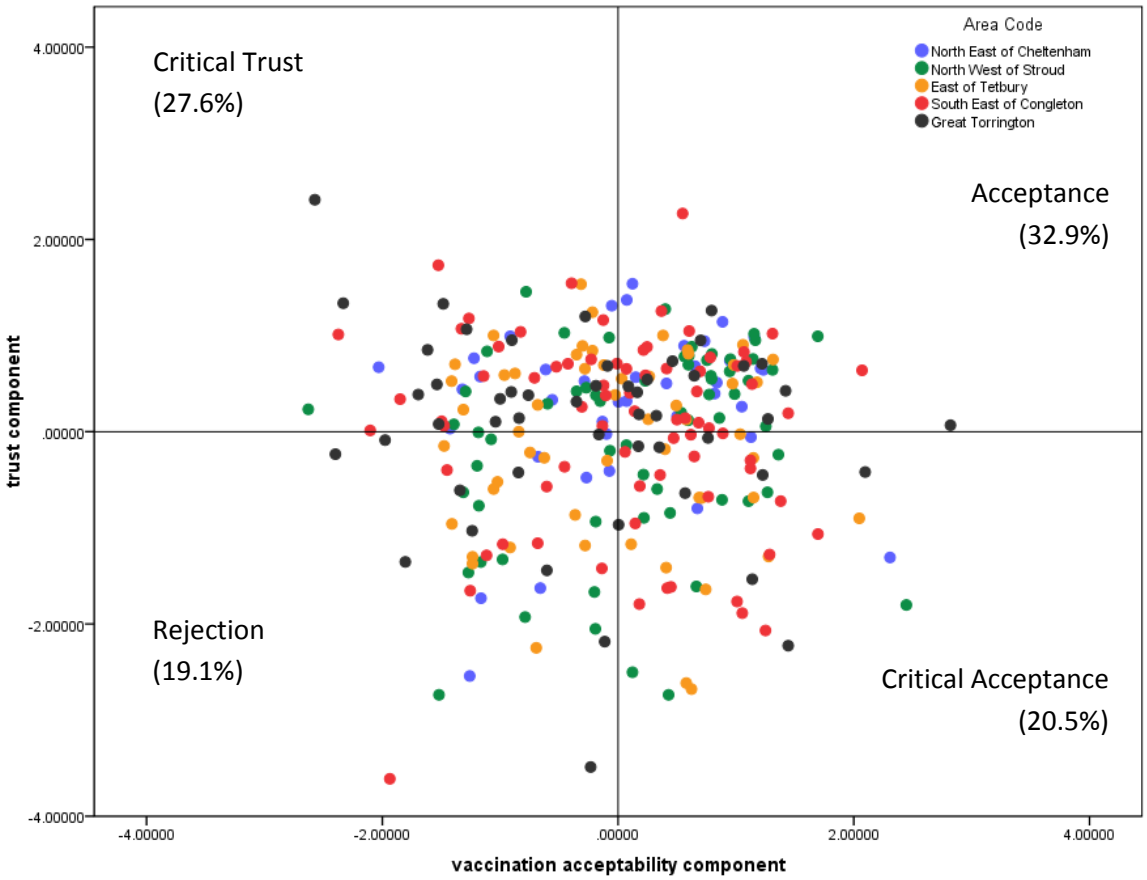
Table 2: Summary of farmers' responses to survey questions relating to their confidence in badger vaccination				
Concept	**Question**	**Response (%)**		
		Strongly Disagree/ Disagree	**Strongly Agree/ Agree**	**Neither Agree-Disagree/Don't Know**
Vaccine Acceptability	Badger vaccination is an acceptable way of dealing with bTB	39.9	41	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 bTB restrictions	39.6	41	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	17.1	20.9
	Badger vaccination will reduce the chances of my herd going under bTB restrictions	24.7	44.9	28.6

Table 3: Summary of farmers' responses to survey questions relating to their trust in the government's approach to badger vaccination and bovine tuberculosis 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	9.7	9.4
	The Government acknowledges mistakes it has made about bTB	43	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
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	57.8	22.7
	Decisions made by the Government about bTB are fair and just	45.7	21.5	30.4

Table 4: Comparison of farmers' willingness to participate in the badger vaccination deployment project and their responses to survey questions relating to trust in government and confidence in badger vaccination.

	Classification of Trust and Confidence (No. Farmers)			
Farmers willing to participate in badger vaccination deployment project in Stroud and Cheltenham	Critical Trust	Acceptance	Rejection	Critical Acceptance
Yes	4	17	3	8
No	12	5	16	3
Don't know	1	1	0	0

Figure 2: Farmers' confidence in badger vaccination and trust in Government derived from a Principal Components Analysis of responses to the survey of farmers' confidence in badger vaccination



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