

REFERENCE No: RES-000-22-1738

BIOSECURITY AND THE REGULATION OF ANIMAL HEALTH:

A CASE STUDY OF BOVINE TUBERCULOSIS

RES-000-22-1738

FINAL SUBMISSION TO THE ESRC

FULL REPORT OF RESEARCH ACTIVITIES AND RESULTS

DR GARETH ENTICOTT

DR ALEX FRANKLIN

Report word count: 4988

REFERENCE No: RES-000-22-1738

1. BACKGROUND

Bovine Tuberculosis (bTb) is an endemic animal disease to the UK affecting cattle and badgers. Cattle are routinely tested and those infected slaughtered. However, the involvement of badgers within the epidemiology of bTb has made managing the disease highly controversial. Badger culling as a means of controlling bTb is supported by farmers and veterinarians, but its effectiveness is questioned by scientists (ISG, 2007) and wildlife groups.

Since 1997, the UK government has been committed to finding solutions to bTb based on “sound science”, reflected in a series of scientific trials to determine the effectiveness of badger culling (Krebs, 1997). In addition, the government has committed itself to making policy in “partnership” with stakeholders; and encouraging farmers to take “ownership” of the problem of bTb by encouraging them to implement forms of “biosecurity” (Defra, 2005).

In defining the solution to bTb in these ways, a need is created, which our research has sought to fulfil, for a social scientific investigation to understand their effectiveness and impacts. The research reported here has therefore consisted of three interconnected strands of inquiry: first, a study of the institutional approaches to bTb policy; second, a study of farmers’ own socio-cultural understandings of animal health and biosecurity; and third, a study of the enforcement of biosecurity regulations.

2. OBJECTIVES

(i) Provide a comparative analysis of institutional approaches to the development of bTb biosecurity policies and assess the role of different forms of knowledge within biosecurity advice.

The objective was met by a comparative analysis of two different partnership groups tasked with producing biosecurity advice. Partnership members were interviewed, observed and documentary evidence analysed. In addition we attended open meetings and interviewed policy staff, scientists and stakeholders associated with the production of bTb policy as a whole. Results are reported in section 3.

(ii) examine farmers' understandings of bTb and biosecurity to help inform strategies for the communication of animal health risks.

The objective was to examine how farmers’ understandings of bTb are constructed, correspond and interact with scientific and policy understandings; and assess the conditions and reasons why biosecurity preventive messages succeed and fail. Similar questions are raised in relation to the sociology of public health (Rose, 1985; Davison et al, 1991). This study applies these theories for the first time to similar strategies now pursued within animal health. This objective has been met by interviewing and participant observation of farmers. Results are reported in section 4.

(iii) examine the implementation of biosecurity regulations by local authorities in order to identify the challenges and solutions to biosecurity regulations .

REFERENCE No: RES-000-22-1738

This objective was met by interviewing Trading Standards Officers responsible for animal health in two local authorities. The research examined how biosecurity regulatory effectiveness was affected by the organisation and management of risks (Vaughan, 2005) and the different styles of regulation employed by enforcement officers (Hutter, 1988). Findings are reported in section 5.

3. METHODS

3.1 Institutional Study

Two partnership bodies responsible for developing biosecurity advice were examined: the Wales TB Action Group (WTBAG) and in England, the TB Husbandry Group (TBHG). These groups were selected because they represented the primary government-led partnership approaches to biosecurity for bTb; involved a range of stakeholders; and allowed a comparison between governmental administrations.

The WTBAG was established in 2004 to advise the Welsh Assembly Government (WAG) on measures to control bTb (EPCC, 2004). The TBHG was established by the TB policy team within Defra in July 2006. The remit of both partnerships was to identify appropriate biosecurity actions and encourage their uptake by farmers. Membership of both partnerships consisted of farming, wildlife and animal welfare stakeholder groups and respectively received support from civil servants within the WAG's Office of the Chief Veterinary Officer (OCVO) or Defra.

All ten members of the WTBAG and four officials from OCVO were interviewed. Seven members of the TBHG and four Defra support staff were interviewed. We were unable to contact two members of the TBHG (from agricultural and wildlife interest groups). Interviews were conducted individually in winter 2006-7. Comparative analysis within and between each group was achieved using a semi-structured interview schedule based around a series of core questions.

3.2 Farmers' Study

Two case study areas were purposively selected in which to conduct the research. The areas (Devon and Monmouthshire) were chosen as extreme cases: both are areas of high bTb risk and farms are tested for bTb annually. High risk areas allowed access to farmers with greater experience of dealing with bTb and allowed comparisons between the different bTb policy regimes in England and Wales.

Farmers were selected purposively. Criteria included: farms constantly suffering from bTb; farms with new bTb incidents; farms that had implemented forms of biosecurity; and farms clear of bTb. This data is not publicly available: research participants were therefore identified by interviewing local vets, agricultural gatekeepers and following social networks. Sample bias was limited by identifying additional farmers based on: farm type and geographical location. In Devon, 30 farmers took part in the research and 26 in Monmouthshire. An additional 5 farmers who had adopted unique biosecurity solutions to bTb were interviewed in a third region (Gloucestershire). Table 1 provides a summary of characteristics of all research participants.

REFERENCE No: RES-000-22-1738

Fieldwork took place in winter 2006-7. Farmers were contacted initially by telephone and interviewed on their farm. Three farmers refused to be interviewed. Interviews were semi-structured, initially piloted with three farmers and lasted between 20 minutes to 3 hours. These data were supplemented with participant observation at markets, during bTb tests, and farm tours. Observations were recorded in a field diary.

3.3. Regulators Study

Biosecurity regulations are enforced by a number of agencies. This research studied the role of Trading Standards because their role has rapidly expanded since 2001; they are responsible for enforcing all aspects of biosecurity (not just in relation to bTb); and they may employ both hard and/or soft (e.g. education) forms of regulation. Two case-study Local Authorities (LAs) were chosen to match the farmers' study (Monmouthshire and Devon). Each LA operated a small animal health team (between 4 and 8 staff). The manager and two field (i.e. enforcement) officers of each team were interviewed in spring 2007. Interviews were semi-structured and lasted between 1-2 hours. We were unable to negotiate access to work-shadow the field officers as originally planned. To compensate, we attended agricultural shows and livestock markets to observe interactions with farmers and field officers for ourselves.

3.4 Analysis and Ethics

Interviews were recorded and transcribed in full where possible. Data was coded and analysed using Nvivo. All respondents were assured of anonymity. For the institutional and regulation aspects to the study, respondents and LAs are anonymised or attributed to partnership members' interests (e.g. agricultural, veterinary, government department). Names of all farmers, place names and locations have been anonymised.

4. RESULTS: PARTNERSHIP AND BIOSECURITY

4.1 Producing Biosecurity

The WT BAG and TBHG were responsible for defining and promoting biosecurity but their approaches and results varied. This derived from different levels of partnership member involvement and interpretations of 'sound science'. Members of the TBHG were initially provided with a 'long list' of potential biosecurity actions. Discussions between members narrowed this down to a short list of 4 actions. Some farming interests insisted that biosecurity advice should have scientific proof that it worked. These interests saw biosecurity as placing unnecessary financial burden and blame upon farmers.

The reliance on science to frame biosecurity was a reversal of farmers' critique of other aspects of bTb science which they argued ignored farmers' practical knowledges (Enticott, 2001, 2008). In fact, Defra officials justified the role of members with farming backgrounds by referring to their practical knowledge of biosecurity measures. The insistence on scientific proof by agricultural interests countered the significance of practical knowledge. However, scientific analyses of

REFERENCE No: RES-000-22-1738

biosecurity interventions are rare and inconclusive. By claiming that biosecurity measures required scientific backing, agricultural interests were able to minimise biosecurity to a handful of measures that were largely already known about by farmers, thereby reducing the significance of the concept of biosecurity.

The TBHG's conclusions were published in two leaflets on Defra's website. Stakeholders were also expected to distribute them amongst their membership networks. However, members did not wholly agree on the content of these leaflets, the method of communication, or the value of their work. In the end, the leaflets did include some common-sense ideas of biosecurity. Some members expressed unease about this because it lacked guarantees. There was also concern about the lack of distribution of these leaflets and their value for those farmers suffering from bTb. For these members, there was doubt that the end product would have an impact. The whole point of the exercise was also questioned: it seemed all that members had done was repackage existing advice rather than generate new ideas.

Biosecurity was constructed differently within the WT BAG. Members discussed which aspects of biosecurity should be included in a trial to encourage on-farm biosecurity in west Wales, known as the biosecurity Intensive Treatment Area (ITA). The group discussed the merits of biosecurity actions and decided that local vets should be used to encourage on-farm biosecurity. The forms of biosecurity that should be promoted were, however, decided at an 'expert opinion workshop' (EOW) using a Delphi methodology to define appropriate biosecurity actions, estimate their importance, and develop a biosecurity quantitative risk assessment, known as the 'scoring tool'. This was to be used by vets during farm visits to provide farmers with a biosecurity action plan.

The EOW involved vets from the ITA and OCVO officials. Only veterinary members of the WT BAG attended. Other WT BAG members' perceptions and ratings of biosecurity risk were therefore not included within the scoring tool. Rather, their main role was to encourage participation and provide legitimacy for the ITA. The scoring tool therefore reflected a scientific rather than a practical approach to biosecurity. It included biosecurity actions that were geographically specific, and those not identified by the TBHG, reflecting different attitudes to biosecurity knowledges and subtle differences in biosecurity actions between England and Wales.

4.2 Partnership Effects

Partnership working is presumed to promote trust between stakeholders, intra-group learning, and consensus decision making (Cowell, 2004). WT BAG members suggested that the partnership had provided a valuable learning function and promoted high levels of intra-group trust between diverse stakeholders. OCVO officials also reported that the partnership had allowed them to learn about different stakeholders' perspectives. However, whilst they respected the group's recommendations when they had been fully debated, the actual process of providing support to the group was seen as a considerable drain on OCVO resources, diverting attention away from developing policy.

However, the WT BAG did not generate trust with the wider political system, consensus-based decision making, or promote attitudinal changes outside the

REFERENCE No: RES-000-22-1738

WTBAG. Members were soon aware that the WTBAG existed so that politicians could demonstrate responsible decision making by making references to partnership and stakeholder involvement and rhetorically deflect tough decisions to the group but remain in total control of policy.

The terms on which the group debated aspects of bTb policy and their recommendations were tightly prescribed. This occurred either by the chair controlling debate; by certain aspects of bTb policy remaining off the agenda; or politicians making decisions without consulting the WTBAG. Examples include the premature cancellation of an epidemiological study of dead badgers; and the limited input group members had in constructing the biosecurity scoring tool.

Consensus was therefore never reached on many issues, either because they were not discussed or only in relation to broad concepts. OCVO officials suggested that the group would not survive discussion of matters such as wildlife control where deep divisions between group members existed. In short, they believed the WTBAG was never going to produce consensus and that partnership appeared to be the wrong vehicle to resolve animal health problems. Group members agreed to an extent, suggesting that what was needed was some strong political direction.

The WTBAG failed to generate any new bTb policy recommendations. Where they had discussed policy, such as the ITA, they were isolated from the process such that their attitudes towards bTb risks did not wholly reflect those within the scoring tool. However, despite their experiences, all members wanted the group to continue. This was because members instead saw the importance of partnership in providing access to key decision makers and the opportunity to influence their thinking, rather than an opportunity for consensus politics. Some members of the TBHG also cited that as a primary motivation for participation rather than promoting biosecurity. Policy was seen as a game – group members had ‘to be in it to win it’, and partnership offered the way in. In Wales, this explains group members’ decision not to abandon the partnership despite receiving little benefit. Thus, when group members were challenged by their peers on the logic of the ITA scoring tool, they suggested that it was something that they had to go along with to be in a position to bargain for a badger cull. In other words, the partnership did not produce a consensus around biosecurity. Rather, biosecurity represented a pawn in a wider policy game.

4.3 Implications

Whilst forms of partnership decision making have extended into many areas of rural governance (Edwards et al, 2001), this research has examined the effectiveness of such approaches within animal health for the first time. In this case, these results demonstrate a large degree of ambivalence towards partnership and consensus based decision making amongst partnership members.

Findings suggest that partnership should be used carefully to resolve animal health problems rather than employing partnership in ritualistic or path-dependent styles of policy making. If partnership is important, new organisational structures for animal health may be required instead. These should promote better engagement with farmers and ownership of animal health proposals. However, these results suggest that partnership may never produce consensual decision making in some cases (such as

REFERENCE No: RES-000-22-1738

bTb). In these circumstances, attempts to use partnership will contribute to loss of trust in government and encourage ineffective policy making.

These results also demonstrate a more complex relationship between stakeholders and knowledge within endemic animal disease controversies compared to studies of exotic diseases such as Foot and Mouth. The alignment of ‘distanced’ and ‘proximate’ knowledges to political and agricultural interests (Bickerstaff and Simmons, 2004) is repeated within bTb debates (see also section 5). But, in attempting to influence policy, partnership members have also shown these relationships to be fluid and dependent on political priorities. These new relationships represent ambivalent commitments to knowledge (Wynne, 1992) rather than consensus based approaches to decision making.

5. RESULTS: FARMERS’ UNDERSTANDINGS OF BIOSECURITY AND bTb

5.1 Understandings of Biosecurity

Farmer interviews revealed that many were dismissive of biosecurity as a form of resolving bTb. Reasons for this include:

(a) biosecurity is understood in relation to particular styles of farming. It is associated with intensive agriculture where cattle are permanently housed. Farmers referred to biosecurity as an attempt to ‘Colditz’ the farm but these styles of agriculture had little cultural value, despite the biosecurity risks of more “open” systems.

(b) biosecurity is primarily understood to refer to disinfection and badger fencing. These meanings have been popularised by (i) the FMD outbreak, and (ii) previous advisory literature. Farmers suggested the impracticality of fencing was symptomatic of Defra’s misunderstanding of agriculture and nature. The connections between biosecurity and previous policy failures provided farmers with a rationale to mistrust ideas of biosecurity from the outset.

(c) definitions of biosecurity vary between farmers, scientists and policy makers. Vets and scientists tend to use a broader definition of biosecurity. The discourse of biosecurity also has cultural nuances meaning that some biosecurity terms such as ‘closed herd’ can have multiple meanings. These differences may mean other ways of describing preventive animal health may be more suitable.

5.2 Understanding bTb: luck and fatalism

Amongst bTb scientists and policy makers, a rational acceptance and diffusion of biosecurity measures is assumed. This is based on presumed economic benefits of biosecurity or the role of biosecurity promotional information. Interviews with farmers suggest a more complex understanding of biosecurity based on their own experiences of animal health. Farmers explain and predict bTb outbreaks using their own and neighbours’ experiences and these stories are transmitted within the agricultural community. This creates an overall profile of the kind of farm, farmer and cattle who are likely to suffer from bTb. This ‘system of candidacy’ (Davison et al, 1991) is used retrospectively to explain bTb outbreaks; to predict bTb based on

REFERENCE No: RES-000-22-1738

particular management practices; or assess farmers' own risk of bTb. The system reveals farmers' knowledge of biosecurity can be well developed. A lack of information therefore can only provide a partial explanation to the absence of biosecurity.

The candidate system does not necessarily result in the implementation of additional biosecurity practices. This is because farmers develop their own "lay epidemiologies" to cover locally contingent factors beyond 'official' scientific and policy explanations of bTb. Importantly, farmers suggest that luck plays a significant role in determining bTb outbreaks. The significance of luck originates in farmers' own observations of attempts to prevent bTb and the circulation of accounts of other farmers' attempts at local and national levels. Luck is demonstrated in relation to exceptions to 'official' preventive measures. This includes, first, farmers' practical experiences and observations of the way the tuberculin test is used and results interpreted to detect bTb infected cows. Second, the apparent lack of cattle to cattle transmission upon farms where healthy cattle have been housed among infected cattle. Third, the uncertainties and exceptions to recommended herd management practices (in particular, advice on restocking practices). Finally, the perceived impossibility and impracticality of preventing badgers entering farm buildings using electric fencing.

These exceptions reinforce the role of luck in determining bTb outbreaks and provide an incentive not to implement biosecurity or ignore existing regulations. In high risk areas, farmers are therefore fatalistic about bTb. They describe bTb as a way of life: outbreaks are no longer a surprise. Importantly, the communication of biosecurity advice may contribute to this fatalism. Where approaches rely on generalised advice, the exceptions to the rules are quickly recognised and used as justifications for ignoring advice – what Rose (1985) calls the 'prevention paradox'. The interaction between farmers' understandings and biosecurity advice leads farmers to rely on their own "lay epidemiologies" to manage bTb. This includes: illegal badger culling; missing bTb tests as a coping mechanism for the stress it brings; failing to isolate infected cattle; and restocking from high risk bTb areas because of beliefs in immunity and susceptibility.

Reluctance to implement new forms of biosecurity was also linked to farmers' distrust of government and science. Faith in bTb science was minimal because it was poorly conducted and its terms of reference "politically slanted". Loss of trust was also connected to distance and isolation from Defra. This reflects criticisms of Defra during the FMD crisis (Anderson, 2002) and suggests a failure to learn lessons from FMD. However, farmers reported that they would trust their local vet to provide them with biosecurity advice, reflecting the local and cultural environment in which farmers understandings of biosecurity are made.

5.3 Implications

These findings show for the first time how farmers' understandings of animal health are constructed. These knowledge processes reflect those found within the sociology of public health (Davison et al, 1991; Rose, 1985). These theories suggest that ideas of 'candidacy' and the 'prevention paradox' emerge in relation to the communication of general health advice to an entire population – what Rose (1992) calls the 'population approach'. However, in applying these ideas to animal health, our

REFERENCE No: RES-000-22-1738

research shows that the candidate system is influenced by interactions between general biosecurity communication and the use of targeted interventions such as diagnostic tests, as well as the social and political contexts in which they are used.

These findings are particularly relevant to the design of effective biosecurity communication. If governments are serious about encouraging biosecurity, new ways of communicating and engaging with farmers' understandings of risk are required. This may involve more targeted methods, social learning and using trusted advisors and 'champions' within the agricultural community. Greater use of social research is also necessary in formulating biosecurity policies. The absence of social research within Defra's portfolio of bTb research has meant that bTb has been framed as a problem that can only be answered by veterinary and scientific disciplines. By ignoring social understandings of animal health, policy effectiveness is compromised.

6. RESULTS: LOCAL AUTHORITIES' REGULATION OF BIOSECURITY

6.1 Recruitment and Training

Funding for employment of enforcement officers is sourced from the LA budget and external DEFRA funds. Support from the latter has been made available since the 2001 FMD outbreak and is based on an authority's needs to meet a set of minimum requirements. Currently, funding is renegotiated every three years. This means that field officers (FOs) are employed on temporary contracts and results in high staff turnover. Recruiting new officers with experience of enforcement and animal health is difficult and the short-term contracts on offer means good staff and their expertise developed during their time in post can be difficult to retain.

FOs are tasked with enforcing a wide range of animal health regulations. However, there is no formal statutory requirement for FOs to have any formal qualification. This contrasts to other areas of Trading Standards (for example, Food Hygiene). Limited funding also means that in the absence of any statutory requirement, the level of training provided either to new or existing recruits is limited. New recruits participate in a five-day training course in Taunton (attended by officers from across England and Wales) which focuses on animal health legislation. The remaining skills are then learnt from direct experience and observation of other enforcement officers during employment. For existing employees, continual professional development training is available on an 'ad hoc basis'. Limited funding means that priority is given to permanently contracted staff.

6.2 Enforcing Regulations

FOs can be characterised by two different forms of experience. First, FOs who possess knowledge of enforcement – often from previous careers in the police force. Second, FOs who possess knowledge of farming systems – usually because of family connections to farming. These experiences, as well as other personality factors inform different styles of enforcing animal health regulations adopted by FOs. Perceptions of these different styles of regulation and the characteristics of field officers were used by Trading Standards managers to guide the management of their department. For example, interviews suggested that recruitment of new field officers

REFERENCE No: RES-000-22-1738

is guided by these factors. In some LAs the good understanding of farming shown by those candidates with farming backgrounds counted in their favour, but in others it did not because of fears of bias. To allay these concerns, newly recruited staff may be initially paired with an officer with a different regulatory background. However, workload pressures mean that lone working is more common for FOs. As a result, the farming community experience a range of different styles of enforcement depending on the mindset of the individual officers which may limit the effectiveness of compliance.

FOs expressed unreserved support for strategies which enable them to create a much stronger profile within the farming community – not only as an enforcement officer, but also as a source of education and advice. This has been assisted and complicated by the challenge of translating new policy into enforcement practice. FOs are required to attend all commercial markets held within their Authority. The effect of this has been to raise the profile of FOs and their work amongst farmers. FOs believe that this visibility alone plays an important role in raising awareness and encouraging good biosecurity practice. Firstly, it provides opportunities for farmers and hauliers to ask FOs questions about regulations. Secondly, the time spent at market provides FOs with intelligence of those individuals who, for example, repeatedly ignore advice.

FOs believe they would achieve better biosecurity through a more proactive educative biosecurity role. However, this is circumvented by new regulatory commitments which are ill-defined and difficult to enforce. One example is the Transport of Animals (Cleanse and Disinfect) Order (2003). All vehicles transporting animals to market have to be cleansed and disinfected (C&D) within 24 hours. C&D equipment is provided on-site, but may be limited, resulting in large queues which discourage their use. If so, farmers/hauliers sign a declaration saying C&D will be performed at their farm and are liable to inspection by FOs to check compliance. The practical realities of this regulation mean that if farmers fail to comply, it is extremely difficult to enforce because:

- declarations are often incorrectly completed;
- if FOs arrive at a farm a few hours before the 24-hour deadline, the owner of the vehicle still has time to comply;
- should FOs arrive after the deadline, the owner of the vehicle can claim C&D has already occurred, but the vehicle has since been used to transport more animals;
- FOs rely on receiving notification from other LAs when farmers attend markets/abattoirs outside of the LA in which they live. Frequently, FOs do not receive this information in enough time in order to act upon it;
- low staffing levels mean that inspection levels are only 10% of the total number C&D declarations. The potential for non-compliance is higher at weekends when Trading Standards is closed, or during market days when FOs are occupied elsewhere.

6.3 Implications

These findings support the existence of different styles of regulation within animal health (cf. Hutter, 1988) and the significance of organisational factors in effective animal health regulation. For LAs to play an effective role in biosecurity regulation,

REFERENCE No: RES-000-22-1738

the research suggests that greater support is required to improve levels of training and address recruitment problems. However, the organisational barriers identified above suggest that proactive biosecurity education may be encouraged by better regulation and coordination between other animal health agencies. As these findings draw on only two LA case studies, further research in other LAs and animal health agencies is also required.

7. ACTIVITIES

Research findings have been communicated in oral and written form to government departments, partnership groups, stakeholders and to government inquiries concerning bTb policy. These include (dates are given for when oral evidence was delivered):

- Welsh Assembly Government (18th January, 2008)
- EFRA Select Committee (November 26th, 2007)
- Defra TB Policy Team & TB Advisory Group (October 25th, 2007)
- TB Husbandry Group (September 7th, 2007)
- Defra TB husbandry policy team (August 31st, 2007)
- Badger Trust (July 29th, 2007)

The research has also featured within the national media:

- Farming Today This Week (August 11th, 2007)

Findings have been communicated to different academic audiences. At the European Congress for Rural Sociology, we organised a working group on biosecurity and rural vulnerability which attracted international researchers. These papers will be published as special edition of *Sociologia Ruralis* edited by the researchers. The Principal Investigator is also jointly editing a biosecurity special edition of *Environment and Planning A*. Research findings were presented at academic conferences and seminars, including:

- Animals and Society Conference, Hobart, Tasmania, July, 2007
- Seminar at the Tasmanian Institute of Agricultural Research, University of Tasmania, July 2007.
- Royal Geographical Society annual conference, London, August 2007
- European Congress for Rural Sociology, Wageningen, Holland, August 2007
- Seminar at the Liverpool University Veterinary School, January, 2008.

REFERENCE No: RES-000-22-1738

8. OUTPUTS

The research has led to a number of conference papers that are currently being prepared for publication. These and papers already submitted are listed below:.

Enticott, G. (2008) 'The spaces of biosecurity: prescribing and negotiating solutions to bovine tuberculosis'. Accepted in biosecurity special issue, Environment and Planning A.

Enticott, G. (2008) "The 'ecological paradox': social and natural consequences of the geographies of animal health promotion. Submitted to Transactions of the Institute of British Geographers.

Franklin, A. and Enticott, G. (2007) "Biosecurity, "Sound Science" and "Partnership Decision Making". Presented at the XXII European Congress for Rural Sociology, Wageningen, August 2007. To be submitted to Sociologia Ruralis.

Enticott, G. and Franklin, A. (2007) Farmers' attitudes to culling and curing badgers from bovine tuberculosis. Presented at the Animals and Society II Conference, Tasmania, July, 2007. To be submitted to Society and Animals.

9. IMPACTS

The activities detailed in section 7 have had the following known impacts:

- Members of the EFRA select committee commented that they found the research helpful in understanding farmers' reactions to biosecurity and using it to write their report to Defra (to be published in 2008).
- The research established a close working relationship with OCVO. We frequently met staff informally during the project to discuss findings and policy implications. This contributed to the inclusion of a social research element to the evaluation of the WAG's biosecurity ITA. The researchers designed and conducted this evaluation.
- The Principal Investigator has been appointed to the evaluation group of the WAG's bTb eradication plan.
- The project has led to new inter-disciplinary and international academic networks which will look at issues of veterinary science, training and practice.

10. FUTURE RESEARCH PRIORITIES

The project has already led to follow-up research activities. Project overheads were used to fund pilot research using participant observation to examine the implementation of animal health procedures by vets. This led to a successful ESRC grant which commences in 2008.

REFERENCE No: RES-000-22-1738

Other priorities for future work include:

1. Further data analysis and publication of research papers. Four papers are currently in preparation dealing with: the effect of animal health partnerships; the construction of biosecurity within partnerships; farmers' understandings of bTb and biosecurity; and styles of animal health regulation.
2. Outstanding questions raised by the research include: analysis of farmers' understandings of biosecurity in low risk areas; quantitative analysis of farmer behaviour following bTb outbreaks; analysis of farmers' health and well-being associated with endemic animal disease; and further analysis of organisational barriers to animal health regulation.
3. Research findings highlighted inter-disciplinary connections between the social, veterinary and agricultural sciences and led to the establishment of new research networks during the project. These connections will be developed by comparing existing data and pursuing inter-disciplinary research funding opportunities.

REFERENCE No. RES-000-22-1738

Table 1: Farm Characteristics of Farmers Participating in the Study

	Devon	Monmouth- shire	Gloucester- shire
Number of Farms	30	26	5
Previously under restriction	25	22	5
Currently under restriction	12	12	3
Never under restriction	5	4	0
Dairy	22	18	4
Beef	8	8	1
Organic	5	5	2

REFERENCE No. RES-000-22-1738

REFERENCES

Anderson, I. (2002) *Foot and Mouth Disease 2001: Lessons to be Learned Inquiry Report*. HMSO: London.

Bickerstaff, K. and Simmons, P. (2004) 'The right tool for the job? Modelling, spatial relationships and styles of scientific practice in the UK foot and mouth crisis'. *Environment and Planning D: Society and Space*, 22: 393-412.

Cowell, R. (2004) 'Community planning: fostering participation in the congested state?' *Local Government Studies*, 30:4, 497 - 518

Davison, C., Smith, G.D., and Frankel, S. (1991) Lay epidemiology and the prevention paradox: implications of coronary candidacy for health education. *Sociology of Health and Illness*, vol.13 (1), 1-19.

Enticott, G. (2001) Calculating nature: the case of badgers, tuberculosis and cattle. *Journal of Rural Studies*, 17 (2), 149-164.

Enticott, G. (2008) 'The spaces of biosecurity: prescribing and negotiating solutions to bovine tuberculosis'. Accepted in biosecurity special issue, *Environment and Planning A*.

Department for Environment Food and Rural Affairs [Defra] (2005) *Government strategic framework for the sustainable control of bovine tuberculosis (bTb) in Great Britain*. Defra: London.

Environment, Planning and Countryside Committee [EPCC] (2004) *Inquiry into Bovine Tuberculosis*. National Assembly for Wales: Cardiff.

Hutter, B. (1988) *The Reasonable Arm of the Law?* Clarendon Press: Oxford.

Independent Scientific Group [ISG] (2007) *Bovine Tuberculosis: The Scientific Evidence*. Defra: London.

Krebs, J. (1997) *Bovine Tuberculosis in Cattle and Badgers*. London: Ministry of Agriculture, Fisheries and Food.

Rose, G. (1985) Sick individuals and sick populations. *International Journal of Epidemiology*, 14(1): 32-38.

Rose, G. (1992) *The Strategy of Preventive Medicine*. Cambridge University Press: Cambridge.

Vaughan, D. (2005) Organizational rituals of risk and error. In Hutter, B. and Power, M. (Eds) *Organizational Encounters with Risk*. Cambridge University Press: Cambridge. pp. 33-66.

Wynne, B. (1992) Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science*, 1: 281-304.