



The Centre For Business Relationships,
Accountability, Sustainability and Society

WORKING PAPER SERIES No. 44

Biosecurity, "Sound Science" and the Prevention Paradox:
Farmers' Understandings of Animal Health



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**Biosecurity, “Sound Science” and the Prevention Paradox:
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Abstract

Drawing on the example of bovine Tuberculosis (bTb), this paper argues that the failure to include social science within discourses of “sound science” has compromised attempts to encourage farmers to implement “biosecurity” and generate agricultural “ownership” of animal diseases. Using theories from the sociology of health and agricultural extension, the paper outlines the importance of cultural understandings of animal health and biosecurity for effective policy making. Analysis of ethnographic interviews with 61 farmers in England and Wales provides a range of reasons why farmers do and do not implement biosecurity. Drawing on the concept of lay epidemiology and ideas of ‘the candidate’ – that is, the terms by which someone/thing is most likely to suffer from a particular illness – the paper shows how farmers construct other farmers, farms, cattle and badgers as likely to be a candidate for bTb; and how aspects of luck and fatalism are significant elements of candidacy. In failing to consider the cultural understanding of disease, the paper argues that official versions of animal health have served to reinforce the explanatory power of candidacy and traditional understandings of bTb, thereby overriding attempts to promote biosecurity.

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Published by

The Centre for Business Relationships, Accountability, Sustainability & Society (BRASS)
Cardiff University
55 Park Place
Cardiff CF10 3AT
United Kingdom
<http://www.brass.cf.ac.uk>

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ISBNs 978-1-906644-00-0 (print)
978-1-906644-01-7 (web)



Introduction

According to the Department for Environment Food and Rural Affairs (*Defra, 2005a*), bovine tuberculosis (bTb) is one of the most difficult animal health problems currently facing the UK. Present in cattle and badgers and transferable to humans, dealing with the problem of bTb currently costs the UK taxpayer £90million per annum. In approaching this problem, Defra has come to frame policy approaches within a set of interlocking discourses. These include, firstly, the use of “sound science” on which to base policy; in turn this has led to the use of “biosecurity” to prevent the spread of disease; which finally relates to the need for the agricultural industry to take “ownership” of the disease for it to be eradicated (*Defra, 2005a*). Such discursive framings have elsewhere been shown to provide the context for environmental political decision making (*Hajer, 1995: 15*). Thus, Ward et al’s (*2004*) analysis of the 2001 Foot and Mouth outbreak concludes that its poor handling can be traced to the framing of the outbreak as an agricultural problem rather than one of the rural economy. Yet, as Ward et al show, changing the frames in which policy is developed remain a challenging task.

Rather than consider the precise processes behind policy framing, the aim of this paper is to demonstrate the impact of the failure to reframe animal disease policy within the policy development process. The central argument relates to the importance of including social science within any “sound science” approach to disease control strategies. In determining the definition of “sound science”, it seems that Defra have ignored vital social questions which affect the implementation of animal disease policy. Whilst Defra have always insisted that any new bTb policies would have to be socially acceptable, this seems to be where any concern for “the social” begins and ends. For example, between 1996-2006, Defra spent approximately £70million on research into bTb. Only 0.1% of this was spent on social research. Similarly, a review of the evidence for bovine Tuberculosis commissioned by Defra’s Science Advisory Council failed to include socio-economic research within its terms of reference (*SAC, 2005*).

Instead, bTb policy has become framed uniquely as a scientific and/or veterinary problem. Such a scenario is not unusual. A quick look through any of the academic journals dealing with disease control (e.g. *Preventive Veterinary Medicine*) reveals that social and cultural factors within

disease control strategies are rarely or only briefly discussed (*see for example Lindberg and Houe, 2005*). However, in neoliberal democracies where governments seek to change behaviour and develop ownership of problems through subtle rather than overt regulations and technologies (*Rose, 1999*), the value of social science lies in understanding social behaviour and constructing subtle management technologies.

In the UK, this challenge has for a long time been taken seriously within the Department of Health. Here, social science is valued for seeking effective ways of changing ‘risky’ lifestyles and monitoring the social impacts and acceptability of medical practices. Defra too accept that ‘social science has a crucial part to play in informing us of likely responses (by the public and by industry) to scientific developments and in helping to design effective policies and strategies’ (*Defra, 2004: 11*). The resulting ‘people-based focus’ approach to social science (*Defra, 2006a: 10*) is seen as vital in understanding and influencing social behaviour. The focus here has related to using social science to address the challenges of climate change and flooding. At the same time, social science has made previous contributions to ensuring agricultural productivity, securing agri-environmental outcomes (*Defra, 2006b*) and designing effective agricultural extension services (*Vanclay, 2004*).

This paper therefore attempts to demonstrate the value of the type of social science used in the sociology of health for animal disease policy makers. Drawing on the concept of lay epidemiology and ideas of ‘the candidate’ – that is, the terms by which someone/thing is most likely to suffer from a particular illness – the paper shows how farmers construct other farms and cattle as likely to be a candidate for bTb; and how aspects of luck and fatalism are significant elements of candidature. The paper argues that the failure to consider the social dimensions to animal disease has resulted in policy which reinforces the explanatory power of candidacy thereby overriding scientific attempts to promote animal health.

To do this, the paper draws on data from 61 ethnographic interviews with farmers in England and Wales conducted during 2006 and 2007 as part of an ESRC funded project examining the regulation of biosecurity and animal health. Fieldwork was undertaken in two case study areas. The two areas selected (Devon and Monmouthshire) were chosen as “extreme cases”: both are

areas of high bTb risk and farms are tested for bTb on an annual basis. The selection of high risk areas allowed the research to access farmers with a greater understanding and experience of dealing with endemic animal disease. Farmers were selected according to purposive criteria, including: farms that had been under bTb restrictions for a constant period; farms with new cases of bTb; farms that had always been clear from bTb; farms that had implemented forms of biosecurity; and farms that had closed down following bTb outbreaks. This data is not freely available: research participants were therefore identified with the help of local vets, other agricultural gatekeepers, and social networks. To limit the possibilities of bias, the sample was also supplemented by contacting other farmers according to other criteria, including: farm type; and geographical location. In Devon, 30 farmers participated in the research, and 26 were drawn from Monmouthshire. The sample was supplemented with a further 5 farmers from farmers in a third region (Gloucestershire) who had each adopted unique approaches to dealing with bTb. In total, the main business for 44 farms was dairy and the remainder beef; 28 farms were suffering from bTb at the time of the research, but 53 had suffered had experienced it in the past. All interviews were semi-structured, recorded and transcribed. Participants were assured of confidentiality and anonymity at all stages of the research. Interview data were also supplemented with other ethnographic data deriving from conversations and participant observation with farmers at markets, during bTb tests, at an abattoir, and unrecorded conversations with farmers during farm tours. These observations were recorded in a field diary. Analysis of all data was achieved using the qualitative data analysis software Nvivo.

The paper begins by providing an overview of bovine tuberculosis policy in England and Wales and the role for biosecurity. The paper then examines the potential for the application of theories from the sociology of health to that of animal health. It then turns to farmers' attitudes towards biosecurity and animal health. In conclusion it considers the extent to which findings could have been avoided using different modes of engagement with the agricultural community.

The Problem of Bovine Tuberculosis and the Rise of BioSecurity

Since the late nineteenth Century, bovine Tuberculosis (bTb) has been recognised as a serious disease affecting both cattle and human health. The turn of the century was characterised by

scientists and politicians debating the best way to deal with the disease (*Waddington, 2006*). Pasteurisation and government meat inspectors began to deal with the public health issues, but it wasn't until 1935 that cattle health was addressed through a voluntary cattle test and slaughter programme. After the Second World War, the policy was made compulsory and by the mid 1960's the government were claiming that the disease had been virtually eradicated (*MAFF, 1965*).

However, by a strange twist of fate, the early 1970s saw two conflicting events that reignited and reframed the problem of bovine tuberculosis. The first was a chance discovery on a Gloucestershire farm in 1971. The cattle on the farm had recently suffered from a breakdown of bovine tuberculosis. Despite the claim of virtual eradication, isolated cases of TB had rumbled on. The 1971 case in Gloucestershire was critical because a dead badger had also been found on the farm. Subsequent post-mortem tests revealed that the badger had also been suffering from bTb. Coincidentally, at the same time, the 1973 Badger Act achieved royal assent. The act has been a long time coming and finally conferred a respectable level of protective measures for the badger (*Meyer, 1986*). In subsequent years, new laws were passed (*e.g. 1981 Wildlife and Countryside Act and the European Union's Habitat directive*), closing loopholes in the original legislation, resulting in the 1992 Badger Protection Act which provided protection to badger setts as well as the animals themselves. These acts also confirm the UK's commitment to the Bern Convention in which badgers are listed as a protected species.

These events created a paradox. On the one hand, badgers were the prime suspect in perpetuating a public and animal health problem. On the other, they were an established cultural icon, protected in law from agricultural interests. For the Ministry of Agriculture Food and Fisheries' (MAFF), this conundrum was easily solved. They proceeded with a range of badger culling experiments, revealing that the absence of badgers resulted in lower levels of bTb. As a result, various badger culling policies were implemented. These strategies were met by public opposition, but policy reviews in 1979 and 1985 upheld the continued culling of badgers, albeit in different forms. However, by the mid 1990s there was concern that the slaughter policies were not working. Cases of bTb were rising so the government called on leading scientists to review the evidence base and propose a solution based on "sound science". The resulting Krebs (*1997*)

report, established a series of scientific culling trials to establish their effectiveness in controlling bTb. The trials were run by the Independent Scientific Group (ISG). They began in 1998 and ran for 7 years. When the final results were released in 2007, the ISG (p.5) argued that ‘badger culling can make no meaningful contribution to cattle TB control in Britain’. Results were based on the significance of badger ‘perturbation’ following culling events. That is, where badger culling does not eliminate entire badger populations, the remaining badgers spread the disease (*Woodroffe et al, 2006*). The positive benefits of badger culling are therefore almost outweighed by the negative (perturbation) effects. Instead, the ISG recommended tighter controls on cattle movements, greater use of better diagnostic tools and enhanced on-farm biosecurity (*ISG, 2007*). At the same time, Defra instigated a system of pre-movement testing: all cattle now have to pass a test declaring them bTb-free before they can be moved (e.g. to market). Compensation levels for bTb infected cattle were also reduced. Agricultural interests nevertheless continue to call for badger culling as a means of eradicating the disease (*EFRA, 2007*) and illegal badger culling continues in bTb endemic areas (*see Enticott and Franklin, 2007*).

Promoting Animal Health: A View from the Sociology of Health and Illness

The ISG’s work followed a definition of “sound science” which broadly followed the traditions of the experimental and positivistic natural sciences. In doing so, a range of social and cultural aspects of illness and disease are ignored. Their significance is explained within a range of theories from the sociology of (human) health and illness. Within the sociology of health and illness, particular attention has been paid to the ways in which health promotion messages are received, understood and acted upon by the general public. This research is similar to that examining the practice of agricultural extension and the ways in which farmers learn to adopt new behaviours (*Pannell et al, 2006*). Of particular use within the sociology of health is Rose’s (1985, 1992) seminal work which contrasts the experiences of ‘sick individuals and sick populations’ and their consequences for preventive medicine. Rose argues that a focus on sick individuals leads to a focus on the causes of individual cases, whilst a focus on sick populations is concerned with the causes of incidence. Preventive strategies also differ along the same lines. For sick individuals, a high risk strategy is required. This provides appropriate intervention relevant to the individual as a result of, for example, screening. This approach is cost-effective,

motivational for both patient and physician, but may also only find borderline cases for whom appropriate treatment is not available. More seriously, Rose argues that the approach 'does not deal with the root of the problem, but seeks to protect those who are vulnerable to it' (p.36). As a result, by requiring individuals to change their lifestyle contra social norms, it is behaviourally inappropriate. As Rose points out: 'no-one who has attempted any sort of health education effort in individuals needs to be told that it is difficult for such people to step out of line with their peers' (p.37).

For sick populations, an alternative population strategy is required. This seeks to 'control the determinants of incidence, to lower the mean level of risk factors, to shift the whole distribution of exposure in a favourable direction...in its modern form it is attempting...to alter some of society's norms of behaviour' (p.37). Unlike the high risk approach, these large-scale communication attempts target whole populations making their interventions behaviourally appropriate. However, a significant drawback is what Rose calls the 'prevention paradox' – that is 'a preventive measure which brings much benefit to the population offers little to each participating individual' (p.38). Rose explains that the population strategy 'offers only a small benefit to each individual, since most of them were going to be alright anyway, at least for many years' (p.38). As a result, these strategies are demotivating for both patients and physicians: 'grateful patients are few in preventive medicine, where success is marked by a non-event' (*ibid.*).

A prime example of the 'prevention paradox' is illustrated by Davison et al's (1989, 1991, 1992; Frankel et al, 1991) work on coronary heart disease (CHD). Davison et al's research highlights the extent to which medical disciplines such as aetiology have 'identifiable counterparts in the thoughts and activities of people outside the formal medical community' (p.6). One example is that of 'lay epidemiology'. Davison et al stress the extent to which this form of lay knowledge has much in common with its scientific equivalent: 'individual cases (from personal observation or report) of people who are known to have suffered heart disease are purposefully linked to other circumstances surrounding the event. From this data, regularities are noted and these contribute to the generation of explanatory hypotheses which serve to challenge or support suspected aetiological processes' (p.7). These ideas are mediated by popular culture but the overall effect is

to give ‘coherent form and substance by the use of an overall profile or image of the kind of person who tends to suffer from heart trouble. This person is the “candidate”’ (p.7).

In relation to CHD, Davison et al identify four distinct uses of the idea of candidacy. Firstly, candidacy is used as a retrospective explanation; secondly, to predict other peoples’ illness and death; thirdly, as a retrospective explanation of one’s own illness; and fourthly, as an assessment of one’s own risk from illness or death (p.8). In each case, candidacy rests on physical appearance, social information and personal information (p.11). Social information relates to hereditary factors, geographical factors and occupational status. Personal information refers to the individual’s own behaviour. For CHD, these factors include ‘smoking, eating large amounts (especially of fatty food), or consuming excessive amounts of alcohol...[or] whose personal natures tend towards nervousness, excessive worry or regular bouts of anger’ (p.12).

Davison et al point out that ‘almost any type of person could be a candidate’ (p.13) but also that the whole system is recognised as fallible (p.14). That is to say that ‘not *all* candidates develop the illness’ and/or that ‘deaths occur to people who do not fit any particular candidacy profile’ (p.14). These anomalies are explained through an omnipresence of chance. In this respect, Davison et al argue that the candidate system provides a second function of explaining the role of bad luck, fatalism, chance and randomness of sudden events, alongside its first function of predicting illness and assessing risk (*see also Pill and Stott, 1982*). In that respect it reflects the importance of the cultural experience of illness. The significance of common-sense and folk ideas has been recognised as a significant factor in determining health-related behaviour (*Helman, 1994*). Inherent within the ‘prevention paradox’ is the ‘privilege of experience’ (*Williams and Popay, 1994*) and its ‘transformative’ effect in understandings of risk (*Hunt and Emslie, 2001: 445*). A focus on risk factors disconnects individuals from their social context (*Popay et al, 1998*) thereby highlighting the ‘fundamental gap which exists between a person’s experience of a given reality and science’s explanation of that same reality’ (*Gifford, 1986*).

For Backett and Davison (1992) however, the significance of these lay epidemiologies lie in relation to the communication of preventive advice. Health promotion initiatives, they argue, ‘are more likely to achieve success if they work with and not against popular culture’. For CHD,

drawing directly from Rose, Davison et al highlight how the ‘prevention paradox’ leads to ‘a situation in which many individuals change their lives to no personal end – they would not have had a heart attack anyway’ (p.15). Davison et al argue that the simple health promotion messages responsible for this paradox have two further consequences: firstly, because so many other factors are involved in illness causation, the number of individuals who survive risky behaviours becomes greater. This happens because aspects of lifestyle previously considered ‘normal and safe’ become labelled as pathogenic. Secondly, while the number of coronary cases who were not apparently at risk diminishes, ‘the cases of the individuals who do all the ‘correct’ healthy things and yet still succumb to heart trouble become very well known’ (Davison et al, 1992, p.683). These ‘unwanted deaths’ are part and parcel of the candidate system. However, the ironic consequence of the population approach to health promotion is therefore ‘that these cultural concepts are given more rather than less explanatory power by the activities of modern health educators, whose stated goals lie in the opposite direction’ (p.16).

Biosecurity and Candidacy: Explaining Farmers’ Understandings of Bovine Tuberculosis and Biosecurity

The lesson of the ‘prevention paradox’ suggests that care needs to be taken when using a population approach to manage and promote animal health. The remainder of this paper attempts to show how this lesson has not been applied to the communication of biosecurity advice for bovine tuberculosis. Firstly, the paper shows how the population approach has resulted in a series of messages focussing on a range of specific risk factors in bTb transmission. Secondly, it explores reactions to these messages by focussing on the construction of candidates and the role of luck. Thirdly, it highlights the consequences of the resulting prevention paradox.

(i) Biosecurity as a Population Approach to Animal Health

Following the outbreak of 2001 Foot and Mouth Disease in the UK, the concept of ‘biosecurity’ became a key concept in the management of animal health. Whilst the meaning of biosecurity is multiple and contested (Donaldson, forthcoming), its essential meaning of preventing contact with disease allows for a variety of control measures. Primarily, biosecurity for bTb has relied on

testing cattle using an intradermal tuberculin injection (known as the ‘skin test’), slaughtering cattle that react to the test, and imposing cattle movement restrictions on infected farms until subsequent tests prove the absence of bTb within the herd. Early investigations into outbreaks of bTb also focussed on the role of husbandry measures such as double fencing (*Richards, 1972*). More recently, as the ISG’s experiments have suggested that badger culling has a limited future in managing bTb (*ISG, 2007; but see King, 2007*), the need for ‘enhanced on farm cattle and wildlife biosecurity’ (*ISG, 2006: 6*) has been highlighted. Research revealed that badgers infected with TB were likely to forage for food in cow sheds at night, urinating and defecating upon silage and other food sources (*Garnett et al, 2002, 2003*) and a correlation between this behaviour and bTb infection (*Gettinby, 2004*).

Support for these arguments came from the Agricultural Select Committee which argued that farmers should take more responsibility of its own interests. An expert panel was established to review evidence on husbandry and biosecurity (*SCA, 1999, para. 111*), concluding by advocating enhanced biosecurity measures. By 2004, improved biosecurity and husbandry were therefore seen as key weapons in the fight against bTb by scientists, politicians and conservation groups. The minister for animal health, Ben Bradshaw MP, exhorted farmers to do more to prevent badgers from entering their cattle sheds and feed stores and fence off pasture from badgers, claiming that the farms he had visited had ‘*absolutely no bio-security whatsoever*’. They have gaps this big between the walls of the cattle feeding areas and the floors, they have modern dairies that are completely open to the elements. Nothing is being done on a lot of these farms as far as bio-security that I can see’ (*Ben Bradshaw MP, quoted in EFRA, 2004*).

In seeking to promote the role of biosecurity in reducing bTb, Defra have relied heavily on a population strategy. Government sponsored biosecurity advice has been passed onto farmers in four main ways. Non-statutory biosecurity advice has identified general risk factors and communicated them to farmers through various media. For bTb, this has occurred through a series of leaflets aimed at farmers. Firstly, the ‘TB in your herd: reducing the risk’ booklet was produced by the Ministry of Agriculture Fisheries and Food in 1999. This focused on two risks that farmers could deal with: minimising cattle to cattle spread; and minimising wildlife contacts. In 2006, this advice was updated following new research which suggested that the previous

advice was in fact wrong. New guidance leaflets focussed on three main risks: keeping badgers away from stored cattle feed; make farmyards less attractive to badgers; and awareness of high risk areas at pasture. In providing general forms of advice, these leaflets also encouraged farmers to speak to their vet about biosecurity – just as many human health leaflets advise people to speak to their doctor before beginning a new, for example, exercise regime. General biosecurity messages have also been communicated to farmers through other leaflets. These leaflets have invariably focussed on the role of cleanliness and disinfectant as a means of reducing risk. Leaflets by Defra (*“Don’t Spread Disease” [2005b]*) focus on the statutory requirement for vehicles at markets, abattoirs and animal gatherings to be thoroughly cleansed before leaving. Other leaflets by MAFF (*“Farm Biosecurity” [undated]*) and Defra (*“Better Biosecurity Provides Peace of Mind” [undated]*) highlights the need to regularly clean and disinfectant buildings and equipment; have pressure washers, brushes, hoses, water and disinfectant available and make sure visitors use them use clean overalls and footwear; wash hands before and after handling cattle; and avoid sharing injecting and dosing equipment. These leaflets encourage farmers to keep livestock away from freshly spread slurry for 6 weeks, implement a pest control programme, and fence off streams and rivers and ensure a clean supply of fresh drinking water in troughs.

In providing this advice, the effect of all these leaflets is to attempt to create an image of a particular style of farming that reduces the risk of succumbing to a bTb breakdown. In other words, whereas the population approach in human health relies on changes in lifestyle factors, the population approach to animal health attempts an important transformation within farming by encouraging a shift in farming styles. Research (*Vanclay, 2004; Silvasti, 2003*) suggests that cultural styles of farming play an important role in guiding and constraining farmers’ decision making processes, such that encouraging the adoption new styles may prove extremely difficult. It is likely that the promotion of biosecurity faces the same challenges, particularly where social research has not been used to identify appropriate agricultural extension messages (*Vanclay, 2004*).

These are not, of course, the only ways in which advice is communicated to farmers, but it is the main way by which the state has sought to publicly communicate this advice. However, it is also

likely to be the case that general biosecurity advice is passed on by other actors, including: veterinary practitioners, trading standards officers, social networks and the farming press. For example, following bTb breakdowns, farmers are asked by state vets what forms of biosecurity (such as the presence of perimeter fencing) are present on their farm. Whilst the purpose of this is to collect epidemiological data, they also serve to highlight more generally those forms of biosecurity that might have prevented the breakdown. Moreover, the significance of the scientific debate about what to do about bTb within the agricultural community has also meant that various ideas of biosecurity have been promoted by scientists, politicians and policy makers, and stakeholders within various media. The Badger Trust (2007), for example have argued that electric fencing around farms may provide greater benefits than culling badgers. These activities may be seen as acts of ‘popularisation’ and/or ‘pollution’ (see Hilgartner, 1990) of biosecurity which may also contribute to a social amplification of risks (Kasperson et al, 2003) or ambivalence towards biosecurity arising from loss of trust within social relations (Wynne, 1992). It also suggests that the division between Rose’s population and high-risk strategies and its relationship to the prevention paradox is not clear-cut. Rather, it appears that there is a circular relationship between the two, such that both strategies contribute and amplify the ironic consequences of the prevention paradox.

(ii) Candidates for bTb

Farmers use the candidate system to explain animal health in a similar way to which it is used to explain human health. They create candidates (of farmers, cows and badgers) by themselves and within their own cultural environment. Thus, stories of bTb candidates circulate around farming communities, creating and perpetuating beliefs about bTb.

Firstly, farmers use “candidates” retrospectively to explain why they have suffered a bTb breakdown. For example, they might blame their breakdown on feeding on the ground or on using mineral blocks in a field that encourage badgers into cattle fields to share feed, thereby providing the opportunity for disease transmission. Said one farmer:

“I had molassed mineral blocks out because I could pinpoint the fields... everything that went down were all...on the one block of land and they all had the mineral tubs...but there was no contact with anyone else's

cattle because it's all road boundary. The only thing that was common was the river. So to me that was enough. I have never put any bloody minerals in the field since. It was so obvious but I was sort of complacent”

Secondly, they may try to predict who is likely to go down with bTb based on the way neighbours farm. This may relate to management practices, such as where people source replacement stock, but it might also relate to the presence of so-called “rogue” badgers that have got into cattle sheds, or alternatively those farmers who have “taken matters into their own hands” and encouraged perturbation. Thirdly, the candidate system is used to assess one’s own risk. In this, farmers may assess their risk status as high if they have a flying herd and if they show cattle. For example:

“Yes, my problem, what worries me is the fact that I buy cattle in to finish, if I’m buying them from 12 months old they will be here until 30 months, so they are here quite a long time, it’s the fact that I am susceptible to buying in... I’m a big risk factor because I’m buying in where I don’t necessarily; I don’t know necessarily where they come from. I will know from their passport and everything after I’ve bought them in auction but I don’t know before”

Farmers identify a range of factors by which they understand bTb breakdowns. Firstly, they talk about different cattle being at risk from bTb. Some farmers will say that older cattle are more likely to go down with bTb. Others will suggest that it is actually younger cattle. Stress is a common factor to those explanations, which also explains why cattle on some types of farm are likely to be susceptible to bTb. Other farmers talk about the role of genetics and how bTb seems to go through particular lines or families of cattle. Secondly, farmers talk about the geography of their farm as being a factor in going down with bTb. Particular fields are said to be ‘dodgy’ or safe; farms either side of natural boundaries are said to be susceptible to bTb or not; and land type also seems to be a factor for some.

Thirdly, different management systems are at greater risk. The dairy sector is more at risk given the time cattle are on the farm; intensive systems are more at risk because of the stress they put their cattle under; and management styles such as the New Zealand system where cattle are out all year round. This is seen as a risk because cattle are under stress, not eating properly and therefore likely to eat “infected” grass. For example:

“Well the thing is these cows graze that tight and the whole system is based on grass, they sit and wait for the grass to grow and so you are going to get such a... a lot of my cows wouldn't... my cows where a badger had been they are that fussy they most probably wouldn't graze because we feed them with a mix every day of the year so they are never hungry-hungry, but these cows have to eat grass and that's why”

Growing maize is a contested issue, with some farmers blaming others for bTb breakdowns on how and where they grow maize. For example:

“[my neighbour] put a game strip [of maize] right above a field right by his house which runs right along the top of two of his buildings... The cattle grazed against it and ran right up to his buildings. He went down with a massive amount [of bTb because] his badgers... travelled to him for his maize. So I look at him and think good God he is smoking 60 fags a day by doing that - how stupid but that's a bit like telling somebody in the 50s that smoking was bad for you - everybody was doing it and nobody was listening or nobody even knew so I blame him but other people don't blame him. I would be the abnormal one and he would be the normal”

Fourthly, there are also certain farmers who are perceived by others as likely to go down with bTb. In particular, there are those who are running flying herds and there are those “hobby farmers” who “hard core” farmers do not believe have the ability or the knowledge to farm properly. At the same time though, some farmers suggest that even “ordinary” farmers are too busy to look out for the signs for bTb these days. Finally, farmers will point to particular types of badgers and their behaviours as suggesting that a particular farm is at risk. Farmers’ characterise the badger as a particularly intelligent and tough animal, one which many have respect for. At the same time, these characteristics mean that no biosecurity measures could ever separate them from their cattle. Even electric fencing is no guarantee:

“the badgers go under it but it is still electrified...They don't really seem to take a lot of notice of it”

So-called “rogue badgers” wandering around during the day or those found in cattle sheds represent behaviour consistent with bTb infection. Accordingly, any farmer with these badgers on his land is assessed as likely to be going down with bTb pretty soon. Some farmers will suggest that badgers living in particular setts are those that are infected, and target those for (illegal)

eradication. The same farmers might also point to sudden localised declines in badger populations as a signifier of bTb infection within the badger population which also alerts them to dangers of new badgers moving in to the area. Either way, farms living in these areas are at risk from going down with bTb. Alternatively, other farmers will suggest that their badgers must be “clean” because they have yet to suffer a bTb breakdown. For these farmers, the last thing they would countenance is any illegal removal of the badgers. To do so would disrupt badgers’ social territories, allowing new and potentially infected badgers onto their farm.

The Role of Luck

The point of this is to highlight the range of factors producing a number of different candidates for bTb. But just like the use of the candidate system to explain human disease, so the system is recognised to be fallible. Indeed, if there is one thing that characterises farmers’ understandings of bTb, it is that there is not much they can do about – it is purely down to luck. The importance of luck originates in all the exceptions to the rules that farmers encounter. The common example is the ‘closed herd’. According to the general risk factors within Defra’s advice, these herds are less likely to suffer from bTb because cattle brought into herds may be hiding infection but thereby providing opportunities for cattle to cattle transmission of the bTb. Farmers though will point to numerous examples of ‘closed herds’ suffering from bTb breakdowns to demonstrate that it offers few guarantees:

“My cousin has a closed herd – it has been completely closed for 20 years now, they are good farmers, but they have spent thousands of pounds over the last 9 years because of TB. It throws cattle to cattle transmission out of the window”

The use of the “closed herd” also offers a good example of the importance of understanding the cultural significance of biosecurity language. Scientists differentiate between those herds that have cattle movements on the farm (the so-called “flying herd”), and those that do not (the closed herd). Their scientific data shows that ‘closed herds’ rarely exist in reality. Farmers though tend to use the term in more fluid ways, rather than the binary classification envisaged by scientists. Thus, whilst some farmers will claim definitively that they have a closed herd, others will describe themselves as “nearly closed” or “90% closed”. What they refer to here is the process of

becoming a closed herd, a process which is a valid state, and not one equivalent to routinely buying in replacement stock (i.e. a flying herd). In this, farmers will also recognise that maintaining a closed herd is difficult and there may be times which require emergency restocking (e.g. if a calf dies) or to help manage the characteristics of the herd (e.g. bringing in a new bull). Neither of these compromise the status of the closed herd, because the closed herd is constantly in the making. This more finely grained classification of herds therefore points for the need for a different language. One which imparts only binary classifications would seem, in this case, liable to be misunderstood. The uncertainties provided by a closed herd reinforces farmers' views that going down with bTb is a matter of luck. But luck is also generated by observations of how "super farmers" go down just as "poor farmers" do. Or, it is those "high risk farmers" that never go down whilst the "good ones" do:

"This bloke is buying them all the time and he has never gone down and he has bought from TB infected herds or herds that have passed the test to be sold. He has bought them there, takes them home and he has never had one go down. So no, I don't think anybody can be blamed for getting TB."

Luck also originates in the "strange" procedures and exceptional results of the skin test. Some farmers complain about "false positives" – the absence of confirmed TB in cattle that reacted to the skin test following a post-mortem. The ISG (2007) suggest that this is likely to be due to the perfunctory nature of post-mortems and the difficulty of finding infection at its early stages. However, the comfort farmers take from knowing that their cattle really were (rather than likely to be) infected should not be underestimated, particularly when their views can influence their behaviour and knowledge towards managing bTb on their farm. Like studies within human health (*see Parsons and Atkinson, 1992*), it seems that the very nature and the organisation of medical screening can therefore contribute to the prevention paradox within animal health as well as feeding the mistrust of science and policy makers. Moreover, where it seems likely that cattle-to-cattle transmission should have occurred, farmers often point to those obvious exceptions to show that the testing regime or theories of cattle-to-cattle transmission provide no guarantees or should be trusted. For example:

"we've had a cow with visible lesions so therefore it's presumably coughing out TB stuck in a shed, it's been in that shed for the last 3 months with 40 mates, those 40 mates haven't got TB".

“you cannot have this heifer spewing TB, I mean like they told us to go to the doctors. She was so bad we had her shot on the farm. Something like that fair enough, she will pass it about and we know – but she hadn't done though and she was in with the cows and she hadn't seemed to have done and so our evidence points to the badgers”.

The Effects of Fatalism

Farmers' experiences of bTb and of official attempts to control it inspire a sense of fatalism. For many farmers, this fatalism means that bTb has just become a way of life. It is not a surprise that they go down anymore and there is little motivation to do anything about it:

“people have got to that point now that they think it's continuous, isn't it. It's not, you don't get over it, it's not like Foot and Mouth where you get it and then you're clear and you don't have it again. But with TB it's a continuous thing that you've got that 6 month period where you're clear and then you're down again. It's a bit disheartening in the way that you're not able to get clear as back in the 1970's or 1980's where they were clearing the disease out but now the disease is just climbing and climbing”.

For these farmers, bTb has become a way of life. Some farmers become stressed by this. They see no way out, their business is tied up by restrictions and they commit desperate acts. This includes the illegal culling of badgers and even keeping valuable cattle in sheds all year round out of fear that they might go down with bTb. Farmer suicide can accompany bTb breakdowns – it is one thing that can tip some farmers over the edge. Some farmers therefore help others to “take care of wildlife” – a euphemism for illegal badger culling – out of a concern for people and communities. Said one farmer:

“Id rather someone shoots a badger than they shoot themselves, and that's why I've done it for people...what I can tell you is this: that there might be somebody out there now that might be still here because of something I'd done and that's enough for anybody”

Others adapt to farming under restrictions: they are in a “state of readiness” to change their farming practices to fit in with the demands of being under restriction following a positive bTb test. This will include shooting bull calves to manage numbers and having systems in place to finish cattle for beef. These are not options open to all farmers, neither are they adopted easily:

they may cost money and run contrary to farmers' own dominant cultural styles of farming. However, the over-riding sense of fatalism does not drive them to implement new biosecurity measures. That too would be just too open to chance. Even for those farmers who have constructed electric fences around their badger setts, there is little sense of doing something worthwhile:

“it would be better if you were doing your biosecurity or doing things to prevent TB and they were working, but what you do to prevent it doesn't seem to really have any effect on what rate of TB you go down with.”

Their failure of combating bTb adds to the stories circulating in the farming community that feed the “prevention paradox”. Instead what farmers do is rely on their own “lay epidemiologies” and management practices. In practice that means “taking care of wildlife”; missing or delaying annual or short interval bTb tests as a coping mechanism for the human and animal stresses associated with it; and compromising existing biosecurity regulations, such as isolating reactors. The decision of from where to buy new cattle is also structured by the reliance on “lay epidemiologies”. “Lay epidemiologies” may discourage farmers buying from herds from low risk bTb areas because the “stress” of moving cattle long distances may make them susceptible to bTb when they arrive in a high risk area. Equally, these “lay epidemiologies” may encourage farmers to restock from areas with high bTb because of beliefs in immunity and susceptibility:

“you would be more likely to buy things closer to home from a local supplier off local farms because they are more likely to stay clear – you are likely to be better off. There seems to be greater immunity to the local cattle to ones from other parts of the country”

These lay epidemiologies and the dominance of fatalism mean that there seems little point in adopting new farming practices. But there are also a number of other factors driving this behaviour. One of them is the low levels of trust that farmers have in Defra. This originates in their experiences of the ISG's experiment to assess the role of badgers in the epidemiology of bTb. In following the experiments, the social and political construction of science was made obvious to farmers. As a result, the experiment was seen as working for conservation interests rather than agriculture and is symptomatic of the wider belief that the countryside is under attack from urban values by ‘people sitting in distant offices who know little about the reality of country

living'. At the same time, those farmers with land within the ISG's trial areas highlight how the culling trial left many badgers behind. The difficulties of the trial were acknowledged by staff undertaking the cull (EFRA, 2006) but downplayed by the scientists in charge. Equally, farmers in the trial areas complain that the cull was never going to succeed anyway. They complain that they were told that the trial was going to cull all badgers in certain areas, but these claims were later denied by the scientists in charge as 'being impossible to achieve'. That culling badgers would lead to a perturbation effect was a long held view within the farming community. That the scientists have proved that it occurs, merely reinforces a view that the scientists did not do their job properly and simply killed the "wrong" badgers. Clearly, there are great parallels between these stories and those told by Wynne (1992), reflecting broader institutional failings in disease control policies.

However, trust is not entirely related to the perceived political nature to bTb science, but a whole number of other factors. These include the debacle over the Single Farm Payment, the failure to reign in the power of supermarkets, a belief that the state has played a significant role in all agricultural problems (e.g. FMD, BSE), and the economic climate livestock farming currently faces. As Vanclay (2004: 214) points out, 'it is hard to be green when you are in the red' and suggestions to the contrary are not likely to succeed (Pannell *et al*, 2004). Nevertheless, economics are not the over-riding concern for many farmers in adopting new agricultural technologies (Vanclay, 2004). Whilst some farmers might say they would like fully automated biosecurity if it was affordable, biosecurity may also be understood through cultural 'styles of farming' (Vanclay, 2004). For many farmers, the concept of biosecurity is associated with highly intensive, factory farming. The idea of trying to turn the farm into a "Colditz"-like fortress, aside from being practicably impossible, was also contrary to their aim of farming to preserve a particular kind of landscape and husbandry (*cf. Silvasti, 2003*). These cultural connotations of biosecurity, combined with these styles of farming lead to the rejection of biosecurity, but also link back to concepts of luck and fatalism and reinforce the legitimacy of traditional management techniques. Thus, as one farmer said :

"it's a farm, its open – that's what farming is".

Conclusion

Farmers are fatalistic about disease because the apparent biosecurity certainties on offer are contrasted by a *'fundamental gap which exists between a person's experience of a given reality and science's explanation of that same reality'* (Gifford, 1986). Their own experiences of bTb tell them biosecurity solutions will not work; these conclusions are sustained by farmers' social environment and the stories of bTb candidates that circulate within farming communities; and finally their previous experience of dealing with Defra tells them not to trust them.

These findings highlight the importance of engaging with the cultural understanding of animal disease. Indeed, even the definitions of biosecurity terms – such as the closed herd – are embedded in cultural notions of farming. Whilst it would be easy to suggest that farmers reject biosecurity simply because they believe that badgers are the real problem, the significance of these different cultural understandings of biosecurity has important implications for the communication of biosecurity advice. Whilst, the ISG and Defra have sought to promote enhanced farm biosecurity to bring the disease under control by promoting biosecurity through leaflets containing general animal health messages, these findings, however, suggest that such a task may reinforce traditionally held views of disease control. This then is the “prevention paradox” in action, a paradox which stems from a failure to include social science within Defra's “sound science” trajectory to drive bTb policy.

These findings though have two significant problems. Firstly, presuming that biosecurity remains a worthwhile endeavour how is it possible to encourage farmers to adopt measures which are precautionary? Even with fairly reliable technologies, agricultural sociologists have long shown how cultures of farming make technology transfer a difficult task (Vanclay, 2004). For biosecurity, this is made more difficult because all aspects are precautionary, some have little or no scientific proof that they “work”, and nor is there a dedicated practical advisory service. In fact, proving that biosecurity “works” is incredibly difficult, particularly with a multi-factorial disease like bTb. With Defra saying that policy should be based on “sound science”, the lack of scientific knowledge on the effectiveness of biosecurity suggests that its popularisation may be a form of discursive ‘pollution’ serving to amplify the risks associated with bTb (Hilgartner,

1990). Perhaps it would be better not to speak of biosecurity at all, at least not in the terms Defra have adopted?

Secondly, if the promotion of biosecurity is a worthwhile task, and if Defra is serious about encouraging “ownership”, it would be wrong anyway to rely only on “sound science” – even if it existed for biosecurity. Instead, as this paper argues, the problem relates more to developing the cultural conditions in which farmers can constructively learn and apply biosecurity. In many ways it is pointless recommending biosecurity if farmers cannot afford it or have limited support to personally advise them (*cf. Pannell et al, 2006*). What studies from the sociology of health and agriculture have shown countless times before is that behavioural changes initiatives are more likely to succeed by working with rather than against popular culture (*Beckett and Davison, 1992*). What this means is acknowledging the importance of the socialisation of health (*Davison et al, 1991*).

The candidate system that farmers create does recognise the risk factors that are also identified within scientific discourses. There are some biosecurity activities that farmers do implement from which they create their own codes of appropriate behaviour (e.g. not putting mineral blocks out, not feeding on the floor etc.) although by no means do all farmers subscribe to these and in all cases it is mediated by local experience and observation. In this way, the candidate system does not merely operate as a means to propagate a set of rural myths. Rather, the challenge lies in working with these cultural understandings of disease to help understand how biosecurity can achieve cultural currency within the farming community. Why some aspects of biosecurity have already achieved this is unclear: the ignorance of social research within bTb policy has meant that this is unknown. It may relate to ‘farming styles’ (*Vanclay and Lawrence, 1995; Vanclay, 2004*) but instead of seeking to identify and engage with the different cultural conditions of farming, the approach has been uniform and reliant on a general leaflet made freely available. Any change to the delivery mechanism of these messages may also be hampered by the decline in trust between farmers and Defra arising from both farmers own experiences of biosecurity, as well as the wider bTb policy environment. The reluctance to take social research seriously, learn from other social theories of health promotion and include it within definitions of “sound science” has meant – despite any best intentions – the implicit promotion of the “prevention paradox”.

There are a number of other ways of promoting animal health. The development of social learning (Röling and Wagemakers, 1998) and encouraging the appropriate conditions for farmers to establish their own solutions and take ownership of the problem may offer some hope. Such methods have been used to help promote agricultural efficiency but not, it seems, address bTb. Equally, the loss of trust between farmers and government may mean the need for broader institutional changes. In each case, these are challenges to the social organisation of risk management (Hutter and Power, 2005). Thus, if Defra are serious about encouraging ownership of bTb amongst the farming community, then it is these social aspects of disease control that need to be understood and evaluated. However, for as long as bTb is framed as a uniquely veterinary or scientific problem and fails to engage with the social understanding of bTb this will be a hard task with inevitable consequences for cattle, farmers and badgers.

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