

# **Behavioural Appraisal of the Recommendations of the TB Strategic Partnership Group (TBSPG)**

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## **TERMS OF REFERENCE**

The following section outlines the advice/analyses which **must** be provided by the appointed consultant(s) to inform the Group's decision making and Final Report and recommendations: -

### **A. Assessment of potential effectiveness of the TBSPG's draft recommendations**

The consultant(s) will undertake assessments of the behavioural (non-monetary) impact of the individual draft recommendations;

The consultant(s) will undertake assessment of the draft recommendations as an integrated package of actions;

The consultant(s) should in particular review the organisational infrastructure recommended by the TBSPG. The consultant(s) should determine if there is opportunity within the framework for effective engagement, interaction and ownership by all of the key stakeholders;

### **B. Assessment of potential effectiveness of the identified draft recommendations**

Assess the behavioural impact of the following options and identify the preferred option in terms of optimum positive impact on behaviour:

- (i) 'Do nothing' option – which would see no government testing or bTB programme;
- (ii) 'Status Quo' option – current bTB programme to tackle the disease;
- (iii) 'Implement TBSPG recommendations in full';
- (iv) 'Implement TBSPG recommendations in part' – this will include prioritisation of recommendations based on the consultants' analyses of individual proposals referred to in (1) above to design an option for comparison which would be likely to stack up well with regard to economic and financial considerations;
- (v) 'Staged implementation – this will consider progressive implementation of recommendations included in (iii) and (iv) above.

### **C. Assessment of potential behavioural implications of identified preferred option(s)**

The consultant(s) will, from a behavioural perspective, be required to advise the group on potential principles and models for their proposed programme, drawing on their knowledge of what has worked well in other countries in tackling endemic diseases;

To act as an independent critical friend to the TBSPG by undertaking behavioural analysis of the Group's draft recommendations.

Provide a report containing an analysis of the draft recommendations programme.

The consultant will be required to work to a very tight timescale.

## EXECUTIVE SUMMARY

- Bovine tuberculosis (bTB) has been an expensive and frustrating problem in Northern Ireland (N. Ireland) for many decades. Although the disease had been almost eradicated from cattle by the early 1970s after a concerted effort begun in 1959, disease levels once again increased through the 70s, and have fluctuated up and down ever since.
- Years of testing and the removal of thousands of positive reactor cattle have failed to return the disease levels to the point of eradication, and research has shown that many stakeholders despair of any brighter future without significant changes to the eradication programme.
- This report appraises the potential attitudes and behaviours in response to the recommendations of the TBSPG. It recognises the recommendations as imaginative, innovative and comprehensive, and likely to change attitudes and behaviours in relation to this disease.
- With significant changes to the governance of the programme offering a wider range of stakeholders the opportunities to work together and make decisions at all levels, there is potential for partnership between previously divergent groups to achieve common objectives for a future free of bTB in cattle and wildlife.
- Helping farmers to protect their herds through improved biosecurity will see more individual and collective responsibility to halt the spread of infection between individual cattle, cattle herds and wildlife species.
- It is accepted that there is heterogeneity between farmers, with factors such as herd type, production system, full-time or part-time, age and geographical location all having an influence on the challenges of practising biosecurity and likely responsiveness to knowledge transfer efforts. The solutions must be tailored to the recipient, and veterinary advisors have an excellent opportunity to add value on the ground in this area.

- Expanding and strengthening existing tools will address weaknesses in the programme and promote the use of new technology to help further investigation of bTB in the field and in the laboratory.
- Addressing compensation for animals removed under the statutory programme will help to rebalance the costs of the disease between the private and public sectors, and incentivise farmers and their veterinary advisors to do all they can to prevent infection entering and spreading within their herds.
- Tackling the wildlife reservoir of infection will be the most controversial aspect of the proposals, and while badger removal will be welcomed by some stakeholders, others are likely to strongly oppose the measure. Reaching accommodation between these divergent positions will be a significant challenge for the new governance arrangements.
- Changing a culture of resigned acceptance and misunderstanding of this chronic disease will require intense effort, and bTB needs to be made visible again as an infectious, potentially fatal disease. A new communications strategy will educate, motivate and enrol stakeholders to commit themselves to a disease-free future.
- It will involve intense effort from all stakeholders working in partnership, but with determination and complete commitment to shared objectives, much can be achieved to remove bTB from all of the reservoirs of infection in N. Ireland.
- That vision of eradication needs to be created and sustained over the difficult years of action to come. The TBSPG recommendations set a course for the way ahead, and provide a robust framework for that ambition to begin to be realised.

## INTRODUCTION

This report provides an analysis of the potential attitudinal and behavioural responses to the recommendations of the TBSPG, and an assessment of their likely impact on the overall bTB eradication programme premised on their adoption. This analysis is given with the caveat that attitudes and behaviours in relation to disease and disease control are linked to a complex multiplicity of factors, and it is often challenging to separate these interwoven strands for analysis in isolation, or indeed as an integrated package. For example, research has shown that attitudes and behavioural responses to animal disease may be influenced by risk perceptions, sociocultural background, psychology, economic considerations, uptake of scientific advice and previous experiences of the disease (e.g. Cook, 2013; Duckett *et al.*, 2015; Enticott & Vanclay, 2011; Garforth *et al.*, 2013; Goodwin *et al.*, 2011; Meuwissen *et al.*, 2001; Valeeva *et al.*, 2011).

The TBSPG have commissioned separate analyses of their recommendations for science, epidemiology and economics, and while this report focuses particularly on attitudinal and behavioural responses, there will therefore be inevitable overlap between this analysis and the others because of the complexity of teasing attitudes and behaviours apart from their economic, scientific and social contextual backgrounds.

The attitudes and behaviours of farmers and vets with respect to disease and its control have been studied extensively in recent years using the epistemological frameworks of both the natural and the social sciences, and especially within the (sub)disciplines of veterinary epidemiology, animal health economics, rural sociology and human geography. Despite the challenges, the need to holistically understand animal health problems within multiple frameworks has been recognised, including the social and cultural acceptance of disease surveillance and control by the people involved (Brugere *et al.*, 2016; Rushton *et al.*, 2007).

These principles have importance when considering bTB programmes. All Member States in the European Union are bound by EU legislation to eradicate bTB (Directive 77/391/EEC), but despite many years of effort, that has not yet been achieved in N. Ireland (Robinson, 2015). Socioeconomic and sociocultural factors have been suggested as an important part of the reason why this is the case (Robinson, 2014a). These factors have also been found to be significant in other countries where bTB has been problematic, and at varying stages of

their eradication programmes. In the Republic of Ireland (ROI), for example, O'Connor (1986:52-53) believed that a failure to eradicate the disease had led to 'almost a resigned acceptedness by some herd owners,' and a lack of commitment from both farmers and vets. Moda (2006) also suggests that social issues have hindered progress in bTB control in Italy, with a lack of co-operation from the farmers, and veterinary officials losing motivation, contributing to delays in reaching a successful conclusion.

More *et al.* (2015: 229) conclude that in the successful eradication programme in Australia, 'it is unlikely that TB eradication would have been achieved if TB had not been recognised as an industry problem'. For too long, I would suggest, bTB has been thought of in N. Ireland as a *government* problem rather than an *industry* problem, and many farmers have been disenfranchised from efforts to control the disease in cattle, almost accepting it (with resignation) as a part of everyday farming life which cannot be changed. That does not exempt government from sharing part of the responsibility as to why disease levels remain high when compared to other countries and regions in Europe. Historical analysis and ethnographic research in the recent past has shown that policy decisions and strained relationships with farmers and vets and their representative organisations have also acted as a hindrance on progress towards the goal of eradication through partnership (Robinson, 2014a, Robinson, 2015). There is also the challenge that farmers are not one homogeneous body of stakeholders – there are differences in attitude and behaviour between full-time and part-time farmers; production systems; different sizes of herd; age and gender; geographical location; farm structure; and educational background in agriculture. If progress is to be made in the future, a wider range of stakeholders must become engaged in the programme, ensuring that different types of cattle farmer, conservation and environmental groups, and the views of industry and scientists in N. Ireland are also incorporated in a network or collaborative governance approach.

Discussing disease control in general, but relevant for the bTB problem, Hennessy and Wolf (2015: 15) suggest that 'imagination is required to identify and implement simple policies that can work effectively under biological and business constraints faced by farmers and regulators'. What must also be emphasized is the very challenging and often underestimated nature of the disease itself, as was noted almost a century ago by American research veterinarian Dr Leunis Van Es:



‘Van Es said (1924) it would be a mistake to believe that a low morbidity rate of tuberculosis among a given cattle population is a safe criterion upon which to dismiss the subject ... In no sense is it a self-limiting disease; it does not eradicate itself or recede in the manner of some other animal scourges’ (Myers & Steele, 1969: 86).

The package of measures recommended in this report may not always be simple to implement on the ground, but they are achievable, and they provide a vital opportunity for major new impetus to be injected into the bTB eradication programme in N. Ireland. If bTB is to be eradicated, there must be a change of attitudes towards this persistent pathogen which ‘does not eradicate itself’; all of the stakeholders must put in the intense effort over the years ahead to achieve that ambition.

The report is structured as follows. In Section A, each of the TBSPG recommendations is appraised in the light of the published literatures on bTB and other endemic diseases which may have relevance. The recommendations are appraised individually (Part 1), and then as an integrated package (Part 2). In Section B an options appraisal is conducted, and in Section C the TBSPG recommendations for bTB in N. Ireland are considered in the light of what has worked well in other bTB eradication programmes (Part 1), and for other endemic disease problems (Part 2).

## SECTION A - Part 1

### Potential effectiveness of the TBSPG's draft recommendations:

#### Individual recommendation assessments

##### GOVERNANCE

###### TBSPG Recommendation: Create new programme governance structures

It is recommended that a **new governance structure is put in place**, with a Northern Ireland level oversight body, three sub-regional bodies and local disease response groups. These will involve representatives from the farming industry working in partnership with veterinarians, DAERA, TB scientific experts, environmentalists and other key stakeholders. It will at all levels have the principles of active participation by all, a focus on disease eradication, a remit to influence policy and disease control at a NI level and be independent of government.

**Assessment:** Governance refers to 'how organisation, decisions, order and rule are achieved in ... societies' (Bridge & Perreault, 2009: 476), or 'collective attempts to steer society and the economy in accordance with common goals and norms subject to continuous negotiation' (Torfing *et al.*, 2012, cited in Ansell & Torfing, 2015: 316). Achieving bTB eradication in the future will require the exercise of governance at different scales (from national down to the level of the microscopic) and across multiple actors in the bTB problem.

Based on the evidence of both the past and the present, there is a need for a change on how governance operates in the future for the bTB programme in N. Ireland (Robinson, 2014a). Blame is variously apportioned to each of the relevant actors in the bTB problem; for example, the state, farmers, vets, cattle, badgers and test failures are held responsible in varying measures depending on who makes the judgement (NI Assembly, 2012a; NI Assembly, 2012b; NIBG, n.d.; Robinson, 2014a; Robinson, 2015). The current governance arrangements, where DAERA create and enforce bTB policy, has created a dependence on the state whereby farmers see bTB as a state problem which can only be solved through state action (Robinson, 2014a). The failure to eradicate bTB has therefore been blamed on the state, particularly on the failure to cull badgers as a means of reducing bTB incidence in cattle (NI Assembly, 2012a; Robinson, 2014a).

Rather than the stalemate and inertia of the past, a paradigm shift must be enacted whereby bTB is viewed as an issue for the state, farmers, the cattle industry, environmental and badger welfare groups, scientists and the veterinary profession to resolve *together* in working partnerships with meaningful collective responsibility (Robinson, 2014a). An alternative to the top-down, hierarchical model is a *network* governance approach, which political scientist Maarten Hajer (2009: 30-31) defines as: 'An approach to public problem-solving in which we no longer simply rely on the state to impose solutions, but instead conceive of problem-solving as a collaborative effort in which a network of actors, including both state and non-state organizations, play a part'. He further explains that this means organizing the actors around the problem, seeking constructively to find solutions agreeable to all (Hajer, 2009).

In a similar vein, Ansell & Torfing (2015: 316) suggest that network governance exemplifies 'a plural and distributed group of stakeholders' without hierarchy. While acknowledging the overlap, they differentiate this from a *collaborative* governance model where 'interaction ... is deliberative, multilateral, consensus-seeking, and oriented toward joint production of results and solutions' (Ansell & Torfing, 2015: 316). This emphasis on *joint* problem-solving and providing solutions in collaboration is 'premised on the principle that by joining forces parties can accomplish more as a collective than they can achieve by acting as independent agents' (Roberts, 2000: 6).

The TBSPG proposal on new governance arrangements for bTB is congruent with the network and collaborative governance models, and will only work if all partners work effectively together (Ansell & Gash, 2007). This bringing together of specialists and laypersons ought to demonstrate that 'both categories of actors possess specific forms of knowledge (a capacity for diagnosis, an interpretation of the facts, a range of solutions) that mutually enrich each other' (Callon *et al.*, 2009: 33). The important point here is that when non-state actors are part of this governance arrangement, they must be enabled and empowered to play an active and useful part in deliberation and decision-making and not be 'swallowed up by a powerful state apparatus' (Callon *et al.*, 2009: 241). Likewise, non-state actors must recognise the role of the state to enforce legislation and to act within the constraints of the public purse and all for the public good.

Attempts to engage a range of stakeholders on bTB have been made before in N. Ireland, in formalised arrangements such as the Badger Stakeholder Group (2004-2008) and TB Core Stakeholder Group (2008- ), and ad hoc and reactive engagements between DAERA and farming industry and environmental groups. The final report of the Badger Stakeholder Group concluded: 'It has been difficult to get an agreed position due to the divergence of opinion between the livestock sector and the environmental interests representatives and representatives of the group as to the best way forward.' (DARD, 2008: 2). There have also been difficulties gaining agreement in the TB Core Stakeholder Group, partly due to the perceived imbalance between the Department holding the chair and a lack of power to make decisions by other group members (Robinson, unpublished).

Previous attempts to bring various interests together on bTB have therefore not been particularly successful, but the new model of governance proposed is radically different with its more multiscalar and distributed approach, and with a network across regional and local levels to engage many more (and a wider range of) stakeholders on the ground at the level of the Disease Response Teams (DRT). Indeed, Ansell & Gash (2007) argue that collaborative models of governance are particularly appropriate where there has been a history of conflict and failures to reach consensus to a shared problem: 'In many of the successful collaborations described in the literature, stakeholders have come to see that they cannot achieve their goals without engaging in a collaborative process with other stakeholders whose interests are often diametrically opposed' (Ansell & Gash, 2007: 553). The future must be about face-to-face dialogue, trust building, commitment to process, shared understanding and setting intermediate outcomes (Ansell & Gash, 2007).

The social sciences (especially within the field of Science and Technology Studies) have had much to say about this process of reaching consensus in socio-technical or socio-biological controversies, for example on issues such as radioactive waste, genetically-modified (GM) crops, climate change science and bovine spongiform encephalopathy (BSE). Callon *et al.* (2009: 32) argue that the conflicts and controversies mean the contrasting positions need to be brought out into the open and debated, allowing 'the design and testing of projects and solutions that integrate a plurality of points of view, demands, and expectations ... which takes place through negotiations and successive compromises'. Crucially, it is not enough in the minds of Callon and his colleagues to merely discuss and exchange views: 'A gain must

be produced. New knowledge must be acquired and shared, and new ways of thinking, seeing, and acting must be developed, pooled, and made available' (Callon *et al.*, 2009: 33).

If stakeholders engage in the proposed oversight body, sub-regional committees and local disease response teams with that committed intention to produce gains, perceptions will change, and divergent positions can be brought much closer together. The literatures of collaborative governance and environmental conflict resolution have proven that this is possible through case studies presented across many different issues where stakeholders came together to produce constructive solutions to very difficult issues (e.g. Emerson *et al.*, 2009; Policy Consensus Initiative, 2007). Getting people who are committed to working together constructively, with access to the best information available, and strong mediation of the discussions, are the keys to success (Emerson *et al.*, 2009).

The new structure proposed by the TBSPG involves layers of governance with varying responsibilities. The TB Eradication Partnership (TBEP) provides an oversight and advisory role at a high level which links with the Agriculture, Environment and Rural Affairs (AERA) Minister and the Chief Veterinary Officer of N. Ireland (CVO). The three sub-regional eradication partnerships (SEPs) provide specific regional focus to bTB eradication in those particular areas, and at the local level the DRTs will be formed on an ad hoc basis in response to specific circumstances in localities such as disease outbreaks. The layers provide both grand scale and fine resolution to the overall objective of disease eradication.

What is particularly attractive about the pyramidal structures proposed are the wide *range* of stakeholders involved, and the potential *number* of stakeholders involved on the ground. For example, the DRTs should engage *all* farmers and private vets in local areas alongside DAERA, local environmental groups and others deemed appropriate to the particular circumstances. The DRTs cope with the heterogeneity in farmer types and aspirations by co-opting *all* of them together to respond to disease in local areas. The power of peer pressure will hopefully ensure that farmers and vets are reluctant to opt out of engagement, and instead take on their share of the responsibility to work in partnership for the greater good. At the level of the TBEP, political representatives are engaged through the Minister and AERA Committee and linked directly to the DAERA Board, CVO and Senior DAERA Policy Leads. In the SEPs, Divisional Veterinary Officers (DVOs) from the DAERA Veterinary Service

provide detailed knowledge of the bTB situation in their respective divisions which will guide decision-making at the regional level and link higher level strategic thinking to on-the-ground implementation and accountability.

These levels of governance differ from both the ROI and England, but are closer to the governance arrangements in Wales and to a lesser extent, New Zealand. To my knowledge, there are no direct comparisons with the ROI, which retains a government-led approach on bTB eradication. In England, the Bovine Tuberculosis Eradication Advisory Group (TBEAG) engages a range of interested stakeholder groups to advise on bTB strategy to DEFRA, but there are no formalised national governance structures beyond the Animal and Plant Health Agency (APHA) structures at a sub-regional or local level apart from ad hoc and informal arrangements. In Wales, a TB Eradication Programme Board is chaired by the Welsh CVO to oversee the whole programme and includes government officials, farming industry representatives, vets and the APHA (Welsh Government, 2012). Wales also has three Regional TB Eradication Delivery Boards which include government officials, farmers, vets, auctioneers, APHA representatives and council trading standards officers. And lastly, a Welsh Eradication Programme Technical Advisory Group (TAG) brings together scientists, vets, social scientists, disease modellers, agricultural economists and public health experts to provide technical advice for the programme. Meetings are held with other stakeholder groups in Wales (e.g. badger groups) to update and inform. In New Zealand, the 15 TBfree committees promote the eradication programme in their regions and report back to OSPRI (the not-for-profit limited company which runs 'TBfree New Zealand') on policy and operational issues from the ground level (TBfree, n.d.).

The proposals of the TBSPG are therefore wider in scope, and engage a greater number and wider range of stakeholders than any other governance model in the British Isles or beyond. Significantly, the chair of TBEP and SEPs will not be a civil servant, and the governance structures proposed also directly involve environmentalists in the decision-making process at all levels. The structure also has the potential to enrol any farmer or vet in N. Ireland in governance of disease through the DRTs working in local areas to solve local problems.

Before that process of engagement begins, an assessment must be made of the current situation. For bTB, the belief is currently lacking on the ground that the disease can be

eradicated, and the optimism of the early years of the eradication programme has largely disappeared (Robinson, 2014a; Robinson, 2015). An open and honest appraisal needs to begin about what the governance of the new programme plans to achieve over at least the next 1, 5, and 10 years. Primary responsibility for that will rest with the future TBEP, but there has to be combined commitment to the goal of eradication of the disease in cattle and wildlife by all stakeholders. England's national target is to eradicate bTB by 2038, and the programme is firmly committed to tackling the disease in cattle and the reservoirs of infection (DEFRA, 2014; DEFRA, 2016). Setting national, regional and sub-regional targets in N. Ireland will provide definite intermediate goals to aim for, and particularly provide a sense of purpose and accountability for the sub-regional committees and on-the-ground disease response groups who will help to achieve the targets in their local areas, but these must be realistic. Discussing global leprosy elimination programmes, Lockwood *et al.* (2014: 3) warn that there are hazards in setting targets if they are not realistic, evidence-based and achievable, but acknowledge that 'targets used judiciously can energise programmes'. They emphasize the need to regularly review targets, and to amend if inappropriate. With a bTB eradication programme in N. Ireland which has been running for decades, there is a need to re-energise the objectives and the stakeholders, and create a vision for what can be achieved going forward. It must also be acknowledged that governing bTB is particularly challenging because it is a chronic and persistent infectious disease. Targets must not be over-ambitious or a distraction from getting on with the job.

This is a new and radical form of bTB governance for N. Ireland, and is (to my knowledge) a unique coalition in terms of managing bTB globally. Bringing together such diverse actors – government officials, farmers, vets, environmentalists, scientists, and industry bodies – in TBEP, SEPs and DRTs will most definitely bring challenges for all of the stakeholders involved, particularly for the state as it seeks to organise and implement the TBSPG recommendations. For DAERA veterinary services and policy makers, it will involve losing some of the power they currently hold in order to share decision-making and responsibility with others. Such a state organisation will also be able to take criticism constructively, for as Tania Murray Li (2007: 280) asserts: 'A state ... agency willing to govern and improve itself in dialogue with its critics, learning from scientists and the new experts in community, strengthens its claim to govern'. Li warns that this process of multi-stakeholder engagement

can be difficult: 'Sparks fly. Disgruntled parties walk out. There are risks involved in assembling people in one place' (Li, 2007: 282). But the fear of failure must not stand in the way of making the concerted attempt to succeed.

The collaborative governance must take place around the table in the meeting room, but must also work in the field. For farmers and their representative organisations, coming in from arm's length will mean rebuilding confidence that in seeking to promote the eradication of bTB, government is acting to protect farming incomes and a vital export industry for cattle and cattle products that sustain the farming economy. It will also mean farmers as individuals and collectives in local areas taking more responsibility and ownership for disease prevention at farm and animal level, seeking to halt the spread of infection through enhanced attention to biosecurity and enhanced compliance with bTB regulations. For private vets, it will mean acceptance of state testing inspections and accountability in the governance of public monies when testing cattle with due diligence, but it will also mean working in much closer partnership with their colleagues in the state sector to investigate bTB and advise farmers how to reduce the risk of disease introduction. For scientists it will mean producing science which helps advance the ability to detect and eradicate bTB, and communicating that science to the public as well as to fellow scientists, closing the lay-expert divide, and avoiding misunderstanding of the power of scientific discovery and application. And for badger interest groups and environmentalists, there will need to be acceptance that badgers are linked to the problem of bTB in cattle, and tackling the disease in both cattle and badgers must proceed to produce a solution. Their knowledge and expertise in ecology can play a valuable role in providing evidence bases and co-constructing disease management strategies at a national and local level.



## BIOSECURITY AND FARM PRACTICES

### TBSPG Recommendation 1: Improving biosecurity - preventing disease

It is recommended that herd keepers be pro-actively encouraged to **improve farm management security** in relation to TB, to take responsibility for bio-security on individual holdings in relation to cattle movement; nose to nose transmission; securing wildlife access to animal housing and feed stores; addressing the potential for infection by wildlife through the use of secure fencing around setts and latrines, and monitoring contractor hygiene and movement.

- a. It is recommended that a bio-security self-assessment checklist is developed and made available to farmers.
- b. It is recommended that PVP and DAERA staff provide advice to farmers about on farm bio-security measures to increase herd keepers' awareness and knowledge, identify areas for action and improvement, and to help reduce the risk of TB breakdowns and disease spread. They may use the self-assessment form as a starting point.
- c. It is further recommended that a system similar to that operated in Wales of 'Improvement Notices' is given consideration if it is apparent that good practice in farm health self-assessment which takes into account risk assessment, bio-security, farm practice and herd health is not being adopted voluntarily.

**Assessment:** Persuading farmers that farm biosecurity is an important issue for animal health is often difficult, and not just for bTB. Studies in different countries and for different disease issues have shown wide variations in farming practices and attentiveness to biosecurity, suggesting that the implementation of biosecurity depends on more than providing education on best practice (e.g. Cross *et al.*, 2009; Frössling & Nöremark, 2016; Hoe & Ruegg, 2006; Sayers *et al.*, 2013). The value of social science research investigating attitudes and behaviours of farmers is being increasingly recognised in the veterinary literature. For example, research examining mastitis control in dairy farming (Jansen *et al.*, 2009), zoonotic disease control (Ellis-Iversen *et al.*, 2010), and attitudes to biosecurity in Johnes disease control (Benjamin *et al.*, 2010) all found that the attitudes and behaviours of the farmers, including knowledge of disease, had an effect on the success of disease control. As Cook (2013: 118) so appropriately argues: 'Realising the full potential of farm biosecurity requires an understanding of the socio-economic factors involved in decision-making at farm and broader animal population levels, as well as robust documentary evidence of the benefits of implementation'.

Researching bTB from a social science perspective, Enticott focuses on biosecurity in England and Wales, framing it as the attempt to separate disease agents from animals in time and space (Enticott, 2008a, 2008b; Enticott & Franklin, 2009; Enticott & Vanclay, 2011). Connecting biosecurity and animal health policy, he describes how this has become a key component of the government's strategy to regulate the flow of disease between and within agricultural enterprises, but farmers have resisted such policies, dismissing them as unworkable (Enticott, 2008b). Badger interest groups have also called for farmers to increase their farm biosecurity, suggesting that more could be done:

'TB risk can also be reduced by improving farm biosecurity - avoiding badger-cattle transmission - and biocontainment - avoiding cattle-cattle transmission. There is much recently-published evidence that simple biosecurity measures are extremely effective and cost effective in preventing badger-cattle contact around farmyards, yet few farmers employ such methods.' (Badger Trust, n.d.)

Despite these calls, many farmers remain to be convinced of the link between improved biosecurity and bTB reduction. Robinson (2014a) found that many believed there was little or nothing that could be done to prevent bTB entering the herd due to its inherent unpredictability and lack of patterns in transmission. For some, biosecurity was seen as an additional burden on farming, leading one vet to suggest that farmers 'feel that all this biosecurity stuff is nearly a punishment rather than a thing that is actually helping the in the long run' (Int A60 from Robinson, 2014a: 269).

In the early 20<sup>th</sup> century American veterinary pathologist and bacteriologist Dr V. A. Moore stated that: 'The only way an infectious disease can spread is by means of the germ that causes it escaping from the infected, and gaining entrance to the body of the uninfected individual' (Moore, 1913: 33). According to Moore, there was therefore a very logical solution to preventing bTB in cattle: 'The disease is produced by the tubercle bacilli and if we keep these bacteria away from our cattle they cannot possibly develop tuberculosis' (Moore, 1905: 15).

Robinson (2014a) found that farmers rarely considered the scale of the microscopic – *M. bovis* was the 'forgotten actor' in the bTB problem. Thinking of biosecurity as how to 'keep

these bacteria away from our cattle’ may be a helpful way of framing the issue. This therefore means thinking of separating the herd from other cattle which may be infected with the bacteria; doing what is practically possible to minimise contact directly or indirectly with badgers; and thinking about contaminated environments – housing, pasture and fomites.

Agricultural economists Hennessy and Wolf (2015:15) argue the following: ‘With endemic disease pools, there is an incentive to free-ride on the efforts of others. In guarding against disease entry, a coordination failure arises in which all will agree that things could be better all-round but no one is prepared to act unilaterally.’ Biosecurity needs to have collective and social, but more importantly, individual, efforts to make farms more bio-secure with respect to bTB. As Hennessy and Wolf (2015) also point out, there is a need for ongoing and persistent communication about biosecurity as a way of encouraging farmers to have stronger incentives to protect their own herds from bTB (and other infectious diseases).

## **TBSPG Recommendation 2: Improvement Notices**

It is recommended that consideration be given by the new oversight body to the **introduction of statutory Improvement Notices**, for use in circumstances where it is considered that on-farm bio-security improvements have not been implemented despite identification of need and consistent advice and support.

**Assessment:** Many cattle farmers practise biosecurity on their farms, and do so willingly and without coercion, but the measures taken vary according to the disease under consideration and have multiple other influences, including attitude to risk and perceived benefit, and bTB is not always top of the list of biosecurity considerations (Gunn *et al.*, 2008; Robinson, 2014a; Toma *et al.*, 2013). There may also be a divergence between stated belief and actual behaviour. When farmers in Co. Down were surveyed about bTB, 68% thought that biosecurity measures had a significant impact on the risk of bTB entry into a herd (O’Hagan *et al.*, 2016b), but this did not always result in taking action to reduce the risk (O’Hagan *et al.*, 2016a). Other social science studies have consistently shown that farmers often believe that there is little or nothing that can be done to prevent bTB entry into herds, and it is due to chance or ‘bad luck’, and therefore take little action to prevent bTB incursion (Enticott & Vanclay, 2011; Enticott, 2016; Naylor & Courtney, 2014; Robinson, 2014a).

For farmers who refuse to adopt biosecurity practices despite consistent veterinary advice, and who pose a risk to the ongoing spread of infection through negligent practices, there is a place for improvement notices as a formal enforcement measure. This is likely to be well received by industry stakeholders if the notices are used as part of a hierarchy of enforcement, and only when informal approaches have failed to promote change, and others will suffer a higher disease risk as a result of the intransigence of individuals. While Robinson (2014a) sets out how farmers felt overwhelmed by bureaucracy and regulation, there was also a belief that the state's enforcement role was necessary to correct other farmers who refused to obey the law and play their part in disease control, an opinion typified in this farmer quote:

'Well, it's necessary because if they [*state officials*] weren't there, farmers would do what they liked basically, so you need somebody there to keep things in check and to police things because I know, and you know, that farmers generally like to get away with whatever they think they can - they push the boundaries. So I think from that point of view [they] need to be there, and need to be policing the thing' (Int A4, dairy farmer, cited in Robinson, 2014a: 240).

Furthermore, state vets described how some farmers hindered the efficient functioning of the bTB programme (Robinson, 2014a), a problem certainly not unique to N. Ireland. Writing in relation to bTB in the ROI, O'Connor (1986: 65) wrote:

'Most herd owners do their best to obey the rules, but there are many others, some well-known to the authorities, who flout the rules continually, either through carelessness, design, or ignorance and are mainly responsible for spreading the disease to clean herds.'

These are the occasions when an improvement notice is appropriate, and resonate with this description of a pollution inspector's approach to enforcement on farms in England in the early 1990s:

'A farmer initially characterized as persuadable or cooperative might eventually exhaust the patience of a Pollution Inspector through failure over a protracted period to take any remedial measures, leading to reclassification as a "problem" farmer. Informal approaches might then give way to the issuing of a warning letter' (Lowe *et al.*, 1997: 112).

It is likely that environmental groups and the veterinary profession in N. Ireland will welcome the addition of another tool to enforce better biosecurity where the farmer has

ignored all previous attempts to improve farm practice and reduce the risk to that herd and contiguous others.

### **TBSPG Recommendation 3: Informed purchasing**

It is recommended that the farming industry should lead in the **adoption of an informed purchasing** approach to bringing in stock to their farm, i.e., buy stock where the health status of the cattle is known.

To promote information openness and transparency TBSPG recommends that **livestock markets be encouraged to display as much information** as is practically and legally possible to better inform prospective purchasers as to any potential risk from individual cattle being presented for sale. This will require leadership from industry to encourage the adoption of changes to buying practice. TBSPG is conscious that direct farm to farm purchases also take place, but even in respect of these transactions it should be possible, through awareness-raising and informed dialogue, for all parties to the transaction to determine, and share, the animal's TB test history before purchase and transfer.

TBSPG is aware that information displayed must be compatible with data protection legislation, in particular that data which is considered "personal information" may require the permission of the individual before being displayed. In this context, informed support and leadership from the farming community will be required to make this recommendation effective.

It is also recommended that **awareness-raising actions** on "informed purchasing" are put in place, as an integral part of the overall communications strategy, (see Section x) led by the new oversight body in partnership with industry.

**Assessment:** The movement of cattle between herds either through markets or directly is a known risk factor for between-herd transmission of infection and has been shown to be significant in multiple scientific papers, but the overall impact varies between countries and regions (Broughan *et al.*, 2016). In N. Ireland, local contiguous spread of infection from infected cattle or wildlife is likely to be more important than the movement of cattle between herds, but molecular epidemiology has demonstrated the translocation of *M. bovis* genotypes into distant geographical areas away from their normal 'home range', presumably through cattle movements (Skuce *et al.*, 2010). If cattle movements between herds are therefore a recognised risk factor for the spread of bTB, the challenge is how to lower that risk through encouraging farmers to think more about whether they can keep a closed herd, or how better information about an individual animal or herd's bTB risk can lower the risk from purchase. This principle formed the basis of a farmer association in Denmark as far back as the early 20<sup>th</sup> century, where Bang (1908: 20) describes how the objective was to 'facilitate the purchase of healthy [bTB-free] animals, as members who

want to buy or sell may apply for advice to one of their number, who keeps a list of the farms where healthy animals are for sale’.

Robinson (2014a; 2014b) demonstrated that while the majority of farmers interviewed knew about veterinary advice to keep a closed herd to reduce the risk of buying in disease, most thought that this was not always possible. Some farm business models depended completely on purchase for further rearing and fattening, and others, while striving to maintain a closed herd, still thought it essential to buy breeding bulls or to replace stock lost unexpectedly through disease (Robinson, 2014b). Some farmers also spoke of the importance of cattle auction marts as part of the rural fabric of their lives and communities, and buying or selling at the market was seen as a social as well as a commercial activity (Robinson, 2014a; 2014b). The veterinary advice to keep a closed herd is therefore unlikely to be heeded in many cattle herds in N. Ireland because of this complex economic and sociocultural mix of factors affecting cattle trading, particularly in smaller herds and in the part-time farming sector.

If extensive trading is to continue, informing farmers of the likely risks that cattle may pose through undetected bTB infection is one possible solution, and this has been considered or implemented in other jurisdictions. A working group on ‘risk-based trading’ under the chairmanship of Professor Bill Reilly produced a report in GB in 2013 in which they stated the rationale for increasing the amount of information available to cattle purchasers: ‘Risk-based trading is not about preventing trading or creating a two-tier market for cattle; it is about empowering farmers to make informed buying decisions’ (Bovine TB Risk Based Trading Group, 2013: 10). Despite the recommendations of the group to provide ring-side bTB history in markets as an early preliminary measure before development of a comprehensive database to inform trading, this has not yet been implemented in GB.

Australia had a risk-based trading scheme based on herd classification during its successful eradication programme (More *et al.*, 2015). In New Zealand, forms of risk-based trading have been in operation since 1991, when a regional animal health advisory committee insisted that cattle on sale in their markets would have to have herd bTB history on display to reduce the likelihood of disease spreading from high incidence areas into their own through cattle purchases (Enticott, 2016). Risk-based trading is an integral part of the

national bTB eradication programme in New Zealand, with herds classified C1-C10 according to the number of years they have been free of bTB, with infected herds classified separately (Enticott, 2016). Herds purchasing from lower status herds adopt the lower herd status, thereby providing incentive to avoid purchasing from a higher disease risk herd, and farmers actively use the C-status in making judgements about whether to buy from particular herds (Enticott, 2016).

The C-status herd classification in New Zealand succeeds in 'making disease risks visible to farmers' (Enticott, 2016: 316), but there is no such classification in N. Ireland for animals which are available for trading beyond Officially Tuberculosis Free (OTF). A herd can be restricted for bTB one day and free to trade the next, despite the risk that it still carries animals which are infected but misclassified as negative due to failings in the sensitivity of the SICCT. A voluntary scheme of declaring number of years free of bTB is very unlikely to succeed in N. Ireland – there is currently no demand from the market (particularly processors), and unless and until the market demands such information, there is no incentive for a herd with a recent history of bTB to declare that information voluntarily. There is also little prospect of the wider cattle industry demanding it lest trade be impeded and stock from certain farms become less valuable, and farming leaders may be unlikely to call for change given the possibility of being in the same unfortunate position themselves as sellers in the future due to the unpredictability of bTB occurrence.

In addition to raising awareness of the risk of acquiring infected animals through trading as part of an overall biosecurity strategy, herds in N. Ireland could be classified according to number of years free of bTB (similar to the NZ system). This information could be used voluntarily as a more objective measure of bTB risk which farmers could use to make risk assessments in private purchases. Similarly, the herd status could be voluntarily disclosed at sale rings. The herd status could therefore be promoted as a voluntary market instrument to encourage the purchase of cattle from herds at lower risk of bTB.

Adkin *et al.* (2016a) have demonstrated scientifically how such a risk-based herd classification could be developed for herds in England and Wales, and similar classification could be developed in N. Ireland. One of the key messages that Adkin *et al.* (2016a) advocate passing on to farmers is that a clear herd test is no guarantee that an individual

animal from that herd is free of bTB infection, given the relatively low sensitivity of the SICCT. This recommendation was based on stakeholder meetings where many farmers asserted their belief that animals which are tested negative were clear of bTB (Adkin *et al.*, 2016b). There therefore needs to be a shift in mind-set from a position where farmers believe that if any animal for sale it is therefore *a priori* free of bTB (Robinson, unpublished), to making more informed risk decisions using herd classification to affect purchasing behaviour.

#### **TBSPG Recommendation 4: Farm Fragmentation**

The Group recommends that DAERA undertakes a review of existing farm fragmentation data to establish whether the practice of farm fragmentation (conacre) adversely impacts on the control of disease following a TB breakdown.

The Group also recommends that a formal means of reducing the risk of within-herd spread associated with individual breakdowns should be introduced. This should take the form of a notice which would be used to protect other herds from disease spread from high risk groups within TB breakdown herds. The notice would be applied by DAERA staff and would specify where animals must be kept, thereby preventing movement of high risk animals in breakdown herds to grazing in areas removed from the main breakdown.

**Assessment:** Studies on bTB and brucellosis in N. Ireland have emphasized the fragmentation of farm businesses as a factor in the spread of disease (Abernethy *et al.*, 2006a; Abernethy *et al.*, 2006b; Abernethy, 2008). O'Hagan *et al.* (2016a) found in a biosecurity study in N. Ireland that 83.8% of case farms and 78.7% of controls rented conacre land. But despite these risks, there are underlying reasons why cattle farmers are very limited in what they can do to reduce farm fragmentation given the production pressures that they face in a global marketplace, especially in the dairy sector. Many farmers (particularly dairy) have great difficulty in acquiring enough land to support the size of cattle herd which they maintain, and as a result, they rent or purchase land some distance away from their main holding, as these farmers testified when interviewed (Robinson, 2014a: 206-208):

‘Northern Ireland’s biggest weakness is the fragmentation.’ (Int A32, dairy farmer)

‘Land here is very scarce, and if you have ambition to have a few more acres, you just can't get them. I can certainly understand people selling up [and moving to GB].’

(Int A28, dairy farmer)



‘I suppose farmers in Northern Ireland - it's small ... You're fighting for space ... A lot of people rely very heavily on conacre, and some of it is all over the place.’ (Int A8, dairy farmer)

The majority of farmers therefore dislike having to conduct their farming operations over multiple parcels of land, but feel constrained, with no viable alternative other than selling up and moving outside of N. Ireland (Robinson, 2014a). The fragmentation of farms is therefore less than ideal, but it is difficult to see how the trend will be reversed in the short-to-medium term, but may change over the longer term if herd sizes continue to increase and pockets of farmland consolidate through purchase. An increasing trend towards zero grazing in the dairy sector may also have an impact on the numbers of cattle which are grazed (Robinson, 2014a).

Currently bTB-infected herds are not prohibited from making within-herd moves and use of conacre and land parcels removed from the main holding. The recommendation to introduce stricter controls on where groups of animals in an infected herd are allowed to graze should reduce the likelihood of contiguous spread through cattle-cattle contact. Such restrictions will interfere with normal herd management and grazing patterns, and are therefore likely to be resisted by herdkeepers, and viewed as an added layer of bureaucracy.

While acknowledging the underlying political economy of why farmers have fragmented farms, from a disease control perspective there is merit in implementing the TBSPG recommendation of restricted grazing notices. Similar restrictions were used as part of the measures required to eradicate brucellosis, and there is merit in making similar veterinary risk management decisions for bTB. This is likely to be welcomed by both private and DAERA vets, as farm fragmentation is repeatedly suggested by vets as a reason for the spread of bTB between cattle herds (NI Assembly, 2012b; Robinson, 2014a), with some vets even suggesting it is one of the most important reasons why the disease has not yet been eradicated from N. Ireland:

‘Animal movement, conacre, cattle all over the country ... one man has 500 cattle in ten different sites, and they move them about with impunity. And that is bound to be a problem, almost unique to NI.’ (Int A46, private vet; cited in Robinson, 2014a: 211)

## **TBSPG Recommendation 5: TB Reactor – Quality Assurance Checks**

It is recommended that action is taken to design and implement a field trial of countermeasures to:

Gather evidence of the number of volunteered reactors;

Develop our knowledge of re-examining TB reactor lumps;

Develop our understanding of post-skin test IFNG testing, in particular correlation with skin test results;

Enable a policy decision on the best overall approach to take regarding volunteered reactors.

**Assessment:** Animal health is a public good, and to achieve the highest standards, quality control and strong governance must be an integral part of any national Veterinary Service and disease eradication programme (Schneider, 2011). Duignan *et al.* (2012) demonstrate how this has been achieved in the ROI for the bTB programme. Ensuring that animals which are presented as reactors are truly such must be an integral part of ensuring quality control.

Any attempt to interfere with bTB test sites or corrupt the detection and removal of bTB from herds in N. Ireland compromises the quality of the programme (NIAO, 2009). In addition to costing the taxpayer, such activity has a demoralising effect on all stakeholders who are committed to eradicating bTB from the national herd. Robinson (2014a) found that farmers were keen to see enforcement action taken by the Department on others who tarnished the reputation of N. Irish agriculture and harmed the bTB programme through neglect or deliberate action. The recommendation is likely to be welcomed by all stakeholder groups, and that includes the tax payer.

## **TBSPG Recommendation 6: Cattle Vaccination**

It is recommended that TBEP keep the development and research of a cattle vaccine under review. Additionally, DAERA to bring any new developments or trials to the attention of TBEP.

**Assessment:** Robinson (2014a) found that farmers in N. Ireland were keen to see cattle TB vaccination introduced to protect their herds against the disease, and were frustrated that, in contrast to many other infectious bovine diseases, no vaccine was forthcoming. Vets also suggested that a cattle vaccine was the best hope for dealing with the disease (Robinson, 2014a). A recent report from a coalition of badger groups calls for the implementation of

cattle vaccination as a way of tackling the spread of the disease between cattle (Eurobadger, 2016). But despite many years of research to make better use of BCG and develop new vaccines and DIVA tests, Vordermeier *et al.* (2016) note that 'significant hurdles remain before these vaccines will be available for use in the field'. In the absence of the scientific and technical ability, and legislative provision, to allow cattle vaccination in the field, other measures must be implemented. Stalling the eradication programme to wait for a cattle vaccine is not currently a viable option, and other countries (e.g. Australia and New Zealand) have proven that progress towards eradication is possible without vaccination.

## EXISTING TOOLS & PROCESSES

### TBSPG Recommendation 1: Expand severe interpretation of the skin test

Currently one of the first two herd tests in an OTW breakdown must be fully interpreted on severe interpretation and there is discretionary removal of severe reactors at other tests during the course of an OTW breakdown. The group recommends that DAERA should expand their use of severe interpretation during a TB breakdown to, as a minimum, compulsory removal of all animals that are positive on severe interpretation and all animals that are inconclusive on severe interpretation during the course of an OTW breakdown.

In the medium term it is recommended that **further epidemiological analysis** should be carried out to assess the case to further increase the use of severe interpretation (by measuring the relative risk posed by animals that are inconclusive or positive on severe interpretation in particular circumstances but are not currently removed.) This would involve assessing the relative risk posed by animals in OTS/singleton breakdowns, and animals that are positive on severe interpretation in risk tests.

**Assessment:** Robinson (2014a) found that many farmers in N. Ireland were sceptical about the SICCT's ability to accurately detect bTB, and were frustrated by false negatives (test negative only to be found with lesions soon afterwards at slaughter), and false positives (skin test positive but 'No Visible Lesions' - NVL - at slaughter). An increasing number of false positives or truly infected animals with NVL may therefore increase farmer scepticism about the accuracy of the test, but the importance of the earlier detection and removal of reactors outweighs this perception, and the science of sensitivity and specificity must be communicated clearly to stakeholders to explain the policy. As Medley and Green (2013) argue, improving test sensitivity in endemic disease control is more important than the cost of reduced specificity. NIBG (n.d.) have pointed out the deficiencies of the skin test in detecting bTB infected cattle, and are likely to welcome any amendment to testing procedures which will increase the sensitivity of the test.

### TBSPG Recommendation 2: Expand IFN-gamma Testing

The Group recommends that the **use of IFNG testing is expanded** to remove as many diseased animals as quickly as possible with four objectives:

- To limit impact on the infected herd
- To prevent spread to neighbouring herds
- To prevent spread through movement of cattle
- To eradicate TB from Northern Ireland as part of an inclusive and integrated strategy

In order to achieve these objectives, it is recommended that the number of herds and animals that can be **blood sampled is significantly increased** to facilitate IFNG testing in order to improve test

sensitivity and therefore facilitating detection and eradication in all herds including large or herds with unresolved disease outbreaks.

It is recommended that when it is determined that an IFNG test is required it is **compulsory for the herd-keeper to comply**. The removal of test positive should also be compulsory. Currently the constraints that limit the number of samples and the selection of herds must be resolved to achieve this e.g. DAERA policy would have to be changed to allow testing of pedigree herds, and laboratory capacity would have to increase.

It is recommended that the **wider use of the IFNG test** on the basis of local epidemiological assessment is deployed on an area basis, and that it is used to resolve high risk herds/groups or whenever depopulation is considered.

It is recommended that the **IFNG test is used to quality assure** the results of the SICCT where there is either suspected under reporting or over reporting of diseased animals. (See TB reactor Quality Assurance Checks)

It is also possible that a REP or DRT may recommend **additional compulsory use of IFNG testing** in a particular disease situation

The implementation of these recommendations will require a phased approach.

**Assessment:** The IFNG test has been used as an ancillary test for diagnosing bTB in N. Ireland since 2004 (Lahuerta-Marin *et al.*, 2015). A European Commission Report on the eradication of bovine TB in the EU (European Commission, 2013: 10) stated that the 'use of the IFNG assay in parallel with the tuberculin test in infected herds results in a considerable increase in Se [sensitivity] and this allows the earlier removal of a considerable number of infected animals that would have given a false negative reaction to the skin test'. The Eurobadger (2016) report also calls for the extension of cattle testing, including the further use of IFNG.

Removal of IFNG positive animals in N. Ireland is currently voluntary, and the decision rests with the farmer as to whether the animals are removed from the herd for slaughter. Based on research in N. Ireland, Lahuerta-Marin *et al.* (2015) found that there were 4606 IFNG test-positive animals between 2004 and 2010, and 25% (1146) of these positive animals remained on farm. Given that a quarter of the IFNG positive animals remained on farm in the study sample, Lahuerta-Marin *et al.* (2015) speculate that this may have been due to a farmer's risk perception, or the value of the animal making the farmer unwilling to surrender it. Now that the Lahuerta-Marin *et al.* (2015) study has for the first time provided objective scientific evidence for the increased risk of such animals, it would be expected that

the risk perception of both vets and farmers should be altered, and this risk must be effectively communicated by DAERA.

The IFNG test does though have a lower specificity than the SICCT, and will therefore produce a greater number of false positives than the skin test (Gormley *et al.*, 2013). Multiple false positives can lead to both unnecessary economic losses as well as the demotivation of farmers, vets and veterinary officers (Praud *et al.*, 2016), but the strategic use of the IFNG test in high risk herds, chronic breakdowns and as a quality assurance measure justifies the expansion of its use in more herds and more animals. Sinclair *et al.* (2016:98), extolling the benefits of the IFNG test in New Zealand's bTB eradication programme, states that: 'The slaughter of some false positive reactors in infected herds due to the lower specificity of the test combination of [skin test] and IFN is a necessary price to pay for the eradication of the disease, and helps to prevent future losses'.

### **TBSPG Recommendation 3: Expand use of DNA tagging**

The use of DNA tagging is an important tool in ensuring that TB reactor identification, valuation and removal is well correlated. There is a gap in the process and this should be resolved to ensure that all animals with positive readings at test read off have a DNA tag applied. To achieve this objective it is recommended that **AVS should apply DNA tags** to any animals that they detect with reactor readings at the level of interpretation specified for the test.

**Assessment:** The key issue of concern here is that animals revealed as reactors by private veterinary practitioners are not DNA tagged until valuation. This allows ample time for the identity of the animal to be changed through fraudulent activity, or in the event that both of its ear tags are lost between the test and valuation there is the possibility of erroneous identification without deliberate intent.

This is not just an issue which has been addressed in N. Ireland. DEFRA announced on 31 March 2011 that all cattle which tested positive for bTB would be DNA tagged after evidence of some farmers in parts of England having swapped ear tags illegally with the intention of retaining productive TB-positive animals for less productive ones (Anon, 2011). The earlier use of DNA tagging on farm at the time of the test should reduce the attractiveness of this practice and act as an extra deterrent.

#### **TBSPG Recommendation 4: Genotyping of *M. bovis***

The group recognises the value of VNTR typing and recommends that **DAERA continues to VNTR type all culture positive cattle and badgers** and works to expand its use of the information, especially on an area basis through the auspices of the GIS which is currently under development i.e genotype data for cattle and wildlife superimposed on maps of breakdown herds and their surrounding area. Expertise in this area must be maintained and developed in line with technological advances.

**Assessment:** Genotyping of *M. bovis* isolates from both cattle and badgers provides valuable insights in to the molecular epidemiology of the spread of the infection in both species. Such work in N. Ireland has demonstrated that sources of infection tend to be localised, and allows differentiation from breakdowns likely to be due to the introduction of infected animals carrying different strains of the bacterium from other geographical locations (Skuce *et al.*, 2010). VNTR has also been used as a molecular epidemiology tool in the analysis of bTB (Wright *et al.*, 2013) and bovine brucellosis in N. Ireland (Allen *et al.*, 2015).

The VNTR information should be more extensively used by Veterinary Officers and private vets in conjunction with improved GIS mapping capability to more fully investigate breakdowns and provide objective evidence to farmers of putative breakdown sources. Based on my own professional experience, this should act as a motivational factor encouraging more in-depth epidemiological investigation in the field, and help communicate the bTB biosecurity risks to farmers about local spread and through purchasing infected cattle. This should support evidence-based disease investigation and control efforts at both a farm and regional scale, and could be used by DRTs to guide interventions in both badgers and cattle in outbreaks. The ARD Committee's review of bTB in 2012 showed that various stakeholders valued the importance of genotyping and strain data (NI Assembly, 2012b).

#### **TBSPG Recommendation 5: TB Testing Services**

The TBSPG has been involved in discussion and agreed that the nature of the new contract ties in with their direction of travel and is content with the introduction of the arrangements under Phase 1 of the new PVP contract. It is recommended that DAERA continue to work closely with TBSPG/TBEP to **ensure that Phase 2 of the contract with PVPs reflects the agreed recommendations** in this report.

**Assessment:** The TBSPG recommendations encourage a much more inclusive role for the AVS (PVP) in the bTB eradication programme, with the 'use of AVS knowledge and skills to provide bespoke advice to farmers and input to farm and area-based disease investigations'.

With respect to bTB testing, it is intended that more Reactor Herd Tests (RHTs) should be conducted by the AVS rather than DAERA testers, and veterinary practices should be responsible for supervising their own AVS staff throughout the year, with an enhanced role for DAERA auditing of testing within this framework. The AVS will answer routine breakdown queries, provide more advice on bTB control, and also be expected to attend breakdown investigation meetings with Patch VOs.

The principle of involving PVPs more in bTB breakdown management is an attractive one, and has already been adopted in Wales. Explaining the rationale for the approach, Welsh CVO - Dr Christianne Glossop - expressed her belief in involving private vets more: 'I believe that a farm's own private vet should be at the very heart of the response to a TB breakdown' (Glossop, 2013: 200). The Cymorth ('Help' in Welsh) TB Pilot project in Wales, where PVPs were more specifically engaged in bTB control on farms in addition to testing, generated positive feedback from both the farmers and PVPs involved in the pilot (Enticott & Ward, 2014). Farmers felt they had additional support and bespoke advice suitable to their farm, and vets thought that their deeper involvement in bTB control enhanced their value as vets. All the PVPs thought that they had a useful role to play in control and eradication of the disease (Enticott & Ward, 2014).

This corroborates earlier evidence from both Wales and England about how private vets could become usefully involved in bTB advice and investigation. Based on evidence from the Welsh Government's Biosecurity Intensive Treatment Area (ITA) which ran from 2006-2008, Enticott *et al.* (2012a) found that farmers appreciated the biosecurity advice on bTB provided by their own vets. As well as their local knowledge of the farm, the success of the scheme was based on established rapport and relationship: 'In trusting their vet, farmers believe that they will do their best for them and look after their interests' (Enticott *et al.*, 2012a: 335). Similarly, Fisher (2013) found that farmer trust and confidence in their PVPs was higher than their trust of state vets and officials. This belief was exemplified by a quote from a Gloucestershire beef farmer cited in the paper: 'I've known my vet for 30 odd years so I have the greatest respect for the man. He has the wellbeing of my herd and the industry at heart which I sometimes doubt if the Ministry has' (Fisher, 2013: 19). Fisher concludes that 'In relation to knowledge transfer, relationships between farmers and government



representatives are limited at best, with farmers unlikely to utilise or act on the information that the Government provides' (2013: 20). In Australia, local vets were seen to act as a bridge between the government and the farmers involved in the BTEC campaign, and 'were often able to help open up communications between district veterinary officers and [farmers] averse to having government people interfere with the running of their properties' (Lehane, 1996: 239).

Robinson (2014a) found that farmers in N. Ireland had mixed feelings about their relationship with DARD (now DAERA) vets. Many farmers were very positive, and reported good working relationships with DARD staff on the ground, but others felt detached from government officials, and complained about a lack of contact and support from DARD during chronic breakdowns in particular. This appeared to be more of a problem in higher bTB incidence divisions, possibly because of the higher individual breakdown caseload on Veterinary Officers (VOs). Some reported difficulties in contacting a DARD vet for assistance, and a lack of empathy. A UFU official believed that many farmers were asking advice on bTB breakdowns from their local UFU office because of a reluctance to deal directly with DARD officials, or asking the UFU to act as a go-between.

Working relationships at a local DVO level between DARD VOs and PVPs were generally perceived as being strong on both sides, but PVP concerns about testing supervision had placed strain on the relationship between PVPs and DARD in general (Robinson, 2014a). If PVPs are to be more involved in the day-to-day management of bTB outbreaks at farm level, and are also to be involved in breakdown investigation alongside VOs, particular care will need to be taken that VOs are not demotivated by a perceived lessening of their role and possible fears over job security. Protocols will need to be established to ensure that communication between DAERA and PVPs at both a local and a regional/national level to ensure consistency of approach and advice, and excellent co-ordination and demarcation of roles and responsibilities for bTB breakdown management. While training was perceived by PVPs to be satisfactory in the Cymorth TB pilot in Wales, communication between vets and PVP understanding of government decision-making was reported to be in need of improvement (Enticott & Ward, 2014).

Attendance at a mandatory CPD seminar, as proposed by the TBSPG, will help with training and communication. Advocating an increased role for practicing vets in advising farmers on bTB control in GB, Woodroffe (2014: 255) suggests that 'meeting this challenge may require continuing education to help vets to keep abreast of a complex and dynamic area of epidemiology'. A strong underlying framework of good working relationships is already in place in N. Ireland, especially between practice principals and VOs, but this must be further refined to cope with staff turnover, and two-way communication needs to operate effectively on a daily basis on the ground, backed up by formalised and ongoing education.

The governance of bTB testing and the standard of provision by vets is also an important issue. Concerns over the quality of bTB testing by PVPs have arisen in GB and in a number of EU countries (Enticott, 2012b; Humblet *et al.*, 2011a; Humblet *et al.*, 2011b; Meskell *et al.*, 2013), leading to increased awareness and training for vets, and stricter enforcement by state authorities. A NI Assembly Public Accounts Committee Report on TB (PAC, 2009) reported concerns about testing by private vets, with the Committee believing that some vets were failing to meet the high standards required of them. Reporting in the same year, the Northern Ireland Audit Office Report on bTB (NIAO, 2009) described failings in the testing provided by PVPs in N. Ireland, and recommended that DARD devoted sufficient resources to the supervision of PVPs. Robinson (2014a) found that private vets in N. Ireland were opposed to the manner in which DARD supervised their testing, and some objected to the principle of their professionalism being questioned.

The proposed new system will devolve primary responsibility onto veterinary practices to supervise their own staff, in a form of self-governance which is likely to reduce this tension between DAERA and private practitioners, and is based on a reliance on the practices to deliver their contractual obligations. Enhanced auditing by DAERA will seek to ensure there is not a reduction in testing quality. A situation must not arise whereby there is a significant variation between the quality of disease diagnosis delivered by private vets and that delivered by their counterparts in the public sector (Enticott, 2014), and this should be monitored and kept under review using test statistics held by DAERA. For example, Enticott (2014) found that government vets working for AHVLA in Great Britain were more than twice as likely to diagnose bTB infected herds, suggesting that this was due to the greater

'relational distance' between state vets and farmers when compared to private vets testing their own clients' herds. Similarly, in N. Ireland it was found that DARD staff were between 1.5 and 1.8 times more likely to classify a herd as a breakdown (NIAO, 2009). The ARD Committee Report in 2012 stated that 'the Committee emphasizes that it wishes to see that all testing, be that by a private vet or by a DARD vet, is done to the same standard and with the same rigour and consistency' (NI Assembly, 2012b: 12).

### **TBSPG Recommendation 6: Full and Partial Depopulations**

TBSPG recommends that in addition to application of more severe levels of SICCT interpretation and use of IFNG testing, the benefits of **depopulation should be considered in herds with multiple reactors**, and partial depopulation should be particularly considered in herds where those reactors represent a significant proportion of a particular group. The existing disease levels in the locality, and likelihood of recurrence should play a major part in these considerations. It is also essential to identify how resource is best utilised.

**Assessment:** In its final report of the inspection visit of June 2015 (FVO, 2015), the FVO recommended that the Competent Authority 'ensure that decisions on full depopulation of cattle herds with recurrent bTB breakdowns are based on clear guidelines and substantiated by a sound epidemiological evaluation of the possible long-term benefits for the elimination of infection with *M. bovis* in the herd and the local area.' Eurobadger (2016: 5) have recommended that governments 'reinstate whole-herd depopulation of bTB infected herds with immediate effect' in regions or countries where bTB is endemic or persistent.

Farmers and vets may react in different ways to whole herd removal. Many cattle herds were slaughtered during the brucellosis eradication programme, and during Foot-and-Mouth disease in N. Ireland (2001). There is therefore fairly recent precedent and experience of the policy, albeit with widely varying reactions of apparent apathy or alternatively despair and traumatisation (Robinson, personal observation). More extensive use of partial herd removal is less likely to meet with resistance from farmers, and less likely to be traumatic.

Epidemiological evidence (e.g. Good *et al.*, 2011) suggests that even full depopulation of bTB-affected herds will not significantly reduce the odds of recurrence after restocking unless additional actions are taken to deal with ongoing risk in the farm environment. This

will therefore need very careful consideration by the vets managing the breakdown. Considered risk judgments must be made on the likely benefits of partial or full depopulation, including the likely re-stocking response of the farmer following depopulation. Replacing an infected herd with one which is almost as likely to be infected through multiple purchases of cattle from sources of unknown bTB history may replace like with like, and achieve little to nothing. Nor must a situation arise whereby depopulation becomes an attractive proposition for farmers to gain extra financial compensation, and strictly enforced measures must be taken on any fully or partially depopulated farm to reduce the likelihood of recurrence of infection on restocking.

### **TBSPG Recommendation 7: Chronic herds**

The Group recognises chronic herds as an entity, recommends implementation of measures that will be relevant to resolving or minimising their impact and recommends the findings of **ongoing research into chronic herds** is used to develop the approach to dealing with them.

**Assessment:** Chronic herds may have a disproportionate impact on the overall incidence of reactor animals compared to other types of breakdown herd. The FVO inspection report of 2015 stated that the failure to adequately deal with chronic herd breakdowns was an important impediment to the eradication of bTB in N. Ireland (FVO, 2015). Epidemiological research in N. Ireland has demonstrated the significance of chronic herd breakdowns on the overall programme. For example, research by the DARD VEU discovered that between 2001 and 2003, just 27% of herds provided 56% of all test reactors (Unpublished DAERA data, cited in Doyle *et al.*, 2016). More recently, Doyle *et al.* (2016) performed separate case-control studies to investigate both the duration and recurrence of chronic herd breakdowns initiating between 2005 and 2010 (inclusive) in N. Ireland. This study found there were 679 case herds which met the criterion of a breakdown greater than or equal to 365 days in duration, and 657 case herds for the recurrence study which included any bTB breakdown of less than a year in duration followed by at least two further bTB breakdowns within the two following years (Doyle *et al.*, 2016). Between them, these herds accounted for nearly 40% of all reactor animals in N. Ireland in the study period, with the authors emphasizing the potential benefit in concentrating programme efforts on these particular herds.

Recurrent breakdowns and herds with breakdown episodes of long duration can have a major demotivating effect on the herdowners whose herds are affected, and also on the vets (both private and DAERA) who are testing the herds and investigating breakdowns (Robinson, 2014a). These chronic breakdowns have a desensitizing effect whereby bTB becomes an accepted and perpetual hazard, and there is little (if any) hope of resolution. For some farmers, these prolonged breakdowns bring despair and severe distress through overstocking and financial hardship, for others, there is an acceptance but frustration about repeat herd testing (Robinson, 2014a). There is a danger of a mind-set of resignation; that it will never be any different.

Chronic herds must therefore be particularly targeted through in-depth investigation and case review using all available information such as VNTR and detailed mapping, together with examining test and movement history of the affected farm. Consideration should be given by the Veterinary Service to having appointed VOs to have specialism in particularly investigating chronic herds across N. Ireland, and working closely with the herdkeeper, patch VO and private vet to develop an action plan to resolve the breakdown. A culture of acceptance of the status quo (at herd and regional level) must be changed.

#### **TBSPG Recommendation 8: Require herd test prior to restocking after TB breakdown**

TBSPG recommend that DAERA adopts a phased approach and moves immediately to prevent restocking of all breakdown herds until after the first herd test (and subsequent removal of any reactors), and further prevent restocking of herds that do not test clear, subject to epidemiological assessment). Licenced moves in exceptional circumstances would be allowed e.g. for welfare reasons.

In the longer term, and once the implications of the referendum decision are more clear, TBSPG should consider moving towards full compliance ie, require a negative full herd test, before allowing movement onto a farm following any disclosure episode (OTS and OTW) and further prevent restocking of herds subject to epidemiological assessment, with licensed moves into breakdown herds allowed in exceptional circumstances.

TBSPG recognise that this may require legislative changes.

**Assessment:** EU legislation prohibits the movement of cattle onto premises where bTB has been confirmed after slaughter, and all cattle remaining in the herd over 6 weeks old have had at least one clear test (Articles 15 and 17, 78/52/EEC). The failure to comply with this

legislation was highlighted by the FVO inspection team in 2015 (FVO, 2015: Recommendation 5). Unpublished DAERA data show that in 2014, 43,000 cattle were purchased during the course of a bTB breakdown, and this involved 900 herds. Over half of these herds purchased animals before the first herd test. Clegg *et al.* (2013) suggest that further research should explore why some farmers purchase cattle early in a bTB breakdown, and postulate there may be a correlation with other higher risk behaviours with respect to bTB. Robinson (2014b) shows that there are multiple reasons why cattle are purchased by farmers, and it may be that cattle are purchased soon after a breakdown begins to replace reactor cattle have been removed at the initial test. It can be argued, *a priori*, that to add cattle to an already infected population merely adds to the number of susceptible animals, and increases the risk of further infections, even if that risk is low; the aim should rather be for biocontainment (Mee *et al.*, 2012). It therefore seems logical to enforce 78/52/EEC, even if that requires amendments to current N. Ireland legislation, based on the epidemiological principle of limiting the spread of infection within the herd through reducing the number of susceptible individuals until the herd can be demonstrated to be a lower risk further into the breakdown. This is liable to be resisted by the industry and seen as a barrier to trade, but allowing the introduction of more animals into a high risk herd early in a breakdown episode to allow them in turn to become infected is not a sound basis for effective disease elimination.

#### **TBSPG Recommendation 9: Reduce no. of NVL reactors for herd to be classified OTW**

The group recommends that:

- Herds with **two or more NVL reactors should be classified as OTW** and require two consecutive clear herd skin tests at least 60 days apart to regain OTF status; and that tracing and checking of epidemiologically related herds is carried out.

Further VEU analysis should be done with a view to **extending OTW classification to herds with one reactor based on epidemiological risk** assessment, where a favourable risk assessment would be required to be upgraded to OTS status.

**Assessment:** Herds which have 5 or less NVL (No-Visible-Lesions) reactors without laboratory bacteriological confirmation are currently classified as OTS rather than OTW. This means that one clear herd test after 60 days allows the herd to trade freely again, and have OTS status removed from the herd. This is out of step with NVL policy in the ROI, Wales and England, and may mean that truly infected herds are tested less frequently, and derestricted

earlier than they should be, allowing the continuation of infection within the herd and possible spread to other herds. It also signals to farmers that NVL animals are of lesser significance and further evidence of the diagnostic capabilities of the SICCT. This is despite the oft-repeated veterinary mantra that NVL does not mean that an animal is not infected, merely that the lesion could not be found at slaughter. The sensitivity of post-mortem detection in abattoirs is known to be low (Corner *et al.*, 1990).

The current NVL policy contradicts scientific evidence from epidemiological studies, but also has an attitudinal dimension. Effectively dismissing multiple reactors revealed by the SICCT weakens farmers' faith in the test, creating a sense of injustice that the animals had been wrongly classified as positive and slaughtered unnecessarily (Robinson, 2014a). The policy has been criticised by PVPs as being counter-productive to the programme's objectives by undermining belief in the test's high specificity (Robinson, 2014a). The issue of terminology surrounding confirmation of reactors or otherwise was also addressed in the report of the Bovine TB Eradication Group for England (2009), and the report recommended using OTW or OTS rather than the terms confirmed/unconfirmed.

#### **TBSPG Recommendation 10: Routine Post Mortem Examination**

The TBSPG agrees that this important aspect of disease surveillance must be as rigorous as possible across all NI slaughter houses. The group agrees with the approach being taken by DAERA and will continue to monitor the surveillance outcomes as evidenced by future VEU reports.

**Assessment:** While meat inspection has the ultimate aim of declaring meat and offal fit or unfit for human consumption, it has also been integrally linked with surveillance for disease since almost its inception (Stärk *et al.*, 2013). In N. Ireland, slaughter surveillance by vets and meat inspectors means that bTB lesions can be detected in inter-test periods allowing earlier detection of infected animals, and often detects animals which have not responded to the SICCT due to anergy. It is also very important for reactor cattle, where lesions confirm the SICCT result. DAERA research has shown wide variation in both submission rate and confirmation rate for bTB across abattoirs in N. Ireland (VEU, unpublished report). Measures have already been implemented by the Veterinary Service and Food Standards Agency to improve submission rates.

Human factors have been shown to be important in explaining the differences in suspect sample submission rates between abattoirs in scientific studies, emphasizing the need for monitoring, training and ongoing motivation for meat inspectors and vets. For example, Olea-Popelka *et al.* (2012), analysing lesion submission rates in ROI, found that monitoring and training of meat inspectors had increased submission rates in the period since the previous analysis (Frankena *et al.*, 2007). Abattoir surveillance played a central role in Australia's successful bTB eradication programme, and included a National Granuloma Submission Program (NGSP) which actively encouraged sample submission and gave regular feedback on lesions to inspectors and producers (More *et al.*, 2015). In the USA, Kaneene *et al.* (2006) describe how financial incentives were used to increase submission rates from abattoirs and encourage effective animal trace-back to bTB-affected farms.

Providing meat inspectors with appropriate image-capture technology and encouraging submission of images and samples to academic experts in pathology has provided a useful means of linking slaughterhouse surveillance to bTB (and many other diseases) at a regional level in Catalonia, Spain (Vidal *et al.*, 2016). Consideration should therefore be given to photographing all visible lesions at slaughter with a view to providing a training resource for meat inspectors, OVs and pathologists, but also to provide post-mortem feedback to producers, PVPs and VOs as a way of making bTB visible again [see Culture and Communications section]. This would be particularly valuable in convincing farmers that the reactor which had been removed from their farm did indeed have lesions of bTB.

### **TBSPG Recommendation 11: Fattening Herds under alternative operating conditions**

TBSPG endorse the movement of cattle from TB breakdown herds to other herds where the following conditions apply:

1. The destination herd is 100% housed and completely separate from all other cattle.
2. Cattle can only be moved from the destination herd directly to slaughter in N Ireland or to another approved 100% housed herd under licence.
3. Management of the herd does not pose a TB risk to other cattle.
4. Slurry and manure disposal does not pose a TB risk to other cattle.
5. A biosecurity protocol is developed for each destination herd and agreed by DAERA



6. An approval and audit process is in place to ensure high biosecurity standards are maintained. Failure to maintain high biosecurity standards would result in the herd losing approval status and it would become a standard TB breakdown herd.
7. Any vehicle used in the transport of the animals must be cleansed and disinfected after each use.

**Assessment:** Herds under bTB restrictions for prolonged periods of time can suffer severe financial hardship and overstocking is a major problem. Robinson (2014a) found that overstocking and lack of feed and accommodation was a common issue and a major stressor for affected farmers under movement restrictions. Cash flow was also an issue for farmers unable to sell livestock. This recommendation is therefore likely to be welcomed by the farming industry, and mirrors similar arrangements in England (Approved Finishing Units). It is most likely to be used by dairy farmers selling unwanted male calves, and suckler herds selling calves which cannot be held on the farm beyond weaning. In the ROI, 'feedlot herds' may accept cattle from bTB-restricted herds under license, but the aspiration is for feedlot herds is to achieve OTF status rather than being permanently classified as OTW (DAFM, 2015).

What must be considered is whether cattle are allowed to move from any OTW herd at any stage and from any type of breakdown, or whether criteria should be introduced regarding length of time the herd has been closed, severity of the breakdown, number of restricted herd tests which have been completed, and the need for pre-movement testing. There is a difference between overstocking and cash flow issues which are an inconvenience (but bearable) early in a breakdown, and those where there is a serious human or animal welfare problem. The approval and audit process must seek to ensure that these higher risk cattle do not pose an infection risk to other herds or wildlife in the vicinity.

It must also be remembered that moving animals out of bTB breakdown herds is in breach of Article 17 of Council Directive 78/52/EEC as they are not going direct to slaughter, and may therefore raise opposition from the FVO and affect approval of future eradication plans by the European Commission. While the post-Brexit implications for future animal health policy in the UK are yet to be decided, there may be trade implications in the future if

import requirements into EU markets are to be mirrored on EU legislative requirements for Member States.

### **TBSPG Recommendation 12: Geographic Information Systems (GIS) resource**

TBSPG recommends that GIS is a **resource to be developed** to meet the requirements of DAERA staff, PVPs and the governance groups as the strategy evolves.

**Assessment:** The use of mapping technology is fundamental to the management of infectious disease in the modern world, with ever-improving GIS capability enabling the development of spatial epidemiology as a sub-discipline to manage both human and animal disease (Carpenter, 2011; Meliker & Sloan, 2011). Indeed, Carpenter (2011:119) states that ‘spatial epidemiology is now more of a necessity for outbreak investigations, surveillance, hypothesis testing, and generating follow-up activities necessary to perform a complete and proper epidemiologic analysis’. Consideration should also be given to the use of geographic positioning systems (GPS) technology to enable officers in the field to map breakdown farms and locations of reactor animals etc. The increasing use of technology in disease management will increase the capacity for in-depth epidemiological investigation and improve motivation for all concerned.

### **TBSPG Recommendation 13: Genetic susceptibility of bovines – conduct further research**

**Assessment:** Scientific research has demonstrated that there is a genetic component to the susceptibility of cattle to bTB (Bermingham *et al.*, 2014; Richardson *et al.*, 2016). Selection for bTB resistance should therefore be part of a holistic strategy to eradicate bTB in cattle (Anon, 2016). ‘TB Advantage’ was launched by AHDB as a genetic index to enable farmers to make informed choices in their breeding policy to factor in resistance to the disease in Holstein dairy cattle (AHDB, 2016). Dairy farmers should be actively encouraged by DAERA and the industry stakeholders to incorporate bTB resistance into their long-term breeding policies, and it is to be hoped that genetic indices can be determined for beef breeds and other dairy breeds as well as Holstein. The current attitudes towards breeding for bTB resistance in N. Ireland, and how much that influences farmer decision-making in choice of sire, are not known as no research has been conducted in this area and it is a recent introduction. A strategy to breed for bTB resistance is likely to be welcomed by stakeholder

groups outside of the cattle industry as a way of the industry taking pre-emptive action to manage the disease.

#### **TBSPG Recommendation 14: Additional 6-month test after CHT**

The group recommends requiring a herd test 6 months after the CHT following higher risk breakdowns, and define a higher risk breakdown as one with 2 or more skin test positive animals. This proposal brings forward the next test by 6 months for a subset of herds which are currently on an annual testing cycle but have been shown to have a very high risk of breakdown for this test type.

**Assessment:** Doyle *et al.* (2014) explored risk factors associated with the time from the post-outbreak test (CHT) to subsequent herd breakdown in N. Ireland, and found that herds which had been through a bTB event disclosed further bTB reactors significantly earlier than control herds with no bTB history. An additional herd test to deal with this problem will not be welcomed by affected herdkeepers, as testing is regarded to be one of the worst aspects of the bTB programme (Robinson, 2014a). Farmers spoke of the difficulty in mustering animals for testing, particularly in the summer, and the injuries and loss of production which resulted from testing (Robinson, 2014a). If this measure is to be implemented there needs to be clear risk communication to stakeholders to explain the reasoning behind it. Vets are unlikely to oppose the measure, given the scientific evidence revealing its potential importance, and badger groups are likely to welcome it, as they have already called for further testing in cattle (Eurobadger, 2016).

## FINANCE

### TBSPG Recommendation: Cap and reduce compensation for reactor animals

TBSPG are minded to recommend that:

- A cap in compensation levels be introduced with a maximum of £1,500 for non-pedigree bovine animals and a 20% premium for pedigree bovine animals (to a maximum of £1,800), with valuation determined by appointed valuers. This would keep the generality of valuations broadly on a par with those in the RoI;
- A herd-keeper will be permitted to receive compensation up to a cap of £3,500 for one pedigree stock bull per year with no carry-over from one year to the next;
- The cap be introduced as soon as practical;
- and that following the introduction of a cap, further legislation should be brought forward to introduce a percentage reduction in the level of compensation paid following valuation. This would be in addition to the introduction of capped payments. Thus for a non-pedigree animal valued at £1600 the cap would be £1500 and if the percentage reduction were to be 25% then the actual payment would be £1125.

TBSPG makes this proposal to help drive behavioural change and ensure that the other proposed changes in the strategy are financially viable.

However, TBSPG has not ruled out any other options and will give this further consideration depending on the assessment of the economic and behavioural consultants in terms of likely achievability compliance and impact.

**Assessment:** Compensation for diseased animals removed compulsorily by the state is used as a policy instrument to encourage compliance with disease control and eradication programmes (Wolf, 2013). There is also the risk that compensation could distort market signals and remove or reduce the incentive for farmers to take appropriate measures to avoid disease (Bicknell *et al.*, 1999). The FVO Inspection Report on bTB in N. Ireland (2015: 26) states that: 'compensation schemes in bTB eradication programmes should be subject to regular review and aimed at modifying the behaviour of farmers in avoiding introduction and further spread of the disease.'

Robinson (2014a) found that the costs of bTB were not just financial, and varied widely across farmers and different types of breakdown. For prolonged or severe breakdowns, statutory compensation for reactors was felt to be very inadequate to cover the much wider

costs of replacing cattle, losing production income, coping with overstocking, purchasing feed, and seeing years of breeding effort being wasted. As expressed by one dairy farmer, the overall costs of bTB meant that 'even if the compensation was three times the price of an animal, I wouldn't want to go down' (Int A11, cited in Robinson 2014a: 158). Vets were more likely to believe that the compensation contributed towards lax attitudes to biosecurity and a lack of concerted effort to manage bTB risk at herd level, especially for short or infrequent outbreaks (Robinson, 2014a). This quote typified the effect of a short and rare breakdown on a dairy farm: "It has never really had a significant impact apart from the fact you are closed and can't sell calves. This last outbreak – I'm calling it an outbreak, but it wasn't that major, it wasn't major at all – we're fortunate enough that it didn't impact on cash flow – we were able to keep going' (Int A36, cited in Robinson, 2014: 157). Taken together, these interview quotes illustrate the 'heterogeneity in individual perception of and response to disease risk, and response incentives to control disease' (Gilbert & Rushton, 2016: 3).

The key issue is whether the provision of 100% compensation for reactors discourages farmers from taking more proactive steps to reduce the risk of bTB entering their herd or spreading within it. A European Commission Task Force on bTB in N. Ireland reported that: 'The rate of compensation seems to be very high and overcompensation may be a factor acting as an impediment to the reduction of reactor numbers' (EC, 2004). This is supported by some empirical evidence. Abernethy (2008), comparing DARD valuations to market values of cattle in 2003, found that animals removed for bTB were valued significantly higher than those removed for brucellosis. Abernethy (2008) also demonstrated that for all cattle removed under both disease schemes adult commercial dairy cattle were valued 45% higher than the market values, and beef breeding cattle 20-30% higher. It is indeed likely therefore that the bTB compensation policy creates an *ex ante* moral hazard, where a producer knows what biosecurity arrangements are in place (or not) before an outbreak of disease takes place, and the indemnity paid by government acts as a kind of insurance policy (Gramig *et al.*, 2009). This moral hazard links to Buchanan's *Samaritan's dilemma* theory (Buchanan, 1975), where a donor (e.g. government) provides income to recipients who are supported in situations of disaster, and the recipients become less likely in future to take

action to lessen the impact of the disaster through personal insurance or other mitigation if guaranteed future donor support.

Until 1998 compensation payment for animals removed under the bTB programme was set at 75% of the animal's market value, but this was then increased to 100%, irrespective of its individual bTB disease status (NIAO, 2009). This reduction was based on the precedent set in GB by DEFRA that because of the role of badgers in the spread of bTB to cattle, the farmer should not be penalised when reactors were removed through receiving less than market value for the animal. Various investigative reports by public bodies looking at bTB in N. Ireland have criticized the level of reactor compensation awarded by the Department, and also have questioned whether this incentivizes farmers to actively reduce the risk of bTB entering their herd (NIAO, 2009; PAC, 2009), but the reduction of compensation was rejected following the ARD Committee investigation into bTB in 2012 (NI Assembly, 2012b).

The Ulster Farmers' Union, in their submission to the ARD Committee Bovine TB Review in 2012, linked any future reduction in compensation to badger removal having started: 'The UFU recognises that it remains an aspiration of DARD to reduce TB compensation levels, but no such reduction will be implemented by the Department until an agreed intervention programme is operational in rural areas' (NI Assembly, 2012a: 3). In 2014, this position was reiterated: 'One overriding issue is that the industry cannot accept any changes to be made to compensation rates until all factors are addressed and in particular the issue of TB in wildlife' (UFU, 2014).

There may be significant opposition to the TBSPG proposal to cap compensation rates, especially in the pedigree sector, even though such a measure was introduced to the brucellosis eradication campaign. Reducing compensation to 75% of market value is likely to be more strongly opposed by all farming stakeholders, as this could have a significant impact on chronic herds with repeat reactors and those with severe breakdowns, both pedigree and commercial, but again there is also precedent with the brucellosis programme. Capping compensation and reducing it to 75% may have the cumulative effect of reducing the attractiveness of 'volunteer' reactors in both the pedigree and the commercial sectors.

Given the stated UFU position linking compensation reduction to badger removal, there may be strong opposition to lowering of the compensation rates *before* badgers are culled, but it could be argued that there is no *a priori* justification to link the two. Having previously rejected a reduction in compensation (NI Assembly, 2012b), there may also be political opposition in the NI Assembly. Any measure which reduces the burden on the public purse is likely to be welcomed by taxpayers and the general public, and if it can act as a tool to change farmer risk-taking behaviour and incentivize biosecurity measures on farm then environmental groups and vets will also welcome the proposal.

Wolf (2013) has described how compensation for slaughtered animals in disease control is a trade-off between being high enough to encourage disease reporting and programme compliance, yet not so high as to discourage disease prevention because the payment lessens or eliminates the financial loss caused by diseased animals. Partial compensation at less than market value 'shifts some of the risk to farmers' (Wolf, 2013: 135) and is fairer for the taxpayer. As Wolf (2013: 135) warns: 'An indemnity plan that does not shift risk ... may actually create incentives for infection.' It is to be hoped that a reduction in compensation will encourage farmers do to all in their power to reduce the risk of bTB entering and spreading within their herd through implementing appropriate biosecurity measures. The main impact of the reduced compensation will be on herds affected by severe breakdowns and in chronic breakdowns with repeat reactors, reinforcing the need to target effort to resolving these breakdowns as soon as possible. There may also be a disproportionate effect on pedigree herds with high value animals, where the cap on compensation may mean a substantial loss on individual reactor animals. The onus is therefore on the herdkeeper to ensure all practicable measures are taken to protect the health status of the herd.

Much depends on the risk perception of the farmer on the impact of a bTB incursion in the face of uncertainty, and past experience will have a major influence on the risk mitigation strategies employed. Animal health insurance is also an (underused) option (EC, 2005; Meuwissen *et al.*, 2013). It is right that there are both public *and* private incentives to control disease (Biira *et al.*, 2016; Umali *et al.*, 1994), and ensuring the right mix is important for the promotion of bTB eradication.

## WILDLIFE

### **TBSPG Recommendation: Badger removal and vaccination**

The TBSPG recommends that a badger vaccination strategy along with the strategic removal of badgers is implemented in support of an effective disease control strategy. The Group further recommends that the injectable vaccine is used as part of the intervention approach, until an oral vaccine is available.

It is recommended that, when available, the oral badger vaccine could be deployed via an effective bait method on a more widespread basis (provided it is cost effective). This widespread vaccination of badgers, deployed in areas with an increased risk of TB transmission, will be an integral part of any successful and sustainable, long term curtailment of TB infection in badgers.

The Group would encourage the early use of the badger vaccine as a protective measure, with the input of local stakeholders, as part of an overall strategic control programme in combination with the removal of infected badgers in identified bTB “hot spots” / high risk areas.

The TBSPG recommends that DAERA implements a badger control policy to reduce the overall level of infection in both the badger and cattle populations.

The TBSPG also recommends that any badger policy is based on a multiplicity of tools which can be used as appropriate, subject to the particular circumstances that pertain. These tools will include (a) the removal of badgers in areas of high incidence of bTB in cattle, and (b) the vaccination of badgers together with removal of test positive badgers in a surrounding area to mitigate the risks associated with perturbation.

TBSPG also acknowledge that consideration needs to be given to the pragmatic aspects of resources and budget, in coming to any recommendation, but particularly in relation to wildlife, given the resource intensive nature of any intervention programme.

The approach recommended by TBSPG combines the use of removal programmes to deal with infection in a targeted area, with the concurrent vaccination and removal of test positive badgers in a buffer area around the removal area. This will to minimise the impact of a potential perturbation effect.

An additional, and critical, benefit is that vaccinated badgers could migrate into the removal area and be protected from any residual infection in the badger and cattle populations, and the sett environment. In adopting this approach, the TBSPG recommendations will also encourage farmer participation, for example, by taking adequate bio-security measures, especially in intervention areas

This programme will not be universally popular but the TBSPG considered that there is currently no other viable option and as such, must be included within an effective and inclusive eradication program to control TB in both the badger and cattle populations. Consideration has been given to rolling out of the TVR Study approach. However, the group considers that this study, while it may contribute to our understanding of Badger behaviour, is unsuitable for a wider control programme although some of the principles have been applied below

It is anticipated that the total area(s) identified would be as large as is possible to effectively manage - e.g. circa 100 sq. km (radius of 5.64 km). This correlates with the area size selected in England and



is compatible with the principle that natural boundaries should be selected e.g. rivers, mountain ranges etc wherever possible to reduce any possibility of a perturbation effect; additionally in larger areas the buffer area will be proportionately less and therefore easier and more cost effective to manage. TBSPG strongly recommends that a minimum of two badger removal areas would be piloted concurrently in different parts of Northern Ireland.

TBSPG are conscious of the sensitivities surrounding this work and of any intervention and the effective monitoring of it will help to provide assurances and transparency.

TBSPG envisage that this element of their overall strategy will be rolled out progressively with a minimum of two initial areas across Northern Ireland being identified.

**Assessment:** The role of badgers in the epidemiology of bTB is well established in the British Isles (Bhuachalla *et al.*, 2015; Godfray *et al.*, 2013). How to reduce the prevalence of *M. bovis* in the badger population has been subject to much scientific and public debate. With strongly-held differences in opinion on the efficacy and ethical acceptability of badger removal, debate has been ongoing since early removal operations in GB in the mid-1970s, and subject to experimental field research and several high-profile reviews in the UK (Bourne *et al.*, 2007; Dunnet *et al.*, 1986; King, 2007; Krebs *et al.*, 1997; Zuckerman, 1980). Badger vaccination using a licensed BCG vaccine has also been used in several regions of the UK and Ireland, and is an integral part of the TVR (Test-Vaccinate-Remove) research study in N. Ireland (DAERA, 2015).

Wildlife removal by killing raises ethical and welfare issues (reviewed by Littin & Mellor, 2005). The ethical acceptability of badger culling has been debated since the 1970s in GB. After the need to cull badgers on infected farms became firmly established amongst MAFF officials, vets and farmers, badger removal proceeded despite public disquiet (Anon, 1978). Debates on the ethics and social acceptability of badger culling continue to divide opinion in the UK today, as has been the case for many years, with often polarised views between farmers, vets, scientists, environmentalists, policymakers, politicians and the general public (Cassidy, 2015; Grant, 2009; Lodge & Matus, 2014; Spencer, 2011).

Contrastingly, in a New Zealand context possum control as part of the bTB eradication programme has been contested by the public because of the *method* of control, but the necessity of wildlife control has been generally accepted (Green & Rohan, 2012). Wildlife control has been viewed by those responsible for implementing the policy as an essential

part of the eradication of bTB in cattle herds in New Zealand (Livingstone *et al.*, 2015; Nugent *et al.*, 2014).

The ethics of killing badgers from the farmer's viewpoint in GB was discussed in Maye *et al.*'s work (2014: 408), where farmers 'argued that there was unequal treatment between badgers and cows, with cows regularly slaughtered and badgers protected and not dealt with.' Killing badgers was therefore viewed by farmers as a rebalancing of the equation, and a way of restoring equilibrium in nature (Maye *et al.*, 2014). Robinson (2014a) found more of the farmers and vets interviewed were in favour of badger removal compared to vaccination, and a selective approach targeting infected badgers was favoured slightly more than a blanket cull of all badgers in an area. There was a general scepticism about what badger vaccination could offer, and misunderstandings about how it could be achieved, but some believed that the TVR approach offered an acceptable compromise between indiscriminate removal and vaccination-only, although the study had not commenced at the time of the interviews (Robinson, 2014a). Some farmers expressed frustration about how thousands of cattle had been slaughtered in a bid to eradicate the disease, and yet badgers had not been killed in N. Ireland, despite their role in the spread of infection to cattle (Robinson, 2014a). O'Hagan *et al.* (2016b) found that a majority of farmers surveyed in the biosecurity study in Co. Down preferred badger vaccination over culling (55.2% v 25.5%), and 38% were concerned about public opposition to culling. O'Hagan *et al.* (2016b) also found that 20.3% said they were opposed to a badger cull, yet 86.5% supported culling in problem areas. This demonstrates that farmers contextualize the acceptability of badger culling to some extent depending on the situation in geographical areas and also in individual cattle herds, and a minority are also aware of potential public opposition to culling.

Engendering discourses of 'clean' and 'dirty' badgers according to their disease status, Robinson (2014a) shows how farmers and vets regarded badgers as a *threat* or alternatively a *defence* against bTB in cattle. 'Clean' badgers were viewed as a natural asset to be retained on the farm, with ill-feeling directed only towards out-of-place 'dirty' badgers with the potential to infect cattle in the locality. Indeed, these 'clean' badgers were seen as a buttress against the influx of 'dirty' badgers due to their territorial behaviour - allies in the

fight against the spread of bTB to cattle, as evidenced in these farmer and vet quotes (Robinson, 2014a: 222-223):

'I was told back in the 1970s if you have badgers on the farm, and no bother with TB, never do them in, because they are clean badgers, and I think that's right. There are clean badgers and dirty badgers, and we never have any problem with TB now ... We never touch the badgers.' (Int A12, dairy and beef farmer)

'I think there's a lot to be said on that story about clean badgers - if you have clean badgers they do seem to keep the dirty ones out, and I would definitely believe that.' (Int A59, private vet)

'But, while I have no TB, I am quite happy to let those badgers stay there, but you could tell me better than I could tell you, but I have heard that if you have healthy badgers you should let them stay, because if you do anything on them - which is illegal anyway, but there's things done - but if you do anything on them, then other ones will spread into that area, and if they have got it, you have just run yourself into a problem.' (Int A9, dairy farmer)

Maye *et al.* (2014) similarly describe how farmers in high bTB prevalence areas of the west and south-west of England had 'clean' and 'dirty' narratives of badgers according to their bTB infection status. While the majority expressed support for badger culling, there was also a preference for retaining 'clean' badgers on their land to protect from the intrusion of 'dirty' badgers (Maye *et al.*, 2014). Given these badger discourses of 'clean' and 'dirty' animals, there may therefore be reluctance by some farmers in N. Ireland to allow badger removal to proceed across their land if they have managed to remain disease-free while surrounded by infected farms.

Overall though, for farmers a significant advantage of badger removal will not be purely in terms of financial savings through an expected lowered cattle incidence, but in acting as a strong signal that government is prepared to implement a radical change in bTB eradication policy to move towards eradication in N. Ireland. This must be matched by equal determination from industry stakeholders to work towards the same goal, as evidenced by individual behavioural responses proving commitment to eradicate bTB in public-private partnership (Bicknell *et al.*, 1999). If a failure to cull badgers is seen by many farmers and vets as a primary obstacle to reaching bTB eradication in N. Ireland (Robinson, 2014a), removal of that stumbling block ought to produce hope to replace some of the despair that

decades of cattle testing and slaughter have produced amongst farmers and vets (Robinson, 2015).

The likely general public response to badger removal in N. Ireland is difficult to project, as it has not taken place before on the scale proposed by the TBSPG. The TVR project has produced a consensus of opinion across a wide range of stakeholders (DAERA, 2014; NIBG, n.d.; UFU, 2013), but this does not guarantee a similar consensus for further intensive badger removal without testing or vaccination. It is likely that badger culling will be strongly opposed by environmentalists and badger interest groups in N. Ireland and across the UK, and indeed further afield. A coalition of badger groups from Ireland, England, Wales, France and the Netherlands called on EU institutions and Member States to immediately ban the culling of badgers, and to 'address the false attributing of significant bovine tuberculosis (bTB) transmission to cattle by badger *Meles meles*' (Eurobadger, 2016: 2). The N. Ireland Badger Group state on their website that: 'We do not believe that badger culling will have any impact on bovine TB in cattle nor is there any evidence to support claims that current badger culls have contributed to bovine TB control in Ireland or Great Britain' (NIBG, n.d.). Similar opposition to badger culling has been expressed by others:

'At the Badger Trust we have openly opposed the cull since its inception; fighting legal battles, calling for scientific research and supporting groups on the ground.'  
(‘Can the Cull’ campaign - Badger Trust, n.d.)

'The Charity favours methods of control based in science and security rather than slaughter.'  
(USPCA, n.d.)

Badger culling is also opposed by The Wildlife Trusts (2016), Team Badger (n.d.) and the RSPCA (2016).

The N. Ireland Badger Group has stated that: 'It has a longstanding commitment to engage constructively with industry and government in a spirit of good faith, common ground and mutual understanding' (NIBG, n.d.), but the TBSPG proposal to cull badgers across wide areas may test that commitment to engagement to the limit.

DAERA already consults with the Council for Nature Conservation and the Countryside (CNCC) as a recognised statutory advisory body, but there is scope for deeper engagement and utilisation of its expertise in issues such as badger ecology. In a spirit of collaborative governance, it is very important to engage all stakeholders from the start of the process, but it remains to be seen whether environmentalists and badger welfare groups will be prepared to countenance badger culling as part of the package of measures which they are asked to deliver. Agreed approaches to the management of wildlife in controversies elsewhere in the world show that collaboration and agreement is possible given the right conditions (Dandy *et al.*, 2012; Dorn & Mertig, 2005; Powell & Ardiaolo, 2016; Robinson *et al.*, 2005).

## CULTURE AND COMMUNICATIONS

### TBSPG Recommendation: Culture and communications strategy

It is recommended that a vigorous publicity and communication strategy is developed and implemented.

The purpose of the strategy is to:

- a. promote the TB Eradication Strategy;
- b. raise awareness of key recommendations and actions;
- c. promote best practice; and
- d. provide stakeholders and the public with key information on TB control and eradication.

It will aim to do this through:

- I. providing regular updates to ensure that the work of the new oversight governance structures working with all partners to eradicate TB is kept to the fore
- II. ensuring effective flow of communication within DAERA from local office to policy and veterinary management and vice versa is effective, and
- III. ensuring that messages are in a format which is appropriate to the audience.

It is recommended that action is taken by all stakeholders to support change in attitudes and approach from a position where bTB is seen as an unavoidable feature of farming life to one which focuses on a concerted effort to eradicate bTB as a disease. This will be reflected across all recommendations which will contribute to this change in culture.

**Assessment:** There needs to be a fundamental shift in the culture and communications surrounding the bTB eradication programme in N. Ireland. Weariness, apathy and despair are firmly entrenched amongst all stakeholders after decades of trying to eradicate the disease without success (Robinson, 2015).

Robinson (2014a) discovered that bTB is no longer feared by farmers as a zoonosis, and for the majority it has become a commonplace which anaesthetizes perception of its threat. The state attempts to raise awareness of the risk, but as O'Neill and Nicholson-Cole (2009) discovered for changing attitudes to climate change: 'Fear won't do it'. Insulated by the guarantee of full compensation for reactors, and with bTB an uncommon event for many farms, there is little fear of stigma, contagion or cost when it comes to preventing bTB in the

herd. Instead, there needs to be a clearer economic case to change attitudes to bTB amongst farmers, but statistics on their own will not be enough. There is a need to make bTB visible again: the lack of clinical signs militates against taking the disease seriously (Robinson, 2014a). Farmers had much more awareness of the biosecurity threat of other common bovine diseases such as BVD, Johne's disease, Salmonellosis, IBR and calf pneumonia. These diseases were seen to be preventable through the strategic use of vaccine, but bTB was viewed differently: there was a fatalistic script that nothing could be done to prevent the disease, attitudes which similarly have been found in high bTB incidence areas of England and Wales (Enticott & Vanclay, 2011).

There is therefore a need to make bTB *visible* again as an infectious disease caused by a bacterium which is harmful for a wide range of mammals, and is also a zoonosis. The lack of a visible bTB presence on farms in terms of clinical cases (wasting, coughing, dying cattle) in N. Ireland has rendered the disease invisible to farmers (and vets?). The need for visibility was recognised in the very earliest efforts to eradicate the disease in both humans and animals in early 20<sup>th</sup> century America. In Ireland, Lady Aberdeen (1857-1939), organised a campaign against human TB which began with an exhibition in Dublin in October 1907 (Breathnach & Moynihan, 2012). It moved north in December 1907, visiting Belfast, Lisburn and Lurgan before being taken around Ireland by horse-drawn caravan. The aim was to make bTB visible. Today's generation of farmers and vets have forgotten what bTB in cattle looks or sounds like if allowed to develop to the clinical stages. It is merely a swelling on the side of the neck at a bTB test, or a granulomatous abscess in a lymph node at slaughter, rather than a potentially fatal infectious disease affecting a wide range of mammals and humans.

The vast literatures of human health behaviour show that the issue of persuasion to avoid risky behaviours or adopt healthier practices to protect or improve health is a great challenge across multiple subject areas e.g. smoking, cardiovascular disease, obesity, exercise and cancer prevention. Ruiter *et al.* (2014), in reviewing the use of *fear* as a motivation to change human health behaviours, conclude that this commonly used method has been unsuccessful in health campaigns, and merely promotes defensive reactions or message avoidance. They offer the following as a solution: 'These counterproductive responses may be avoided by providing instruction on how to successfully implement the

recommended actions as well as convincing people that they are personally susceptible to the threat' (Ruiter *et al.*, 2014:68). There is therefore a need to provide practical instruction on how to mitigate the threat of bTB at farm level through seminars, training courses and online information, and private vets can act as the channels of that information to their clients. What must be emphasized is that bTB is an unpredictable infectious disease, but one that can be eliminated.

Information on the bTB programme must be provided using many alternative forms to engage as wide an audience as possible. This should include: social media through dedicated *Twitter* and *Facebook* accounts; the TB Hub website at <http://www.tbhub.co.uk/>; media advertising; YouTube videos; written publications; posters; trade stands at agricultural events; academic publications; and oral communication. DAERA and relevant agricultural industry bodies should jointly launch of the new TBSPG strategy to reinforce the message that this is not just a government problem: it is for government, the cattle industry and all relevant stakeholders to work in partnership with joint responsibility to eradicate bTB. An extensive outreach programme should be planned where dedicated and passionate speakers (TBSPG members, farmers, vets, DAERA officials, industry representatives, environmentalists) present the new policy in multiple fora and venues across N. Ireland (e.g. UFU farmers' meetings, farmer discussion groups, veterinary association meetings, DAERA staff meetings, processors groups, wildlife groups, auction marts, breed associations, community groups). These meetings will educate and inform, and emphasize this is a new beginning for bTB eradication in N. Ireland. The value of personal persuasion at an individual and small group level must not be underestimated if the cultural change will take place from the ground up which needs to take place of these recommendations are to be successful in the vision of eradicating bTB from N. Ireland. Dorn and Mertig (2005) underline the importance of public education in bTB eradication policies in Michigan, USA.

Describing the success of the American programme for eradication many years ago, Myers (1939) emphasized the importance of meetings where authorities 'put the matter clearly before the people as to every step it will be necessary to take in order that success may be obtained'" (cited in Francis, 1947: 170). All stakeholders must move from a position of despair and frustration to one of hope and enthusiasm that the implementation of these recommendations offers a fresh start; the task is a huge one, but not impossible.



While the key focus in the initial stages of the new arrangements will be to implement a vigorous communication of change, plans must also be laid in place as to how the momentum can be maintained over the years ahead. As can be seen with the rapid and almost ubiquitous adoption of social media across the world in the last decade, it is difficult to envisage what communications technologies may look like in ten or twenty years' time. Communications strategies will have to evolve as the programme embeds and matures, and also as technologies of communication change over time. The common thread must always be public engagement which is simple to understand, measures progress, and motivates all stakeholders to face the challenges of today to create a better legacy for tomorrow.

## SECTION A: Part 2

### Potential effectiveness of the TBSPG's draft recommendations: As an integrated package of actions

- The TBSPG's main objective is to recommend a comprehensive package of measures which will create and enable the conditions which will lead to the eradication of bTB in N. Ireland in the future. Acknowledging the multifactorial nature of the disease, the recommendations, if accepted in their entirety, and implemented together, should make a major impact on the bTB programme and reduce the incidence of TB in both cattle and badgers.
- The new governance arrangements will create a multi-tiered and distributed governance structure which brings together the different stakeholders. Importantly, this invites farmers and vets to work in partnership with government officials, scientists, environmentalists and processors to influence and make decisions *together*. This is a radical shift in governance arrangements, and although it has echoes of the New Zealand arrangement of national and regional animal health boards, is unique in the range of actors brought together in terms of global bTB management. Actors in bTB eradication who may have felt disengaged and marginalised by the government now have opportunity for meaningful engagement.
- Biosecurity is an important factor in reducing the risk of infectious disease incursion into farms, and better understanding and adoption of biosecurity by farmers will have beneficial impacts on the incidence of bTB. There are great challenges in persuading farmers that biosecurity is practical and has benefits in terms of lowering the risk of infection, and this phenomenon has been demonstrated across the world and for many different diseases, not just bTB. The published literature on bTB has illustrated how the disease is particularly challenging in this regard. Private vets have a major role to play in knowledge transfer activities, and the enhanced role for private vets to work with farmers on improving biosecurity through farm visits and practical training will be important. Badger interest groups and the state have often

pointed out the deficiencies in farm practice and biosecurity which help to create the conditions for within-herd and between-herd transmission of bTB, and it is vitally important that the issue is tackled.

- The extension and strengthening of existing tools is a logical step which means that the current programme is fine-tuned to provide maximum impact. If tools are already in use, there may be minimal extra burdens to implement more fully. Badger welfare groups have repeatedly called for increased focus on cattle factors influencing disease spread, and the extension of skin and IFNG testing measures will be particularly welcomed by this stakeholder sector.
- Finance, particularly compensation payments for bTB reactor animals, has been a thorny issue for some time. There has been a belief in government that the 100% compensation rate for reactors has dis-incentivised farmers from taking responsibility to minimise the chances of bTB incursion into their herds. Farming groups have withheld their potential support for a reduction in compensation rates until action has been taken by the government to cull badgers. The recommendation to cull and vaccinate badgers should therefore remove this economic barrier and moral hazard, but as argued earlier in this report, from first principles, the two factors do not have to be linked. There will be pain for many farmers who continue to suffer severe or repeated herd breakdowns, and this may have significant monetary implications for a proportion of farmers who will not be compensated at full market value, especially in the pedigree sector. At the same time, having a bTB breakdown must never be seen as an option which offers the potential to make a profit through 'volunteered' reactors and fraudulent activity.
- The proposal to cull badgers in heavily infected areas, with vaccination in surrounding buffer zones, addresses the ongoing risks of badger-cattle transmission, and addresses an issue which has been repeatedly raised for many years by farmers' representative organisations and many farmers and vets. Many have argued that this factor is the most important reason for ongoing transmission of the disease, and

have argued that cattle testing and removal will never succeed on its own to eradicate the disease on N. Ireland. This is likely to be the most controversial aspect of the overall package of recommended measures, and is likely to be strongly opposed by badger welfare groups. How to persuade all stakeholders to agree to this measure will be the most difficult challenge the TBSPG will face in launching this proposal and in seeking to ensure that the new governance models will include all the stakeholders envisaged, including environmentalists.

- Farmer expectation will also have to be carefully managed, as badger culling on the scale proposed can only occur in selected areas based on epidemiological risk assessment, not in every area where bTB breakdowns occur. While every farmer will have reduced compensation for reactor animals, not every farmer will have badgers culled on their land, but this should not become an argument for farming stakeholders to disengage from the programme. The onus will remain on every farmer to seek to reduce the risk of their herd becoming infected with bTB through the implementation of best biosecurity advice on their own farm and in partnership with neighbouring farmers in localised areas.
- Changing attitudes to bTB will be an essential part of the programme if it is to be successful. Decades of testing and removal of cattle bTB reactors has produced apathy, and even open resentment, especially amongst farmers, as can happen with all disease eradication programmes which take longer than anticipated to achieve their objectives. The optimism of the late 1960s that bTB was eradicated in N. Ireland has long since evaporated, and this has been replaced with a sense of hopelessness that the low-incidence position of the early 1970s can ever be regained. A vigorous communications strategy must be launched to emphasize a new beginning, and to persuade and empower all stakeholders that they have a responsibility and a role to play in bTB eradication. As an infectious disease which is often unseen due to the lack of obvious clinical signs, and therefore mysterious and challenging to understand, bTB must be made visible again; all stakeholders must 'see' the object of eradication. At its most basic, bTB eradication is about preventing

the transmission of *Mycobacterium bovis* between cattle, between badgers, and between badgers and cattle.

- The recommendations must begin to be implemented as soon as possible to effect change on the ground, building trust and obtaining 'buy-in' from all stakeholder groups. Long delays between launch of the recommendations and implementation are likely to lead to loss of momentum for change. Stakeholder engagement and consensus-building must begin even before implementation, and the communications strategy is integral to this process.

## SECTION B

### Options Assessment from Attitudinal/Behavioural Perspective

There is limited evidence on which to base the likely attitudinal and behavioural responses to the following options packages, particularly options 3, 4 and 5, given the unique combination of measures which the TBSPG are proposing, for which there is no direct comparison in N. Ireland or elsewhere. Option 1 was last the position before the 1950s, and evidence is sparse for attitudes and behaviours towards the disease in this period, and is very unlikely to be similar to today in any case. Option 2 can be appraised with more confidence as it is the status quo position, and there has been an eradication programme in place since 1959. Option 3 (Implement in full) is projected to have maximum overall behavioural response and to advance the bTB eradication programme most quickly. This option is premised on the agreement of wildlife stakeholder groups to engage in the governance process.

#### **Option 1: 'Do nothing' – which would see no government testing or bTB programme.**

##### Benefits

- This would remove a major part of the regulatory burden from farmers which they view as an impediment to farming.
- Farmers would no longer be forced to test cattle, a measure which they often resent due to the time taken and the potential injuries and loss of production in their cattle.
- Some vets may welcome the reduction of their bTB testing burden, an activity which some find monotonous and a distraction from other veterinary disease control activities on farm.

##### Disbenefits

- Processors and exporters may anticipate the loss of valuable export markets due to no assurance of freedom from disease in cattle and cattle products, with very serious knock-on effects on producers.

- Farmers and consumers in N. Ireland may become fearful of bTB once again as a zoonotic disease which is not being controlled.
- Many private vets would fear job losses through the reduction in veterinary workforce required, and the reduction of their practice viability due to a business model built around bTB testing income in many (particularly smaller) farm animal practices.

**Rationale:** The disbenefits outweigh the benefits. This option would have catastrophic implications for N. Ireland's future export capability. The gained reductions in bTB incidence since the 1950s would be lost and nearly six decades of effort could potentially be wasted, leading to further demoralization of stakeholders. Robinson (2014a) found no evidence of any stakeholder group calling for the complete withdrawal of the bTB eradication programme.

#### **Option 2: 'Status Quo' – current bTB programme to tackle the disease.**

##### Benefits

- Farmers, vets and the state veterinary services are accustomed to the current programme and roles, responsibilities and working relationships are well established.
- The current programme is viewed as robust and has been accepted by the European Commission.
- bTB is not feared as a zoonosis due to the operation of the N. Ireland programme, and consumers purchase milk, beef and other bovine food products nationally and internationally.

##### Disbenefits

- Farmers and vets have become disenfranchised from the current programme due to decades of testing and removal of reactors without the achievement of eradication.
- There is widespread pessimism that bTB will ever be eradicated from N. Ireland.

- Repeated bTB breakdowns continue to cause severe stress and frustration for many herdowners.

**Rationale:** The disbenefits outweigh the benefits. The current programme is successful in keeping herd incidence below 10%, and allows consumer confidence in national and international markets for N. Irish bovine products, but there is little evidence that proceeding with the current policies will achieve the objective of eradication of the infection from cattle and wildlife hosts. Robinson (2014a) found that the majority of farmers and vets thought that bTB would never be eradicated unless radical changes were made to the current programme.

### **Option 3: Implement TBSPG recommendations in full.**

#### Benefits

- The combination of measures proposed addresses all of the major hurdles to further progress towards the eradication of bTB and promotes confidence that definitive action is being taken.
- Implementing all recommendations in full signals complete commitment to moving bTB eradication forward as speedily as possible.
- Implementing all measures avoids a selective and piecemeal approach where which measures are more important or acceptable becomes debatable.
- Farmers and environmentalists (in particular) are given decision-making powers to affect change where previously they have been excluded by government holding a monopoly on power.

#### Disbenefits

- The implementation of all measures together produces a considerable increase in workload for DAERA staff which may be resisted or deemed unmanageable without additional staff recruitment in the short-to-medium term.



- Environmentalists may strongly oppose the culling of badgers across wide areas of land on ethical grounds and take legal action to prevent such action.
- Even though planning may begin concurrently, it may take longer to plan and implement badger culling than to reduce compensation payments and other measures which primarily affect farmers. Farmers may therefore oppose the early reduction in compensation payments for reactor cattle without badger culling having been instituted.

**Rationale:** The benefits outweigh the disbenefits. There needs to be a radical overhaul of the programme to push incidence towards eradication and promote stakeholder confidence that barriers to eradication are being removed. There are costs for all stakeholders in the new arrangements, and there needs to be a spirit of compromise, co-operation and partnership working to make it a success. Stakeholder expectations will have to be managed to explain what is happening and when as plans are rolled out, and the communications strategy is a vital part of this process. The key factor is to deliver what has been promised in the new programme launch. Experiences from Australia and New Zealand [see Section C] in particular provide encouragement that a partnership approach between farmers, vets, scientists and government can reap dividends in progress towards the eradication of bTB. A key difference in N. Ireland is that a wider range of stakeholders are included by enrolling wildlife groups, but that must be seen as only a positive through opening up democracy and expanding collective decision-making to deal with this intractable problem of bTB. Divergent opinions must be brought together through trust-building and consensus, with decisions made which are guided by science and also take into account wider socio-economic perspectives. All stakeholders must take their governance responsibilities seriously and work to produce gains and progress, not inertia or regression, especially when difficult decisions have to be made. Farmers will have to accept greater responsibility for herd biosecurity; accept the loss of a proportion of the financial compensation previously paid; and cope with stricter rules on how bTB is managed. Environmentalists will have to accept that badgers are part of the epidemiology of the disease in N. Ireland, and culling a certain proportion of the infected badger population will become part of the advancement towards eradication. Political decisions will need to be made on how DAERA organises its changing

role in governance and copes with the additional administrative and technical burdens placed upon it.

#### **Option 4: Implement TBSPG recommendations in part**

[This will include prioritisation of recommendations based on the consultant's analyses of individual proposals referred to in (1) above to design an option for comparison which would be likely to stack up well with regard to **economic and financial** considerations].

##### Benefits

- Measures which are deemed unpalatable by particular stakeholder groups (e.g. badger culling or compensation reduction) could be omitted from the package.

##### Disbenefits

- The piecemeal adoption of certain measures and not others will weaken the overall impact of the whole package.
- The momentum for change will be lost or severely weakened, leading to a continuation of the disengagement from the programme by many key stakeholders.

**Rationale:** The disbenefits outweigh the benefits. Deciding to implement only some of the recommendations is likely to promote disharmony amongst the various stakeholder groups as some may feel the adoption costs are spread unevenly or unfairly. Implementing in full means that all stakeholder groups have to accept change and social, political or economic cost.

## Option 5: Staged implementation

[This will consider progressive implementation of recommendations included in (3) and (4) above].

### Benefits

- This will spread the additional workload for DAERA staff charged with implementing the new procedures and legislative change, making it more manageable.

### Disbenefits

- The momentum for change may be lost or severely weakened through staged implementation, leading to a continuation of disengagement from the programme by key stakeholders.
- Without high impact change management early in the implementation phase, poor biosecurity practices may be further entrenched through time.
- A communications and culture change strategy will become more difficult if momentum is lost over time.
- Staging may promote a sense of disbelief that key measures will ever be implemented e.g. badger culling.

**Rationale:** The disbenefits outweigh the benefits. Staged implementation, while it has the benefit of spreading workload, is likely to mean the loss of momentum and ongoing disengagement. Stakeholders need to see and believe that change is happening across all issues if goodwill and the determination to succeed are to be maintained.

## SECTION C

### **Assessment of potential behavioural implications of identified preferred option: What has worked well in other countries, and for other endemic diseases?**

Houe *et al.* (2014: 13) warn that ‘a control or eradication programme that has been successful in one country may not be transferable to another country without considering the socioeconomic aspects’. While caution therefore needs to be exercised when seeking to apply the socioeconomic lessons of bTB eradication policy from selected other countries, there are still valuable principles which can be applied to the situation in N. Ireland (Part 1). This also applies to other endemic disease control and eradication policies which may have cross-over applicability for bTB (Part 2).

Although scientific, technical and epidemiological themes are more commonly reviewed in the published literatures of disease eradication, the attitudes and behaviours of stakeholders and the governance of programmes is also discussed to a lesser extent. The thread that runs through all of these disease eradication efforts is the importance of gaining wholehearted farmer agreement and support for the aims and objectives of the programmes involved whatever the disease. To maintain that motivation and support over the longer term, effective and ongoing communications between all relevant stakeholders are essential.

#### **Part 1**

##### ***Australia***

Australia eradicated bTB in 1997, after a successful 27 year programme known as BTEC (Brucellosis and Tuberculosis Eradication Campaign) (More *et al.*, 2015). The initial driver for eradication in Australia was the potential loss of important export markets for beef and dairy products to the USA (More *et al.*, 2015), leading to the replacement of State-based voluntary programmes to a coordinated national campaign beginning in 1970 (Cousins &

Roberts, 2001). Lehane (1996: 35) describes how the governance and financing of the programme changed over time:

‘It started as an exercise entirely planned, paid for and run by government – State and Federal. This changed radically as the campaign progressed, with *representatives of the cattle industry becoming heavily involved in planning and management* at both national and State levels, and the industry providing a growing proportion of the funds [*italics mine*]’.

The key change here was to move from a top-down, government-centred approach to one where farmer representatives took on a key role in developing and managing the programme, while also contributing increasingly towards its financial cost. While there was successful industry-government partnership, the campaign in Australia was certainly not easy, and entailed a huge amount of effort. Lehane (1996) acknowledges the great challenges that had to be overcome, but he praises the role of the farmer representative groups across the country who ‘were often critical of aspects of the campaign, [but] always supported its goals’ (Lehane, 1996: 242). Cousins and Roberts (2001: 6) note that ‘without the support of the cattle industry, Australia’s campaign would never have been successful’. But it was not just the cattle industry, for the Australian Government (2012) records the success of partnership between government, producers, veterinary practitioners and the industry to work together to formulate programme definitions and rules. Given the strong multi-stakeholder partnership approach, programme managers were supported even when they ‘imposed relatively draconian measures ... to minimise infection risk from known infected herds’ (More *et al.*, 2015: 231).

### ***New Zealand***

Tweddle and Livingstone (1994), reviewing the bTB eradication campaigns in both Australia and New Zealand, highlighted the need for industry participation and commitment. Replacing earlier district committees of farmers and local Department vets, a National Animal Health Advisory Committee and regional committees were set up in 1969 to include both dairy and beef farmers (Livingstone *et al.*, 2015). With the setting up of an Animal Health Board (AHB) farmers took up the majority of the committee posts, and became increasingly involved in bTB policy and decision making. Livingstone *et al.* (2015: 98) state that the formation of the AHB sought to ‘empower the farming industry to take the

leadership role in funding of TB control, policy development and administration'. With this came much more ownership of the disease by individual herdowners. Tweddle and Livingstone (1994) suggested that efforts were made to minimise the social and economic impacts of bTB on individuals, but not to absolve them from responsibility to move from an infected herd status to a disease-free status.

The creation of a National Pest Management Strategy (NPMS) was formally approved by the NZ Government in 1998 to allow possums (a wildlife reservoir of bTB) to be killed. The programme has been funded by producers, and is administered by the AHB. It has seen overwhelming support from the majority of farmers in NZ, with a survey published in 2011 showing 85% support for the NPMS, but there has been some public opposition to the method of possum killing through aerial 1080 application (Livingstone *et al.*, 2015).

### ***Republic of Ireland***

Sheridan (2011) noted the importance of stakeholder attitudes towards bTB in the development of bTB eradication policy in Ireland. Dissatisfaction with the lack of progress led to the creation of a new agency known as the Eradication of Animal Disease Board (ERAD) in 1986, which radically changed the programme. Despite the most intensive testing programme ever instituted in the country between 1989-1992, little impact was made on underlying disease levels, even with an increase in the number of reactors detected, and 'the confidence of the stakeholders was undermined and morale suffered accordingly' (Sheridan, 2011: 161). Alongside all of the technical and scientific developments in the Irish programme, Sheridan (2011: 168) argued that the challenge was to 'persuade the farmers and other stakeholders that it [was] necessary for them to take back a higher level of ownership of the programme'.

This conclusion echoes the findings of an earlier report prepared for ERAD in 1993 (O'Connor *et al.*), where socioeconomic factors were viewed as impediments to bTB eradication. Based on farmer surveys, 62% of those surveyed believed that farmers had primary responsibility for bTB control, but 23% placed primary responsibility with the government, and 18% with veterinary practitioners (O'Connor *et al.*, 1993). The authors emphasized the need for co-operation between all the individuals and agencies involved,

with ‘continuous negotiation with the various interest groups [as] the only way forward’ (O’Connor *et al.*, 1993: 8).

### **Great Britain**

The report has already highlighted some of the findings of social science research work in England and Wales by geographers (e.g. Enticott, Maye, Naylor *et al.*). The majority of this research has been centred on farmers in areas of high bTB incidence, and has emphasized the gulf between farmer understandings of bTB and state discourses on biosecurity in particular (e.g. Enticott, 2008b; Enticott & Vanclay, 2011). This highlights the need for farmer education on biosecurity and the usefulness of private vets discussing the subject specifically on farms (Enticott *et al.*, 2012). Private vets have also been discussed as links between farmers and government, important in building (or rebuilding) trust (Fisher, 2013; Woodroffe, 2014). Trust between stakeholders working in partnership has also been highlighted as an essential component in the Welsh bTB eradication programme (Glossop, 2013). All of this work demonstrates how valuable social science research can be in helping government to understand the views of other stakeholders in the bTB problem, but what is lacking in the published literature are the views of the members of badger interest groups and the general public on bTB in Britain, although Enticott’s (2015) paper on the views of the public in rural Wales provides an exception. His questionnaire research revealed that a majority of respondents were in favour of badger culling (43% v 36%), and the highest proportion in favour (50%) were in areas of high bTB incidence.

## **Part 2**

### **Other endemic diseases**

Within N. Ireland there are examples of endemic disease control and eradication which provide lessons for bTB management. Brucellosis has been successfully eradicated, with the award of Officially Brucellosis Free (OBF) status in October 2015 after an intensive campaign (DAERA, n.d.). In October 2012 Aujeszky’s Disease freedom was officially recognised by the European Commission, and the Minister for Agriculture stated that this was ‘testimony to the hard work and commitment of the members of the joint Government/industry working group’ (DARD, 2012).

Animal Health and Welfare NI (AHWNI) was formally launched in 2012 as an industry-led, not-for-profit partnership between producers, processors, animal health advisers and government to tackle endemic diseases which were not subject to other statutory schemes. The BVD eradication programme is an excellent example of an initiative led by the farming industry but underpinned by government legislation and facilitation. This governance model echoes what also exists in the ROI: Animal Health Ireland (AHI) was set up in late 2008, with the aim of increasing private sector involvement in animal disease control and the provision of a body to educate farmers, co-ordinate strategy and improve the health of the national herd (More, 2008; More *et al.*, 2011). These programmes, as well as dealing with the endemic diseases, should have added spin-off benefits: in promoting the importance of on-farm biosecurity to keep BVDV or Johne's disease from a herd, this should in turn benefit the national bTB eradication programme by also making *M. bovis* transmission less likely through commonalities in reducing risk factors. The perhaps more tangible link seen by farmers between reducing diseases such as BVD and Johne's through biosecurity efforts and increasing farm profit margins may also help farmers to apply similar economic rationale to bTB control.

## **BVD**

Bovine Viral Diarrhoea (BVD) eradication programmes have been operational around Europe for some time, with the Scandinavian countries being early (and successful) adopters. Describing experiences in Sweden, where BVD eradication began in 1993 as a voluntary scheme paid for by farmers, Hult and Lindberg (2005: 147) state that 'many problems can be solved by informing and cooperating with the ... farmers, the dairy and beef industry, livestock traders, insurance companies and other relevant stakeholders'. Risk-based trading was regarded as a key factor in the success of the programme, where farmers were strongly encouraged to ask for BVD status before purchasing cattle (Hult & Lindberg, 2005).

A succession of papers on BVD control from across various EU countries have repeated the vital importance of farmer motivation to be involved and fully committed to the goal of eradication, with ongoing communication and engagement if the programme is to be successful (e.g. Barrett, 2012 (ROI); Gunn *et al.*, 2005 (UK); Presi & Heim, 2010 (Switzerland); Valle *et al.*, 2005 (Norway)). The BVD scheme in N. Ireland operates under the same



principles, and is underpinned by legislation to provide statutory obligations following on from initial voluntary engagement, as happened in the early years of bTB eradication (Robinson, 2015). The recent launch of the BVD-Free campaign in England is notable for its emphasis on its ambition to use the power of communication through social media, website and leaflets to inspire 80-90% of cattle herds to have engaged in BVD control voluntarily within 1000 days of launch (Gard, 2016).

### ***Johne's disease (Paratuberculosis)***

If farmer and industry understanding of the problem alongside motivation and ongoing engagement are deemed essential for effective partnerships in BVD control, the same messages come from those who have analysed Johne's disease programmes. Citer and Kennedy (2012) discussed how the most effective Johne's control happened in Australia when state departments and producer organisation *collaboratively* designed programmes in local areas which met national objectives. From Denmark, Krogh and Nielsen (2012) emphasize the need to maintain excellent communication between all parties involved to iron out problems instead of ignoring them, and Nielsen (2007) mentions the importance of motivating farmers to deal with a chronic infection which is slow to be eradicated. What Mullaney and Strain (2012: 44) mention in their lessons from Johne's control in Ireland is particularly apposite:

'These included the importance of education of farmers and veterinary surgeons; a clear understanding of the limitations and uses of diagnostic tests; the need to clearly communicate achievable goals and the timelines associated with these; the challenge of motivating farmers to stick with a program and the challenge of scaling up this type of approach to a national level. It is likely that if more effort was put in to engaging more frequently with the farmers and vets involved in the scheme some herds would have participated for a longer time.'

All these very relevant points on paratuberculosis can be applied to bTB with no fear of misapplication.

## **ANNEX 1: AUTHOR BIOGRAPHY**

Dr Philip Robinson is a veterinary graduate of the University of Glasgow. He is a Royal College of Veterinary Surgeons (RCVS) Recognised Specialist in State Veterinary Medicine, and a Senior Lecturer in Farm Animal Health and Welfare at Harper Adams University.

After a period in private veterinary practice in N. Ireland and Scotland, he worked for twelve years in the DARD Veterinary Service, with four of those years spent in the Veterinary Epidemiology Unit focussing mainly on bTB.

He completed his PhD in the Geography Department of Durham University in 2014. The thesis was entitled 'A political ecology of bovine tuberculosis eradication in Northern Ireland', and was funded by DARD as part of their Evidence and Innovation Strategy. The research investigated the bTB programme in N. Ireland from a social science perspective, and was centred on interviews with farmers, vets, policy makers and other industry stakeholders to investigate why bTB had not yet been successfully eradicated.

Dr Robinson holds the RCVS Certificate (2003) and Diploma (2006) in State Veterinary Medicine, and a MSc in Veterinary Epidemiology and Public Health (2010) from the University of London.

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