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Electronic Identification in the Scottish Sheep Flock

Project Co-ordinator's Report

Industry-led EID research pilot: Phase II 2009 - 2011

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SHEEPTRACEABILITY
EID RESEARCH PILOT

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Executive Summary

E1. This report relates to Phase II (summer 2009 to spring 2011) of the ScotEID Pilot, commissioned by the Scottish Government to research sheep traceability systems to comply with EU regulations. An emphasis on working with industry has generated valuable insights into how best to work with regulatory requirements, existing practices and available technologies under commercial conditions.

E2. The number of "partners" enrolled in the Pilot increased during Phase II, with over 3500 farms, 30 marts, 20 abattoirs, two ferry terminals and two collection centres now participating. Considerable effort has been devoted to meeting technical and procedural challenges, often entailing bespoke hardware, software and training to suit particular situations at different sites and variation across users' needs and circumstances.

E3. Nearly 4m tags having been issued and nearly 2m reads having been recorded onto the central database, the majority at marts. In-line with field observations on the ground, statistical modelling suggests some performance differences between different types of tag and reader, but operating environments and users' skills/experience also exert an influence and much variation in performance is not explained statistically. Nevertheless, overall read-rates are approximately 94% with some variation around this average. Some instances of poorer read-rates are due to temporary factors but the hostile nature of commercial environments and diminishing marginal returns to technical efforts are – even with continual incremental improvement – likely to limit average read-rates to the mid-90s.

E4. Many non-farm partners have registered as "Critical Control Points" (CCPs) offering third-party reading to reduce the capital costs of EID to farmers. In many cases, CCPs are reporting in real-time, updating the central database as sheep move. Relative to the previous paper-based systems, such real-time reporting coupled with faster tracing via interrogation of the central database offers potentially significantly enhanced traceability capabilities in the event of a disease outbreak.

E5. Issues identified as requiring attention during Phase III fall into technical, procedural and policy categories. At a technical level, user interfaces to the central database are acknowledged to need further development. Equally, some reader installation issues remain to be resolved and the perceived or actual suitability of some tags (and tagging methods) merit further investigation with respect to performance and welfare issues and the provision of information on best practice and relative performance.

E6. Procedurally, consideration could be given to some verification of data accuracy (e.g. reporting of batch sizes and allocation of post-sale lots) and to the mode and purpose of database interrogation. Separately, traceability gaps in the central database's coverage of movements need to be reviewed. For example, in relation to farm-to-farm moves. Possibilities for linking sheep movement data to other livestock databases (e.g. cattle and pigs) should also be attempted since the overall benefits of traceability are increased if multiple susceptible species are covered.

E7. At a policy-level, views of the imposition of EID amongst the farming community could be improved (as could cost-benefit ratios) through the use of enhanced traceability capabilities to facilitate relaxation of other perceived burdens, such as the need for paper-based flock registers and movement documents or routine movement restrictions (retention periods) outwith a disease outbreak. Similarly, if not addressed procedurally, differences in the tagging rules for young lambs intended for slaughter in England and Scotland could be addressed to reduce both confusion for farmers and practical handling problems at marts and abattoirs arising from cross-border moves. Less contentiously, a policy decision to preclude half-duplex format tags in favour of the full-duplex format would simplify reader installations and marginally improve read rates.

1. Introduction

1. This is the second report from the on-going Pilot study of electronic identification (EID) for sheep in Scotland. The pilot was commissioned by the Scottish Government Rural Directorate (Livestock Traceability Policy) to identify workable and affordable EID systems to comply with European regulations intended to improve livestock traceability – specifically the "EID regulation" EC 21/2004 and its accompanying "implementing regs" EC 1505/2006, plus subsequent amendments to these.

2. Unlike some other EID research projects elsewhere, the ScotEID pilot was designed to involve a large number of sheep under commercial rather than experimental situations. This permits greater practical involvement of stakeholders but also an element of "learning by doing" in testing, monitoring and adjusting equipment and practices under working conditions. This has applied at both the level of the individual farm/mart/abattoir in terms of tagging and reading sheep but also in terms of resolving technical and procedural issues relating to the design of the central database and the transfer of information to and from it.

3. This emphasis on working with industry to improve mutual understanding of the many complex issues associated with EID and how practical solutions might be devised has generated valuable insights into how best to work with regulatory requirements, existing practices and available technologies. This has informed stakeholder and government perspectives on EID and facilitated negotiations with the European Commission regarding some flexibility with respect to implementation.

4. The pilot is managed by the Scottish Agricultural Organisation Society (SAOS) with specialist support from Black Isle Technical Services (BITS), Biomathematics and Statistics Scotland (BioSS) and Pareto Consulting. Participating "partner" farms, marts and abattoirs have been supported through public funding for capital equipment and/or ear tags plus through advisory support via field staff, a telephone helpline, e-mail and web forum facilities. These support mechanisms have also provided qualitative feedback from partners and stakeholder organisations, supplemented by more formal surveys and statistical analysis of the database.

5. Following-on from the previous report which covered Phase I of the pilot, this report covers Phase II – approximately the period from summer 2009 to spring 2011. The next two sections summarise the main activities and findings under Phase II. The fourth section then discusses some issues arising from Phase II that remain to be addressed through further research and negotiations in Phase III. The Appendices contain some additional, supporting material.

2. Phase II activities

Background

6. As detailed in the previous report, Phase I necessarily focused primarily on the practicalities of tagging and reading plus designing the central database and methods for transferring data to and from it. This was prudent since the basic technologies had yet to be proven under Scottish field conditions.

7. However, the lack of appropriate "off-the-shelf" hardware and software meant that – despite considerable efforts and accumulation of valuable experience – the volume of movements recorded and the number of reader installations at marts and abattoirs was limited and it was acknowledged that Phase II would need to address this. The imperative for this was reinforced by the granting of a concession by the EC for greater reliance on third-party (e.g. marts and abattoirs) reading of tags rather than farmers' own on-farm reading. This was a welcome move since one of the main findings of Phase I was that the use of third-party facilities (dubbed Critical Control Points or CCPs in Scotland) for reading would significantly reduce the overall costs of EID.[1]

Farm-level activities

8. Reflecting increased effort further along the supply-chain, the degree of on-farm support offered during Phase II through field staff was reduced relative to that in Phase I in favour of greater reliance on remote support offered via telephone, e-mail and the web forum. Fewer field staff were employed but a dedicated Information Centre was established in Huntly to deal with enquiries.

9. This switch in mode of farm-level support was, however, accompanied by a dramatic expansion in the number of farms enrolled in the pilot. Specifically, whereas Phase I had involved 209 partner farms, Phase II expanded this to over 3500. New partner farms were incentivised to participate through the provision of funding for tag purchases - conditional on providing information to the central database.

10. The primary purpose of greatly expanding the number of partner farms was to tag a greater number of sheep whose movements through the supply-chain could then be traced. Increasing the volume of recorded movements in this manner would test the robustness of CCPs and the central database but also facilitate further statistical analysis of tag reading

[1] Subsequently confirmed by Defra (2009) *Impact Assessment for the Introduction of Sheep & Goat EID under EC Regulation 21/2004* and JRC (2009) *Economic Analysis of Electronic Identification of Small Ruminants in Member States*.

and of movement patterns. In addition, feedback from partner farms on their experiences with EID were sought via a formal repeat survey (see Appendices A, B & C) and less formally through noting broad types of enquiry to the Information Centre and web forum.

Mart and abattoir-level activities

11. The emphasis on progressing developments at marts and abattoirs in Phase II greatly increased their enrolment in the Pilot to 30 and 20 respectively, which collectively represent most Scottish throughput. In addition, two ferry terminals and two collection centres have also been enrolled (see Appendix D).

12. Devising workable solutions at these various sites entailed considerable effort in terms of both on-site support from fieldstaff and off-site research and development by ScotEID staff and equipment manufacturers. For example, background interference from other equipment, the sheer volume and pace of throughput, and the unique configuration of each site typically meant that several iterations of different technical designs were required before adequate performance was achieved. Equally, EID had to be integrated into existing reporting procedures, for example with respect to identifying and allocating separate lots of sheep, and (often) linking to commercial software packages.

13. Enrolling marts and abattoirs into the pilot means that most elements[2] of the full supply chain from on-farm tagging to slaughter are now captured within the EID system. This permits more detailed exploration of how well the system can deliver enhanced traceability and how well CCPs can operate. Such exploration has been pursued through statistical analysis of the database, supplemented by qualitative feedback from partners via fieldstaff and enquiries to the Information Centre and web forum.

CCP and other negotiation-facilitation activities

14. Strictly, CCPs only came into existence at the start of 2011. That is, the first two phases of the Pilot were a research exercise and whilst much of Phase II sought to establish the practicalities of operating CCPs, participating partners were not legally CCPs.

15. However, January 2011 marked the continued incremental implementation of the EID regulations and CCPs needed to be operational from that date. Consequently, the obligations and responsibilities of CCPs have been agreed within a formal legal structure that clarifies their relationship with farmers and respective responsibilities for recording and reporting movement data (see Appendix E).

[2] Farm-to-farm moves remain under-represented, primarily because of separate reporting arrangements with SAMU.

16. Establishing the legal form of CCPs emerged from discussions between various stakeholder groups but is but one example of such negotiation activities stimulated/facilitated by the pilot. Perhaps the most notable other example is the decision to use (single) EID tags for lambs destined for slaughter before 12 months of age. This was significant since the regulations do not require the use of electronic tags in such situations. However, the practical implications of having to record non-EID slaughter lambs differently from all other sheep were viewed as unworkable under commercial conditions at marts and abattoirs and thus agreement was reached to use some form of EID tags.

Database and technical activities

17. Development of the central database continued throughout Phase II. Many of the refinements are invisible to the end-users but relate to ensuring the stability and robustness of the system as it has expanded to accommodate greater volumes of sheep and partners but also the general increase in tags issued. Tag numbers assigned through the UK Electronic Tag Allocation System (ETAS) are notified to the database on a monthly basis.

18. Technical mechanisms for transferring data to and from the central database have also continued to be developed in response to practicalities encountered in the field and the broader policy context. For example, different types and configurations of hardware equipment at given sites were tested and software interfaces have been extended to accommodate different operating platforms and reader interfaces.

19. Ensuring near-universal accessibility for users of the database and website has entailed considerable software development activities. In particular, adjustments have had to be made to accommodate differences between, for example, broadband and dial-up users, PCs of different vintages and capabilities, and different types and vintages of both operating systems and web browsers.

20. In addition, progress has also been made with access via portable devices such as mobile phones to allow usage in the field and/or for farmers lacking PCs/fixed line internet. Initial work has also been undertaken to provide a 'phone facility to allow off-line movement reporting via an ordinary landline connection.

3. Main findings

Tags issued and read

21. Expanding the Pilot membership to over 3500 partner farms meant that nearly 11000 individual flocks were covered, representing around 1.85m sheep. In total, nearly 4m electronic tags have now been issued, of which 2.4m were slaughter tags and 1.5m full-EID tags. Within this, less than 3000 were half duplex (HDX) compared to the vast majority of full duplex (FDX).

22. Around 44% of flocks have been issued with a mix of full-EID and slaughter-only tags, 36% of flocks with full-EID only and 20% with slaughter-only tags. The majority of flocks have had at least some of their tags read, but around 2000 flocks have not yet had any tags read. Nearly 400000 slaughter tags and 36000 full-EID tags have been read at abattoirs, meaning that the majority of issued tags remain in circulation.

23. Overall, around 1.9m reads have been recorded onto the database with around 1.7m in the calendar year 2010, of which around 1.1m were through marts.

Read rates

24. Overall read rates across all sheep are estimated to be approximately 94%, although slightly higher or lower figures can be derived from different sub-sets of database records. Within this, there is a considerable range with over 2/3 of lots achieving 100% success and many others being above 90% but then also a long tail of instances of poorer read rates.[3]

25. Anecdotally, at least some of the latter are due to errors such as inadvertent mixing of EID and conventional tags, the disproportionate effect of missing reads in small lots, incorrect separation of lots or misaligned readers. Similar causes are likely for the small number of lots reporting read rates in excess of 100%. Such issues should be largely resolvable over time as installations are optimised and training in and experience of equipment and procedures accumulates. [4]

26. However, more persistent limits to achievable read rates do arise from genuine equipment constraints and the hostile environment prevailing under commercial operating conditions.

[3] Brocklehurst, S. (2011) *Statistical Analysis of Tag Codes and Types in Electronic Identification Data at Critical Control Points*. BioSS report to ScotEID; Brocklehurst, S. (2010) *Statistical Analysis of Electronic Identification Data (Phase II)*. BioSS report for ScotEID.

[4] Read rates over 100% can arise from, for example, doubling-up of EID tags and software glitches. Failing to separate sequential lots and/or incorrectly reporting a given lot's size (both of which can arise easily if lots are reconfigured) will also affect calculated read rates - as will malfunctioning/degraded tags and readers, tags miss-assigned by ETAS and whether sheep are hounded too quickly around a pen or through a race.

For example, based on a sub-sample of database records, it is estimated[5] that around 93% of tags are read each time that an attempt is made to scan them, a further 5.6% are only read sometimes and 1.4% are never read at any location. Separate analysis suggests that a small proportion of tags have degraded performance due to manufacturing errors.[6]

27. In principle, some read failures might be overcome through repeated attempts at reading individual tags but in practice this would be incompatible with the need to maintain commercial rates of throughput in high-volume situations. Hence, although some incremental gains may be achieved through continual improvement and read rates of 100% will be achieved on many individual lots, they will not be on all lots and the overall average read rate is likely remain in the mid-90%s with diminishing marginal returns to increased technical development.

Tag and reader differences

28. In the absence of any formal experimental design, apparent variation in tag or reader performance remain difficult to attribute to particular causes since the circumstances surrounding a specific read are highly variable and confounded.[7] For example, the tag type, reader type, batch size and user skill/experience can all vary. Nevertheless, statistical modelling suggests some slight differences between types of location (e.g. mart or abattoir), between reader types and between tag types, but less than differences across varying batch sizes. [8]

29. For example, average read rates are higher for smaller rather than larger batch sizes, probably reflecting the relative ease with which "missed" reads can be seen and rectified amongst smaller batches and when under less time-pressure. Smaller, but still statistically significant, differences also exist between handheld and fixed readers (but linked to type of CCP) and between different types of tag. Although the performance differences are statistically relatively marginal and much variation in performance cannot be modelled, the modelling results tend to conform to field observations made by ScotEID staff on the ground.

30. Nevertheless, feedback from farmers reveals perceived variation in tag characteristics that may affect both ease of tagging and subsequent retention. For example, whether paired tags are packaged jointly or individually, whether tags are packaged in numerical sequences

[5] Brocklehurst, S. (2010) *ibid.* These calculations are from a sub-sample of databse records.
[6] Anon (2011) *Initial Comments on Malfunctioning Tags*. York EMC Services Ltd Report to ScotEID
[7] Brocklehurst, S. & Glasbey, C. (2009) *Statistical Analysis of Electronic Identification Pilot Data (Phase I).* BioSS report for ScotEID.
[8] Brocklehurst, S. (2011) *ibid*.

or randomly, how well different tag designs and sizes may or may not suit different sizes and breeds of sheep and how well different tags work with different applicators.

Tag infections and losses

31. Information on the welfare impacts of EID tags and tagging has not been collected systematically by the Pilot and ETAS feedback forms issued with supplied tags are perhaps under-utilised, but complaints from farmers are extremely common both via the Information Centre helpline and the web forum but also the formal survey. For example, with respect to infected ears but also to torn and missing ears through ripping or (in some cases) frostbite.

32. Notably, whilst responses to other survey questions vary between newer and longer-standing partner farms, concerns about tag losses and ear infections are similar for both groups. This suggests that such concerns are not reduced by longer experience of EID and thus that there may be perceived or actual underlying issues with some tag designs, tagging procedures and skills/training. Indeed, the minority of farmers reporting a lack of concern tend to cite a need for familiarity with tagging, matching tag type to the size and breed of sheep and ensuring clean (and preferably) dry conditions during tagging.

33. Some information on tag losses can be inferred from the pattern of reported tag sales. Hence, for example, less than 2.5% of flocks have ordered replacement EID tags but over 6% have ordered replacement non-EID tags. These figures do not necessarily translate into actual tag losses for individual sheep, but do nevertheless imply two important points. First, tag losses are not restricted to EID tags. That is, tag losses (and ear infections and other related welfare problems) are probably a generic tagging issue rather than one specific to EID per se: EID is often conflated with double-tagging.

34. Second, the higher replacement rate for non-ID tags may relate to losses from older sheep still exempt from EID but are possibly indicative of future rates of loss for EID tags. That is, given the relatively short duration of the Pilot and given that many of the movements recorded to date have actually been of lambs to slaughter, the opportunities for electronic tag losses may have been limited. Hence it is possible that the incremental extension of EID to all of the breeding flock will see overall rates of EID tag losses increase slightly.

Farmer attitudes & confidence

35. Ad hoc feedback via the Information Centre and web forums, plus responses to the questionnaire survey of partner farms, confirm continuing resistance amongst sheep farmers to the notion of EID. In a minority of cases, this stems from apparent disbelief in the need for traceability but in the majority of cases it seems to stem from faith in paper-

based batch tracing systems and concerns over the costs and practicalities of EID. Concerns are also expressed about the status of EID under cross-compliance inspections.

36. Participation in the Pilot has improved confidence in EID for 21% of partners but reduced it for 16% (33% and 22% for longer-standing partners). Some farmers and industry representatives are interested in the possibility of EID removing the need for paper movement documents and flock registers (as permitted under derogations to the EID Regulation), thereby avoiding an element of manual record keeping but also making the information more consistent and transparent to both farmers and inspection bodies.

37. Although some (less than 1 in 10) partner farms already use EID for flock management purposes and others (less than 1 in 5) plan to do so in the future, the majority have no positive intentions to do so. This lack of intent to go beyond compliance requirements is associated with concerns about the impracticalities of performance recording in hostile environments (e.g. outdoor lambing on hill farms) but also with complaints about a lack of reliable data from marts and (particularly) abattoirs[9] about end results for individually identified sheep. A lack of general confidence in using computers and/or lack of access to the internet is also commonly cited as a problem in this respect, particularly so for hill farms and store producers.

38. Confidence amongst farmers in using the ScotEID website is low, indeed lower than their general confidence in using computers, prompting frequent requests for training. Questionnaire comments and ad hoc feedback from farmers indicates that the user interface is perceived as daunting, implying a need for some revisions and training support. Alternatively, reliance on CCPs and notifications via 'phone systems might increase farmers' confidence by reducing the need for direct interaction with the database.

Fixed readers

39. Early impressions from Phase I regarding the suitability of fixed readers were confirmed throughout Phase II. That is, readers vary greatly in technical capabilities and cost but, perhaps more importantly, their performance is also affected by their surroundings and integration with management procedures. This means that, whilst experience from previous installations can provide guidance, a degree of bespoke tailoring is often needed to address the site configuration of any given location.
40. For example, surrounding metalwork and other electrical equipment can impair reader performance. This is particularly problematic in abattoirs but also occurs in other situations. Overcoming such problems can involve careful and time-consuming measurement of

[9] Indeed, confidence in EID amongst some longer-standing partner farms has dropped as a result of poorer-than-expected data flows from further along the supply-chain (see Appendices B & C).

background “noise” in order to identify the optimal location and configuration of reader(s) and antennae, and/or re-configuration of the surrounding environment.

41. Similarly, the fast rate of throughput under commercial conditions means that readers have to be integrated into the flow of sheep without causing undue delay whilst still delivering high read rates. Hence, again, iterative testing may be needed to identify where best to place a reader and how best to control the movement of sheep into and out of it. For example, through varying the width of the scanned area, the speed of sheep movements past a reader and adjusting the number and location of antennae.[10]

42. In the majority of cases where fixed readers have been installed, they are performing adequately in terms of read rates. In some cases, physical installation issues do remain to be resolved but in most cases poor performance may be attributed to software issues and/or procedural problems. For example, a variety of hardware and software[11] combinations are in place (see Appendix D) but not all readers report automatically in real time and interfacing with different proprietary software and/or establishing procedures for manual reporting poses challenges in some cases. In addition, calibration for both FDX and HDX tags compromises overall read rates slightly (although as a fraction of reads which are currently missed it may be fairly significant) relative to calibrating to one format alone.

Database robustness & coverage

43. Robustness of the central database has been proven by its ability to accommodate significantly greater volumes of tag and movement data supplied to it in various ways and passed onto different users. Although not yet subjected to formal epidemiological testing, the ability to conduct rapid tracing of movements is readily apparent.

44. For example, a few minutes of clicking-through on-line records can generate sufficient information for the type of both backward and forward cohort tracing required under a Foot and Mouth Disease (FMD) outbreak. Similarly, the effort required to identify apparent breaches of livestock retention periods (i.e. the 13 day standstill) is also relatively trivial, as is the effort required to identify anomalies requiring follow-up investigations such as reported farm locations with significantly more “on” than “off” moves. Such information may be of use for informing risk assessments for inspection purposes.

[10] Adding antennae and adjusting their position is a hugely complicated process affected by spacing, orientation, synchronisation, phase and mutual inductance.

[11] The Pilot has developed open-source free software for use with readers but some users have preferred to use proprietary commercial software (see Appendix D), either because of prior familiarity with suppliers and/or its being bundled with new hardware.

45. Where read data are streamed automatically, as from many marts and abattoirs, the database is effectively updated in real time. However, other data recordings are transmitted manually (but still electronically) and must be carried out within the 48 hour recording time under Annex C para'2(c) of 21/2004. For example, the notification by marts of where lots have been sold to[12] or the uploading of read tags at close-of-business.

Slaughter tags

46. The decision to require the use of EID tags for Scottish-born lambs intended for slaughter before 12 months of age was a pragmatic solution to avoid the difficulties at marts and abattoirs of handling batches with a mix of EID and non-EID sheep. However, its implementation has revealed a number of potential tensions.

47. First, EID tags are marginally more expensive than conventional tags and this additional cost has been borne at the farm-level. Second, although containing them in digital form, single EID tags do not display full identification details, meaning that individual traceability cannot be achieved without a reader unless full-EID (i.e. paired electronic and conventional) tags are used. Third, the requirement for EID slaughter tags raised some expectations amongst farmers that individual carcass data would be matched to identifiable sheep to allow information to flow back along the supply-chain for performance management purposes, but such expectations have not yet been met.[13] All three cases have done little to enhance farm-level enthusiasm for EID.

48. Separately, fourth, at the aggregate-level, the absence of a requirement for EID slaughter tags in England will cause difficulties with respect to cross-border movements. For example, it may result in mixed batches of EID and non-EID tagged lambs moving into Scotland which will pose handling problems for Scottish marts and abattoirs, exacerbated by differences in required tag colours[14] in England and Scotland.

Cost-benefit analysis

49. The Phase I report included indicative cost-benefit estimates of EID in Scotland. Since then, not only has the Pilot generated further Scottish-specific information but a number of new economic studies have been conducted in other countries and it is reasonable to revisit certain aspects of the Scottish cost-benefit analysis.

[12] Whilst the origin of a lot being sold will be known on entry to the market, and individual item numbers of the lot recorded as sheep move through the ring, their destination may not be confirmed until the on-move destination is confirmed by the buyer.

[13] Although work is progressing on this topic.

[14] Notably, the lack of visually distinctive differences between EID and non-EID slaughter tags will hinder drawing prior to entering the ring.

50. Although the context and details vary, for example in relation to mandatory vs. voluntary and electronic vs. conventional tagging, traceability systems are being promoted strongly in other parts of the world. Developments in Australia, New Zealand and the USA are particularly relevant since, unlike most EU studies,[15] some formal quantification of likely benefits as well as costs has been attempted. Notably, both the National Identification and Tracing (NAIT) system in New Zealand and the National Animal Identification System (NAIS) in the USA have been subject to recent comprehensive cost-benefit analyses.[16]

51. In both cases, the studies report significant costs but also net benefits. As with the earlier Australian and Canadian studies,[17] these arise partly from anticipated improvements (including time taken to re-open export markets) in combating possible disease outbreaks of assumed frequency and intensity but also more generally on an assumed need for demonstrable traceability in order to retain normal access to export markets.

52. Drawing direct parallels with the Scottish situation is problematic. In particular, the assumption of traceability being needed to retain access to distant trading partners (e.g. Asia) outwith disease situations is questionable in the domestic context. That is, such an assumption may be reasonable (although still based on assertion rather than evidence) for export-oriented countries such as New Zealand but is less relevant here given Scotland's location within the EU and the dominance of UK and EU destinations for Scottish output.

53. Moreover, the systems being established and assessed in other countries are generally being compared with a different (lower) baseline to that in Scotland in terms of existing traceability and control measures plus – importantly – they embrace species other than sheep.[18] As such, they provide little compelling evidence to revise the indicative headline benefit figures reported in the Phase I report. However, various studies[19] highlight aspects of traceability that do merit repeating here.

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[15] For example, JRC (2009) *ibid*; Velthuis, A. et al. (2009) Costs and reliability of livestock traceability systems for the Dutch sheep and goat sectors, *Food Economics Acta Agricult Scand C*, 2009; 6: 31 42

[16] NAIS Benefit Cost Research Team (2009) *Benefit–Cost Analysis of the National Animal Identification System*; NAIT (2009) National Animal Identification and Tracing. *Stage 2 Business Case.*

[17] Martin, G. (2008) *Potential identification devices for the Australian sheep industry*. Report by IDA Economics to Meat & Livestock Australia, North Sydney.; Pouliot, S. (2008) *Estimating the Costs and Benefits of Cattle Traceability: the Case of the Quebec Cattle Traceability System*.

[18] Linking movement data across all susceptible species (notably cattle and pigs) enhances the value of sheep traceability.

[19] For example: Hagerman, A. et al. (2010) *Rapid Effective Trace-Back Capability Value in Reducing the Cost of a Foot and Mouth*. Texas A&M University; Looney, J. (2009) *Comparative Cost Analysis of Alternative Animal Tracing Strategies Towards Foot and Mouth Disease Outbreaks in The Texas High Plains*. Texas A&M University; Risk Solutions (2008) *ibid;* Ward, M. et al. (2009) Simulation of foot-and-mouth disease spread within an integrated livestock system in Texas, USA. *Preventive Veterinary Medicine* 88 (2009) 286–297.

Tracing times & accuracy

54. The primary rationale for EID in the EU is to assist with combating animal disease outbreaks - with FMD the particular example cited most readily. Crucially, enhanced traceability is seen as a means of limiting the size and duration (and thus economic impact) of an outbreak rather than the likelihood of an outbreak occurring in the first place. This highlights the importance of prior elements of animal disease policy, including routine surveillance and biosecurity measures.

55. Once an outbreak has occurred, traceability of livestock allows identification of where infected animals have been (for example, in the last 30 days) and of any other animals that have resided at the same locations, either at the same time or otherwise within the incubation period, and are thus at risk of being infected.

56. Accurate identification of this contact structure within a network of livestock movements allows other control measures, such as vaccination, culling and carcass disposal, to then be deployed to best effect – including not diverting time and effort to having to discover and rectify tracing errors (both false positives and false negatives).[20] Confidence in the accuracy and comprehensiveness of the tracing of contacts also facilitates earlier relaxation of movement restrictions, thereby helping to alleviate disruption to supply-chains and on-farm management problems. For example, allowing abattoirs to function and sheep to be moved to better grazing.

57. No tracing system can be 100% accurate since patterns of livestock movements can be highly complex[21] and some misreads and misreporting will always occur. However, 100% accuracy is not necessarily required for effective tracing. This is partly because not all points (nodes) or movements within a network are of equal significance and the tracing of moves through (for example) marts is typically more important than for other types of node where volumes and complexity of movements are less.[22] Hence, provided that significant nodes are covered reasonably well, lower overall accuracy is tolerable. For example, several of the American studies report positive results with assumed overall 90% accuracy. Moreover, a combination of batch and individual identification can boost tracing capabilities over multiple moves where the read rate for a given move is less than 100%.[23]

[20] Also referred to as Type I and II errors, and determined by the sensitivity and specificity of tracing.

[21] For example, at the time of an "off" move from a farm, the destination is not necessarily known and any given batch of sheep may be split and mixed with others before reaching its final destination.

[22] Kiss, I. et al. (2006) The network of sheep movements within Great Britain: network properties and their implications for infectious disease spread J. *R. Soc. Interface* (2006) 3, 669–677.

[23] Catterall, S. & Glasbey, C. (2009) *Modelling of electronic sheep identification in the Scottish sheep flock*. BioSS report for ScotEID.

58. Alongside accurate tracing, more rapid tracing offers the potential for speedier identification and handling of infection risks - which can further help to reduce the size and duration of an outbreak. For example, analysis in other countries suggests that reducing tracing times below three days generally has favourable effects on required control efforts and disease impacts. Consequently, many emerging systems have a target tracing time of 24-48 hours. Again, not all nodes are of equal importance and faster reporting from (for example) marts is likely to be more important than from individual farms.

59. Subject to overcoming the remaining challenges noted above (paras 45, 46 & 49) with respect to coverage, EID offers gains in both accuracy and speed relative to previous Scottish systems. That is, relative to paper-based systems reliant upon manual recording and reporting via postal services, electronic recording is subject to fewer errors and reporting can be much faster.

60. For example, electronic reading avoids transcription errors, can report in real-time and the central database can trace movements in minutes. This represents a marked improvement over typical tracing times achieved under paper-based systems where notifications and logging of movements could take a few days and most tracings took up to seven days (typically four) with some tracings taking several weeks or effectively never being made.[24]

61. Similarly, electronic reporting via a central database should[25] improve accuracy by reducing the scope for misreporting of movement types and destinations.[26] In practical terms, this relates not only to improving the detection of infection risks but also the avoidance of incorrectly designating low risks as high risks (false positives).

Net gains and interaction between policy measures

62. However, although more effective traceability does offer potential advantages, the deployment of other control measures can limit the actual net additionality achieved. For example, regulatory restrictions that slow or stop movements will reduce the importance of tracing speed. This means that the disease control benefits attributable to enhanced traceability will be less than would be the case in the absence of other control measures.[27]

[24] Risk Solutions (2008) *ibid.* Anderson, I. (2001) *Inquiry into the lessons to be learned from the foot and mouth disease outbreak of 2001.* Report to Cabinet Office; Pers Comm. SG.

[25] Velthuis et al. (2009) *ibid* suggest individual identification through a central database is more reliable than alternative systems.

[26] Although this does highlight the importance of post-sale lot allocation at marts.

[27] For example: Schroeder, T. & Pendell, D. (2007) *Value of Animal Traceability Systems in Managing a FMD Outbreak.* Final Report submitted to USDA-Economic Research Service; Risk Solutions (2008) *Impact of Sheep EID on Disease Control: Additional analysis*. A report for Defra; Martínez-López, B. et al. (2010) A simulation model for the potential spread of foot-and-mouth disease in the Castile and Leon region of Spain. *Preventive Veterinary Medicine*, v96, 19-29.

63. Alternatively, enhanced traceability may permit relaxation of other control measures and thus avoid some existing regulatory burdens. For example, requirements for paper-based flock registers and movement documents impose modest manual reporting costs that could be avoided through reliance on electronic records under EID.[28]

64. More substantively, enhanced traceability may remove the need for routine movement restrictions (retention periods) outwith a confirmed disease outbreak. Since movement restrictions currently impose costs on the industry, their removal would increase the benefits of EID. Similarly, greater confidence in tracings could allow earlier relaxation of restrictions in low risk areas during an outbreak.[29] Perhaps more contentiously, enhanced traceability could have implications for the necessity and scale of contiguous and proximal (e.g. 3km) culls of livestock if it improved confidence in tracking actual routes of infection and in reducing false positives.

65. Estimation of the cost-benefits of traceability could thus extend to consideration of wider policy options. This would require careful consideration of the individual and joint effects of separate control measures under the variety of conditions that can apply to a disease outbreak. For example, the standard of surveillance in operation and adherence to general biosecurity but also the time of year, the location of the initial infection point and interactions with other susceptible species.[30] Such a move would suggest greater recourse to detailed epidemiological models than has been the case to date in the Pilot research.

[28] See Appendices to Defra (2009) *Impact Assessment for the Introduction of Sheep & Goat EID under EC Regulation 21/2004*

[29] For example, movement restrictions imposed in Scotland during the 2007 FMD outbreak could perhaps have been lifted earlier.

[30] See, for example, Kroschewski , K. Et al. (2006) Animal disease outbreak control: the use of crisis management tools, *Rev. sci. tech. Off. int. Epiz*., 2006, 25 (1), 211-221; Risk Solutions (2008) *ibi or* Hullinger, P. (2008) *New England Foot and MouthDisease Tabletop Exercise*. Lawrence Livermore National Laboratory Foreign Animal Disease Analysis Team.

4. Issues Arising & Further Research

66. In the same way that planning for Phase II was informed by findings from Phase I, issues identified as requiring further attention during Phase II may be addressed during Phase III. Such issues fall into technical, procedural and policy categories.

Technical

67. First, although technical developments under the Pilot have been commendably impressive, further efforts are still required. Some of these relate to remaining installation issues at a few sites - typically software interfaces although evaluation of hardware will also continue. Possibilities for individual identification within abattoirs to facilitate the flow of information back along the supply chain could be explored, although broken-line sequences and read rates inevitably below 100% would pose challenges.[31]

68. Significant challenges may arise from the acknowledged need to improve the user interface with the database, both in terms of computer access but also access via mobiles and landlines. Accommodating the variety of ways in which interaction is sought and the diversity of users' confidence and skills in interacting with the database will require greater stakeholder engagement and "road-testing" of proposed solutions than has been undertaken to date.[32]

69. Separately, persistent concerns over tag losses and ear infections, and frostbitten tag sites during the 2010/11 winter, merit further investigation. Whilst it may be that some issues are related to tagging in general rather than electronic tagging per se, the level of disquiet voiced by farmers signals perceived and/or actual problems that need to be addressed either through further dissemination of best practice in tagging and/or more systematic information provision on the suitability and performance of individual tag types. More consistent use of ETAS feedback forms, available on the ScotEID website, might help to address this, as may further statistical analysis.

Procedural

70. Second, the degree of traceability achievable by EID rests not only on technical aspects of equipment and users' capabilities but also on how well procedures and responsibilities for monitoring and reporting movements are designed and discharged. For example, a reliance

[31] Experience in other countries suggests that reconciliation to kill sheets is possible. Pers. Comms. Susan Hosford (Alberta Lamb Traceability Pilot Project) and Huw Davies (Demonstration of Electronic Identification to support Management and Legislative Requirements on Welsh Sheep Farms). Some related work is currently being undertaken in Scotland. Kinnaird Business & Consultancy Service (2010) *Lamb Supply Chain Study*. Draft report to QMS and ScotEID.

[32] Steps have already been taken to pursue this.

on manual specification of lot sizes and (at marts) on the post-sale allocation of lots introduces some potential for human error. This suggests that some consideration could be given to, for example, checking a sample of movements through CCPs to verify that lot size and destination reporting is indeed accurate. Research work is ongoing to investigate causes of some instances of notably poor read rates, including an alert system for automatic notification to farmers and marts to prompt recording of any obvious cause at the time of reading rather than trying to recall situations after the event.

71. More generally, procedures (and possibly technical interfaces)[33] for the routine and ad hoc interrogation of the central database are being established. For example, the database can be used to identify key nodes in the movement network and/or holdings displaying unusual levels of activity in a way that could be used to help guide risk-based inspection regimes or disease tracing as well as research activities. Equally, adherence to routine movement restrictions could be monitored via the central database, with any breaches being notified automatically. Separately, given that the value of traceability systems increase the more susceptible species are covered, realistic possibilities for linking sheep movement data with other livestock databases should be explored.

72. Currently farm-to-farm movements are reported via SAMU they but not yet logged via the ScotEID database. Requiring farm-to-farm moves to be reported via the ScotEID database may speed up tracing times. However, further technical developments ongoing using telephone key pad notification and greater use of CCPs will support farm to farm 'real time' notification.

73. Although beyond the control of Scottish parties, cross-border movements have the potential to cause some problems. Specifically, non-EID tagged lambs moving into Scotland cause practical problems at marts and abattoirs which have knock-on implications for apparent read-rates and traceability

Policy

74. Third, the policy dimension cannot be neglected. For example, it was a policy decision in conjunction with the industry that led to a request of the Commission for authorisation of movements at the holding of destination on behalf of the keeper at the holding of departure, which led to the creation of CCPs and to the adoption of electronic slaughter tags. Policy decisions on other aspects of EID may be equally significant and the Pilot may serve a useful function in informing decisions and facilitating further discussion between interested parties.

[33] For example, the Australian NLIS has developed epidemiological visualisation and modelling tools alongside the database: Miller, H. (2010) *New Technologies for Epidemiological Analysis of Livestock Traceability Data.* FMD International Symposium 2010, Melbourne - April 2010.

75. For example, using EID systems to maintain flock registers and emulate movement documents is now both technically feasible and permitted (under a derogation to the EU regulations) but requires a domestic policy decision to adopt it. Whilst implications for inspection activities and criteria need to be considered, the relative advantages of holding such data centrally and electronically may (as with actual movement data) be worthwhile.

76. Similarly, although the movement standstill imposed in the event of a disease outbreak will remain a key control measure, the status of more routine movement restrictions is perhaps less certain. That is, enhanced traceability may be sufficient to reduce the need for routine retention periods outwith disease outbreaks and thus (ideally after epidemiological modelling) allow a policy decision to ease the burden on the industry. As with the previous example, this too could reduce some of the hostility to EID amongst farmers.

77. In principle, cross-border issues could be addressed through policy decisions on permitted tags types and reading requirements for English "imports"[34] and Scottish "exports". Less contentiously, a policy decision could be taken to preclude further issuing of half-duplex (HDX) tags. Given that less than 3000 HDX tags have been issued, there would be little effect on farmers but, by permitting calibration of CCP readers solely to full-duplex (FDX), overall read rates would improve marginally.

Conclusions

78. Building upon the foundation laid by Phase I, Phase II of the Pilot has significantly advanced the implementation of EID in Scotland. Many technical and procedural challenges have been overcome, but further work is needed in several respects to address a range of remaining issues. Ongoing research with industry and Government is working to resolve these, with a focus on the movement document derogation Article 6(4), online registers Article 5(4) and reporting transport information (Annex B 1(f)).

[34] Pre and post-movement Bovine TB testing provides an analogy here.

79. Appendix A: Partner Farm Questionnaire 2010

To help us gauge industry views on EID, it would be helpful if you would please answer the following questions by ticking the appropriate box under each one. All responses are anonymous.

1. How important is it to have accurate and fast identification and traceability?

Very Important ☐ *Important* ☐ *Not important* ☐

2. How adequate do you think paper systems are in providing accurate and fast identification?

Highly adequate ☐ *Adequate* ☐ *Not adequate* ☐

3. Do you think electronic identification for traceability has a future role in the sheep industry?

Yes ☐ *Maybe* ☐ *No* ☐

4. Do you think that you might use electronic tags to aid flock management?

Already do ☐ *Yes* ☐ *Maybe* ☐ *No* ☐

5. How concerned are you about the farm-level cost of EID?

Very concerned ☐ *Slightly concerned* ☐ *Not concerned* ☐

6. How concerned are you about tag losses?

Very concerned ☐ *Slightly concerned* ☐ *Not concerned* ☐

7. How concerned are you about ear infections from tags?

Very concerned ☐ *Slightly concerned* ☐ *Not concerned* ☐

8. How confident are you in downloading information from ScotEID website?

Very confident ☐ *Generally confident* ☐ *Not confident* ☐

9. Has participation in the EID pilot made you more or less confident about EID practicalities?

More confident ☐ *No change* ☐ *Less confident* ☐

10. How long have you been participating in the EID pilot?

One year ☐ *Two years* ☐ *Three years* ☐

11. How confident are you about using computers and the internet more generally on the farm?

Very confident ☐ *Confident but unenthusiastic* ☐ *Not confident* ☐

12. How big is your flock .....ewes and how would you describe it? (Tick all boxes that apply)

Pedigree ☐ *Hill* ☐ *Upland* ☐ *Lowland* ☐ *Store* ☐ *Finisher* ☐

Thank you. Please return completed forms in the pre-paid envelope enclosed.

Any additional comments can be made on the back of this sheet.

Appendix B: Summary of Survey Results

Introduction

A postal questionnaire (see Appendix A) based on questionnaires used previously in the Pilot was sent to all partner farms in mid-November 2010. By the end of January 2011, 1917 usable questionnaires had been returned yielding a response rate in excess of 50%. Within this overall sample, the majority of respondents had been in the pilot for a year or less but 186 were longer-standing partner farms. Whereas the latter group joined the pilot proactively and will probably have experienced on-farm support, the newer partner farms' participation will mostly have been confined to providing movement data and receiving support via the Information Centre or web forum.

In total, respondents reported having over 960,000 ewes, approximately half of all ewes included in the Pilot and approaching 1/3 of the national breeding flock. Individual flock sizes varied considerably, from five to several thousand with a mean of 517 and a median of 350. Reported flock types also varied somewhat, with Hill (847) and Upland (806) dominating but Lowland (483) and Pedigree (291) also being present. Store Producers (525) and Finishers (595) were fairly evenly split, although around half the sample did not indicate which category they fell into. Moreover, it is important to note that, reflecting the nature of Scottish sheep systems, flock type categories are not mutually exclusive within a given farm business and many respondents reported having a mix of flock types.

The following paragraphs summarise some findings (see also Appendix C) from the survey, with overall results split by flock type, size and time enrolled in the Pilot where statistically significant differences were inferred using chi-squared contingency tables. Further insights are drawn from the written comments offered by around 15% of respondents on the back of their questionnaires.

Improved traceability and the role of electronic tagging (Qs 1, 2 & 3)

Overall, 86% of respondents agreed that accurate and fast traceability was very important or important, leaving 14% unconvinced. These proportions are similar to those found from the Phase I survey, suggesting a persistent level of disbelief amongst a minority of sheep farmers in the need for traceability. No differences were found across different category of respondent.

However, overall, only 15% considered that existing paper-based traceability systems were inadequate. This figure rose to 30% amongst longer-standing partner farms, perhaps revealing some of their motivations for joining the Pilot earlier than their newer counterparts. Nevertheless the majority of all respondents considered paper based systems to be sufficient. This is reinforced by only 27% overall considering that electronic tagging has a role in traceability, although again this rose (to 38%) amongst longer-standing partners. Respondents with hill flocks were least convinced, with 31% seeing no role for electronic tracing. Many comments were received questioning the basic need for EID.

Flock management & computing confidence (Qs 4, 11 & 8)

Overall, 8% of respondents reported that they already use electronic tagging for flock management purposes with a further 19% stating that they would do so in future. These figures rose to 20% and 29% amongst longer-standing partners and to 11% and 23% amongst pedigree flocks. By contrast, whilst 40% of all respondents stated that they would not use it for flock management, this rose to 46% for hill flocks. Comments offered by some respondents included many references to the

impracticalities of linking dams and lambs in an outdoor environment, but also to a lack of skills and the absence of carcass data from abattoirs.

In terms of confidence with computing in general, 38% overall are not confident although this fell to 25% amongst longer-standing partners and rose to 43% and 45% amongst hill and store flocks respectively. Similar results applied to using the ScotEid website, with 45% of all respondents and 50% of store producers being not confident in using it. Comments offered by many respondents suggest that they find the user interface to the ScotEID website difficult to understand and that, at least for some respondents, a lack of broadband (or even dial-up) internet access and/or poor ICT skills are also problematic.

Practicalities (Qs 5, 6, 7 & 9)

Overall, 74% of all respondents (80% of hill flocks) were very concerned about the farm-level cost of EID. This is slightly less than found in Phase I, possibly reflecting the advent of CCPs to reduce costs, but the proportion reporting no concerns about farm-level costs remains very low at 3% or less in all cases. Unsurprisingly, many of the comments received related to cost concerns.

Similarly, previous findings about the level of concern over tag losses and ear infections are largely repeated with 78% being very concerned about the former and 62% about the latter. Concerns over tag losses were similar across all groups apart from the smallest flocks, and concerns over infections were lower (but still relatively high) amongst smaller flocks – perhaps reflecting greater confidence in identifying and treating any problems involving fewer sheep. The majority of comments received related to tag losses and to ear infections, with the latter being cited repeatedly as a significant welfare issue. Given that concern was expressed by longer-standing as well as newer partners, levels of concern do not seem to be reduced by familiarity/experience and may indicate unresolved issues with underlying tag designs and tagging procedures.

Participation in the Pilot had increased confidence in EID for 21% of all respondents but 33% of long-standing partners. This perhaps reflects the latter group's greater exposure to on-farm support and may have implications for future training and support needs for other farms. Yet, conversely, confidence had decreased for 16% overall but 22% of longer-standing members. In this case, comments offered by some of the latter group suggest that whilst confidence in their own EID capabilities are reasonable, poor read rate from marts and the absence of carcass data from abattoirs have shaken faith in EID along the supply-chain. This perhaps implies a need for further down-stream developments.

Summary

As with the Phase I survey of partner farms, the overwhelming impression is of continuing resistance to the notion that electronic traceability (or indeed any traceability) is needed. Whilst a minority of farms may adopt EID for flock management purposes, the majority of farms will seek only to comply grudgingly with regulatory requirements which they regard as unnecessary and/or onerous. This clearly poses a challenge to those tasked with implementing an unpopular regulation and suggests the need for reaffirmation of the required policy position and the realities of future adjustments. At a practical level, further attention to tag design and tagging procedures may be necessary and improvements to the website interface is needed, with on-going training for farmers also likely to be needed.

Appendix C: Percentage Responses to Partner Farm Questionnaire (p-value)[35]

1. How important is it to have accurate and fast identification & traceability?

By time enrolled in Pilot (p=0.16)

	Overall	*Newer*	*Longer*
Very Important	*30%*	*29%*	*36%*
Important	*56%*	*56%*	*52%*
Not Important	*15%*	*15%*	*12%*

By flock size[36](p=0.01)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very Important	*41%*	*42%*	*36%*	*32%*	*26%*	*28%*	*23%*	*27%*	*27%*
Important	*50%*	*44%*	*52%*	*58%*	*58%*	*57%*	*58%*	*54%*	*55%*
Not Important	*9%*	*15%*	*12%*	*9%*	*16%*	*15%*	*19%*	*19%*	*17%*

By flock type (p=0.01)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very Important	*36%*	*27%*	*29%*	*30%*	*34%*	*31%*
Important	*52%*	*56%*	*56%*	*55%*	*57%*	*57%*
Not Important	*12%*	*17%*	*15%*	*15%*	*10%*	*13%*

2. How adequate do you think paper systems are in providing accurate & fast identification?

By time enrolled in Pilot (p=0.00)

	Overall	*Newer*	*Longer*
Highly adequate	*16%*	*16%*	*11%*
Adequate	*70%*	*71%*	*58%*
Not adequate	*15%*	*13%*	*30%*

By flock size (p=0.01)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Highly adequate	*20%*	*13%*	*10%*	*15%*	*14%*	*15%*	*13%*	*24%*	*20%*
Adequate	*71%*	*78%*	*72%*	*71%*	*74%*	*72%*	*70%*	*66%*	*63%*
Not adequate	*9%*	*9%*	*18%*	*14%*	*12%*	*14%*	*18%*	*11%*	*17%*

By flock type (p=0.05)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Highly adequate	*15%*	*18%*	*17%*	*12%*	*14%*	*15%*
Adequate	*69%*	*70%*	*67%*	*70%*	*72%*	*71%*
Not adequate	*16%*	*12%*	*16%*	*18%*	*14%*	*15%*

[35] P-value for chi-square test of independence; values below 0.05 imply significant differences between responses.

[36] Size categories are sequential and mutually exclusive i.e. 1-24, 25-49 etc, but space constraints preclude full labeling here.

3. Do you think electronic identification for traceability has a future role in the sheep industry?

By time enrolled in Pilot (p=0.00)

	Overall	*Newer*	*Longer*
Yes	*27%*	*26%*	*38%*
Maybe	*48%*	*48%*	*43%*
No	*25%*	*25%*	*19%*

By flock size (p=0.09)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Yes	*31%*	*25%*	*26%*	*29%*	*24%*	*27%*	*28%*	*26%*	*27%*
Maybe	*47%*	*49%*	*57%*	*50%*	*49%*	*50%*	*46%*	*41%*	*43%*
No	*22%*	*26%*	*17%*	*22%*	*27%*	*23%*	*26%*	*33%*	*30%*

By flock type (p=0.01)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Yes	*29%*	*24%*	*28%*	*31%*	*28%*	*28%*
Maybe	*48%*	*45%*	*49%*	*46%*	*49%*	*50%*
No	*24%*	*31%*	*24%*	*23%*	*23%*	*22%*

4. Do you think that you might use electronic tags to aid flock management?

By time enrolled in Pilot(p=0.00)

	Overall	*Newer*	*Longer*
Already do	*8%*	*7%*	*20%*
Yes	*19%*	*18%*	*29%*
Maybe	*33%*	*34%*	*30%*
No	*40%*	*41%*	*21%*

By flock size (p=0.06)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Already do	*7%*	*10%*	*12%*	*11%*	*9%*	*6%*	*6%*	*4%*	*6%*
Yes	*14%*	*18%*	*20%*	*18%*	*14%*	*20%*	*18%*	*21%*	*21%*
Maybe	*39%*	*27%*	*35%*	*34%*	*32%*	*38%*	*36%*	*30%*	*29%*
No	*41%*	*45%*	*32%*	*37%*	*45%*	*35%*	*40%*	*44%*	*45%*

By flock type (p=0.00)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Already do	*11%*	*7%*	*7%*	*7%*	*10%*	*9%*
Yes	*23%*	*18%*	*18%*	*21%*	*18%*	*17%*
Maybe	*32%*	*30%*	*38%*	*34%*	*33%*	*39%*
No	*34%*	*46%*	*37%*	*37%*	*39%*	*35%*

5. How concerned are you about the farm-level cost of EID?

By time enrolled in Pilot (p=0.26)

	Overall	*Newer*	*Longer*
Very concerned	*74%*	*74%*	*72%*
Slightly concerned	*24%*	*24%*	*24%*
Not concerned	*2%*	*2%*	*3%*

By flock size (p=0.00)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very concerned	*58%*	*67%*	*67%*	*68%*	*73%*	*73%*	*78%*	*80%*	*86%*
Slightly concerned	*40%*	*31%*	*30%*	*30%*	*24%*	*25%*	*22%*	*19%*	*13%*
Not concerned	*2%*	*2%*	*3%*	*2%*	*2%*	*1%*	*0%*	*1%*	*1%*

By flock type (p=0.01)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very concerned	*74%*	*80%*	*76%*	*70%*	*76%*	*73%*
Slightly concerned	*23%*	*18%*	*23%*	*28%*	*21%*	*25%*
Not concerned	*3%*	*2%*	*2%*	*2%*	*3%*	*2%*

6. How concerned are you about tag losses?

By time enrolled in Pilot (p=0.35)

	Overall	*Newer*	*Longer*
Very concerned	*78%*	*79%*	*76%*
Slightly concerned	*19%*	*19%*	*19%*
Not concerned	*3%*	*3%*	*4%*

By flock size (p=0.00)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very concerned	*62%*	*70%*	*76%*	*73%*	*77%*	*80%*	*80%*	*82%*	*88%*
Slightly concerned	*31%*	*26%*	*21%*	*25%*	*21%*	*19%*	*18%*	*12%*	*10%*
Not concerned	*7%*	*4%*	*4%*	*3%*	*2%*	*2%*	*1%*	*6%*	*2%*

By flock type (p=0.47)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very concerned	*80%*	*78%*	*80%*	*79%*	*78%*	*81%*
Slightly concerned	*17%*	*19%*	*18%*	*19%*	*19%*	*17%*
Not concerned	*3%*	*3%*	*2%*	*2%*	*3%*	*1%*

7. How concerned are you about ear infections from tags?

By time enrolled in Pilot (p=0.32)

	Overall	*Newer*	*Longer*
Very concerned	*62%*	*63%*	*57%*
Slightly concerned	*29%*	*28%*	*32%*
Not concerned	*9%*	*9%*	*10%*

By flock size (p=0.00)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very concerned	*36%*	*53%*	*52%*	*55%*	*62%*	*63%*	*70%*	*70%*	*74%*
Slightly concerned	*38%*	*28%*	*29%*	*37%*	*30%*	*30%*	*25%*	*24%*	*23%*
Not concerned	*27%*	*20%*	*19%*	*8%*	*8%*	*7%*	*6%*	*5%*	*3%*

By flock type (p=0.21)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very concerned	*69%*	*65%*	*64%*	*62%*	*63%*	*66%*
Slightly concerned	*25%*	*26%*	*28%*	*30%*	*27%*	*28%*
Not concerned	*7%*	*9%*	*8%*	*8%*	*10%*	*6%*

8. How confident are you in downloading information from ScotEID website?

By time enrolled in Pilot (p=0.26)

	Overall	*Newer*	*Longer*
Very confident	*11%*	*11%*	*14%*
Generally confident	*44%*	*45%*	*39%*
Not confident	*45%*	*44%*	*47%*

By flock size (p=0.05)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very confident	*16%*	*12%*	*13%*	*10%*	*8%*	*12%*	*9%*	*17%*	*10%*
Generally confident	*52%*	*39%*	*39%*	*43%*	*44%*	*50%*	*44%*	*37%*	*45%*
Not confident	*32%*	*48%*	*48%*	*47%*	*49%*	*38%*	*47%*	*46%*	*45%*

By flock type (p=0.03)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very confident	*9%*	*10%*	*12%*	*12%*	*11%*	*11%*
Generally confident	*43%*	*41%*	*43%*	*48%*	*39%*	*46%*
Not confident	*48%*	*49%*	*45%*	*40%*	*50%*	*43%*

9. Has participation in the EID pilot made you more or less confident about EID practicalities?

By time enrolled in Pilot (p=0.00)

	Overall	*Newer*	*Longer*
More confident	*21%*	*20%*	*33%*
No change	*63%*	*65%*	*45%*
Less confident	*16%*	*15%*	*22%*

By flock size (p=0.00)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
More confident	*29%*	*29%*	*26%*	*19%*	*17%*	*20%*	*22%*	*18%*	*20%*
No change	*60%*	*63%*	*60%*	*69%*	*65%*	*64%*	*62%*	*60%*	*57%*
Less confident	*11%*	*8%*	*13%*	*12%*	*18%*	*15%*	*16%*	*22%*	*23%*

By flock type (p=0.06)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
More confident	*21%*	*20%*	*21%*	*21%*	*25%*	*20%*
No change	*61%*	*60%*	*61%*	*65%*	*60%*	*66%*
Less confident	*18%*	*19%*	*17%*	*14%*	*14%*	*14%*

10. How long have you been participating in the EID pilot?

By time enrolled in Pilot (0.00)

	Overall	*Newer*	*Longer*
One year	*90%*	*100%*	*0%*
Two years	*6%*	*0%*	*58%*
Three years	*4%*	*0%*	*42%*

By flock size (p=0.02)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
One year	*95%*	*97%*	*92%*	*93%*	*91%*	*90%*	*89%*	*90%*	*86%*
Two years	*0%*	*3%*	*5%*	*5%*	*6%*	*4%*	*7%*	*8%*	*8%*
Three years	*5%*	*0%*	*3%*	*2%*	*4%*	*6%*	*4%*	*2%*	*7%*

By flock type (p=0.01)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
One year	*85%*	*92%*	*87%*	*91%*	*89%*	*87%*
Two years	*8%*	*5%*	*8%*	*5%*	*6%*	*7%*
Three years	*7%*	*3%*	*6%*	*4%*	*5%*	*6%*

11. How confident are you about using computers and the internet more generally on the farm?

By time enrolled in Pilot (p=0.00)

	Overall	*Newer*	*Longer*
Very confident	*28%*	*26%*	*40%*
Generally confident	*35%*	*35%*	*35%*
Not confident	*38%*	*39%*	*25%*

By flock size (p=0.61)

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
Very confident	*27%*	*23%*	*27%*	*26%*	*23%*	*32%*	*28%*	*27%*	*29%*
Generally confident	*39%*	*31%*	*32%*	*34%*	*35%*	*34%*	*34%*	*37%*	*37%*
Not confident	*34%*	*46%*	*41%*	*40%*	*42%*	*34%*	*38%*	*35%*	*34%*

By flock type (p=0.00)

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
Very confident	*28%*	*22%*	*31%*	*31%*	*22%*	*27%*
Generally confident	*33%*	*35%*	*35%*	*36%*	*33%*	*38%*
Not confident	*39%*	*43%*	*34%*	*33%*	*45%*	*35%*

12. How big is your flock (No. Ewes) and how would you describe it?

By flock size

	<25	*<50*	*<100*	*<200*	*<300*	*<500*	*<700*	*<1000*	*1000+*
% respondents	*2.4%*	*5.1%*	*9.9%*	*14.9%*	*10.6%*	*16.5%*	*12.6%*	*10.7%*	*15.4%*
% ewes	*0.1%*	*0.4%*	*1.3%*	*4.0%*	*4.7%*	*12.1%*	*13.9%*	*16.7%*	*46.9%*

By flock type

	Pedigree	*Hill*	*Upland*	*Lowland*	*Store*	*Finisher*
% respondents	*15%*	*44%*	*42%*	*25%*	*28%*	*31%*

NB. rows sum to more than 100% since categories are not mutually exclusive; almost half of respondents did not indicate store or finisher status.

Appendix D: Non-farm Partners

Abattoirs

Name	First Read	Reader Type	Upload Software	Lots completion method
McIntosh Donald Ltd	Mar '09	Fixed Arch	ScotEID	ScotEID
Scotbeef (Bridge of Allan)	May '09	Fixed Horizontal	ScotEID	Online csv
Orkney Meat Ltd	Jul '09	Fixed Arch	ScotEID	ScotEID
Woodhead Bros	Jan '10	Fixed Arch	ScotEID	Manual / Online csv
Scottish Borders Abattoir	May '10	Stick	ScotEID	ScotEID
Vivers (Dornocktown)	May '10	Fixed Arch	ScotEID	
St Andrews Abattoir	Jun '10	Stick	ScotEID	ScotEID
Laxfirth Abattoir	Jul '10	Stick	ScotEID	ScotEID
Miller (Grantown on Spey)	Jul '10	Stick	ScotEID	ScotEID
Mathers (Inverurie)	Jul '10	Stick	ScoteEID	
Sandyford Abattoir	Aug '10	Stick	ScotEID	ScotEID
Wishaw Abattoir	Aug '10	Stick	ScotEID	ScotEID
Shotts Abattoir	Aug '10	Stick	ScotEID	ScotEID
Stornoway Abattoir	Aug '10	Stick	ScotEID	ScotEID
Lockerbie Abattoir	Sep '10	Stick	ScotEID	
DS (Slaughterhouse) Ltd	Oct '10	Stick	ScotEID	ScotEID
Munro (Dingwall)	Nov '10	Stick	ScotEID	ScotEID
Elgin Abattoir	TBA*	Stick	Own	Own
Boddam Abattoir	TBA*	Stick	ScotEID	ScotEID
Lochmaddy Abattoir	TBA*			
Blackwaterfoot Slaughterhouse	TBA*	Stick		
Scarnish Slaughterhouse	TBA*	Stick		
Castlebay - BARRA	TBA*			
Scotch Premier - Inverurie	TBA*			

** Enrolled but not yet EID-operational*

Collection centres

Name	First Read	Reader	Upload Software	Lots completion method
United Auctions - Moleigh Area Office	Oct '09	Race	Newline	Newline
Livestock centre	Aug '10	Stick	ScotEID	ScotEID

Ferry Terminals

Name	First Read	Reader	Upload Software	Lots completion method
Orkney Ferry Terminal	Jun '10	Race	Nedap	Manually online
Shetland Collection Centre	Jul '10	Race	Nedap	Manually online

Marts

Name	First Read	Reader	Upload Software	Lots completion method
Aberdeen & Northern Marts - Thainstone	Jan '08	Race	Nedap	ScotEID
John Swan & Sons - Newton St Boswells	Feb '09	Race	ScotEID	TGI mart software
United Auctions - Dalmally	Oct '09	Race	Newline	Newline
United Auctions - Stirling	May '09	Race	Newline	Newline
Wallets Marts - Castle Douglas	Nov ' 09	Race	ScotEID	Offline csv
Lawrie & Symington Ltd - Lanark	Nov '09	Race	ScotEID	Offline csv
Orkney Auction Mart	Nov '09	Race	Nedap	Offline csv
Lawrie & Symington - Forfar	Apr '10	Race	ScotEID	
Craig Wilson - Ayr	Apr '10	Stick	ScotEID	TGL
Dingwall & Highland Marts - Dingwall	Apr '10	Race	ScotEID	Offline csv
Craig Wilson Livestock - Newton Stewart	May '10	Stick	ScotEID	TGL
United Auctions - Huntly	Jun '10	Race	Newline	Newline
Aberdeen & Northern Marts - Quoybrae	Jun '10	Race	ScotEID	Offline csv
Caledonian Marts - Stirling	Aug '10	Race	Newline	Newline
United Auctions - Lairg	Aug '10	Race	Newline	Newline
Lewis And Harris Market - Stornoway	Aug '10	Race	ScotEID	Offline csv
John Swan & Sons - Newton St Boswells	Aug '10	Race	ScotEID	TGI mart software
Dingwall & Highland Marts - Fort William	Aug '10	Race	ScotEID	Offline csv
Dingwall & Highland Marts - Portree	Aug '10	Race	ScotEID	Offline csv
Borderway Mart	Aug '10	Race	Newline	Newline
Borderway Mart	Aug '10	Race	Newline	Newline
Longtown Market	Aug '10	Race	Newline	Newline
United Auctions - Bridgend	Sep '10	Race	Newline	Newline
United Auctions - Tiree	Sep '10	Race	Newline	Newline
Cumberland & Dumfriesshire - Dumfries	Sep '10	Race	Newline	Newline
Lockerbie Market	Sep '10	Race	Newline	Newline
Aberdeen & Northern Marts - Kingussie	Sep '10	Race	ScotEID	Auxis
Dingwall & Highland Marts - Lochmaddy	Sep '10	Race	ScotEID	Offline csv
Lochboisdale Auction Mart	Sep '10	Race	Newline	Newline
Shetland Mart	Sep '10	Race	ScotEID	Online csv
Caledonian Marts - Oban	Nov '10	Race	Newline	Newline

Appendix E: CCP Agreement

SHEEP ELECTRONIC IDENTIFICATION (EID) - CRITICAL CONTROL POINTS

05/11/2010

This document constitutes an Agreement between Critical Control Points and ScotEID.

Amendments to Regulation 21/2004 to provide for Critical Control Points - From 31 December 2009 this means that the electronic recording of sheep EID numbers can be carried out at Critical Control Point's (CCP's) instead of by keepers as animals leave holdings. Markets and abattoirs may wish to provide such services.

Approval
In Scotland Critical Control Points (CCP's) will be approved by ScotEID on behalf of the Scottish Government as Competent Authority (CA).

Consideration

CCP's are approved on using the ScotEID data base system to record the identification and movement allocation of animal codes on a continuing basis under this Agreement between ScotEID and the CCP.

Contingency Planning

Each CCP must have a Contingency Plan describing action to be taken in the case of equipment/power failure etc – see section on Contingency Planning below. It is fully expected that marts and abattoirs will already have a Contingency Plan in place that should be expanded to include CCP's either as an annex or additional section to it to it. Where there is equipment failure the CCP will inform appropriate sheep keepers.

Operating procedures

Dialogue between the operator of the CCP and ScotEID is required to receive consent on the use/connection to the ScotEID database and other specific aspects of the operation.

Reporting times for CCP's

21/2004 as amended stipulates that CCP's data (individual identification codes) is in the holding register of the (originating) departure premises within 48 hours of the off movement.

Commission Regulation (EC) No 759/2009 states "In order to reduce the administrative burden it should be permitted to allow the identification codes of animals to be recorded at the holding of destination, instead of the holding of departure subject to certain conditions." In the Annex to the regulation the conditions include "the holding of destination is approved by the competent authority for the purpose of recording individual animal codes on behalf of the keeper of the holding of departure"

In practice:

- The CCP will send data to ScotEID immediately at the time of reading
- The data shall not be altered in any manner
- The individual animal codes read by the reader shall be allocated to the CPH of the holding of departure within 48 hours of the off movement from that holding.

- The individual animal codes read by the reader shall be allocated to the CPH of the holding of destination within 48 hours of the off movement from the CCP.
- If the time of reading/recording at the holding of the CCP is to be later than 48 hours following the departure of the sheep from originating holding, the CCP shall read/record the individual animal codes on arrival to the holding of the CCP.

Movement reporting to the Competent Authority (CA)

21/2004 as amended stipulates that movement information is 'provided' to the CA within 48 hours of the off movement.

On/off movements recorded by CCP's must be provided to SAMU:

- at the end of the day's sale or at the latest within 24 hours of the completion of the sale if a Market CCP, or, following receipt of consignment if an Abattoir CCP,
- delivered by e-mail ,
- where a buyer/keeper cannot give a destination CPH then he must provide his own CPH to the CCP until he is able to report the movement to the final destination.

All movements on/off the CCP must be recorded (individually where required) in its Holding Register this can be on the ScotEID database.
Movement records must be completed for "off" moves from the CCP and appropriate documentation must accompany the animals to the destination premises.

Reading equipment

The reading equipment used must be adequate for the volume and speed of animals to be handled and the CCP must obtain from the manufacturer or supplier of the reading equipment confirmation that the equipment meets compliance with ISO/DIS 24631-6 - Radiofrequency identification of animals -- Part 6: Representation of animal identification information (visual display/data transfer).

Contingency Planning

Council Regulation 21/2004 does not provide for contingency arrangements in the event of power or equipment failure. Scottish Government recognise however that there will be, on occasion, instances at high throughput premises when individual recording cannot be achieved due to circumstances beyond their control.

Power failure

- It is suggested that where a power failure has occurred battery powered back up equipment could be used to read individual information, tags to be read manually or the CCP reverts to batch reporting. It is recommended that this is no longer than 24 hours.
- CCP's must ensure that arrangements will be put in place to notify consigning keepers of the reason why individual information is not being provided when the Contingency Plan is in operation and state that the consigning keeper keeps such notification within his flock register.
- Staff are adequately trained to operate contingency arrangements.

Back up generators:-
Generators may cause electrical spikes that can intermittently affect the accuracy of reading. It is suggested that in the event of a power failure where appropriate markets use hand held readers.

Equipment breakdown

- Operators must ensure that equipment is appropriately maintained.
- Operators must ensure that faults/replacement equipment, and problems with software, are rectified within 24 hours but no longer than 3 working days.
- Back up equipment or systems are available e.g. stick reader, manual reading, batch recording where appropriate
- Staff are adequately trained to operate contingency arrangements.

Annex

The Sheep and Goats (Records, Identification and Movement) (Scotland) Order 2009

Contingency planning for power and equipment failure

1.—(1) Local Authorities or officers of the Scottish Minsters may exempt markets and slaughterhouse operators from the need to record:

(a) an animal's unique number on a movement document;

(b) an animal's unique number in a holding register; and

(c) the numbers of animals in any batch bearing a particular flock mark or herd mark,

where a contingency plan agreed has been agreed between the local authority and the market or slaughterhouse operator.

(2) A contingency plan agreed under paragraph (1) must set out the conditions which must be met by the market or a slaughterhouse operator and the circumstances in which, provided those conditions are met; the exemptions in paragraph (1) will apply.

(3) A contingency under paragraph (1) must require a market or slaughterhouse operator to obtain the consent of the local authority on every occasion when they wish to apply the exemptions in paragraph (1).