Associations between membership of farm assurance and organic certification schemes and compliance with animal welfare legislation

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ABSTRACT

Animal Health define the outcome of inspections of livestock holdings as full compliance with legislation and welfare code (A), compliance with legislation but not code (B), non compliance with legislation but no pain, distress or suffering obvious in the animals (C) or evidence of unnecessary pain or unnecessary distress (D). The aim of the current study was to investigate whether membership of farm assurance or organic certification schemes was associated with compliance with animal welfare legislation as inspected by Animal Health (AH). Participating schemes provided details of their members, past and present, and these records were matched against inspection data from AH. Multivariable multilevel logistic binomial models were built to investigate the association between compliance with legislation and membership of a farm assurance / organic scheme. The percent of inspections coded A, B, C and D was 37.1%, 35.6%, 20.2% and 7.1% respectively; there were more A and B outcomes on farm assured and organic certified enterprises than on enterprises not known to be in a scheme. Once adjusted for known confounders, there was a pattern of significantly reduced risk of codes C/D compared with A/B in certified enterprises compared with enterprises not known to be certified in all species.

Keywords: animal welfare, farm assurance, organic certification, welfare legislation, Animal Health inspection

INTRODUCTION

The welfare of farmed animals regulations (as amended) 2007, specifies the minimal legal standards that must be complied with when farming animals in Great Britain (GB). Under the provision of the act, Department for Environment, Food and Rural Affairs (Defra) lay down a series of recommendations (codes) to promote the welfare of farmed animals (Defra 2011). There is a statutory requirement for those responsible for the care of animals to be aware of these codes. Each year approximately 1% of GB livestock holdings are visited and inspected by Animal Health (AH) to check compliance with the relevant animal welfare legislation and code. The animals, their housing and their management practices are observed. A proportion of these visits are made based on the risk of non compliance; this is calculated using the Sparre Andersen risk model (Defra 2007) that includes the time since last inspection, the outcome of previous inspections and, for calves (Ortiz-Pelaez and others 2008), mortality of cattle on the holding.

Organic food production is legislated under the legal framework Council Regulation 2092/91/EEC and implemented in the UK by the Organic Products Regulations (as amended) 2004. In GB, seven bodies are accredited to certify animal products as organic. Organic standards specify production methods that provide natural conditions for the animal, freedom of movement and access to the outdoors. The differences in husbandry systems between conventional and organic farming are most notable in the pig and poultry sectors. Farm assurance was born out of retailers' need to demonstrate due diligence in response to the Food Safety Act 1990 (Duffy and Fearne 2009) but has evolved into industry led certification schemes. Schemes are voluntary and paid for by the producers, however, for many industries such as dairy and pig production membership has become essential for market access (Duffy and Fearne 2009) and coverage of assurance schemes among commercial enterprises in these sectors is high. Farm assurance scheme standards are set by the scheme provider and, in many schemes, compliance is assessed by a UK Accreditation Service (UKAS) accredited certification body at 12 or 18 month intervals, frequently interspersed with self assessment or inspections from the farm veterinarian.

The majority of farm assurance schemes assure baseline standards that are closely aligned to legislation; the exception being the Royal Society for the Prevention of Cruelty to Animals (RSPCA) Freedom Food scheme, where standards are designed to provide higher welfare. There is still debate over the extent to which certification can 'assure' animal welfare and the relative standards of animal welfare on organic verses conventional farms. Higher animal welfare standards are reported to be one of the main attractions for consumers of organic food (Zander and Hamm 2010), while only one third of consumers surveyed associated farm assured products with improved welfare standards (Duffy and Fearne 2009).

Farm assurance and organic certification schemes state that animal welfare complies with high standards on their farms. It is reasonable to expect that compliance with welfare legislation might be better on certified farms; because farmers that join assurance or organic schemes may be more motivated farmers with more awareness and knowledge of animal welfare and regular inspections by external auditors might enhance and encourage higher standards of care of livestock. However, research into the impact of farm assurance schemes on the welfare of animals has produced mixed results. Main and Green (2000) concluded that Assured British Pigs were justified in their claims of providing assurance on some aspects of animal welfare but not others and similarly, dairy cattle on farms that were compliant members of Freedom Food, scored better on some, but not all, welfare measures when compared with dairy cattle on farms outside the scheme (Main and others 2003).

The disease status of animals on organic farms is thought to be similar to that of animals on non organic farms, however, reviews of animal welfare in the organic sector argue that extensive production methods offer organically reared livestock the potential for better welfare than conventional production (Castellini and others 2008; Sundrum 2001) although the use of extensive systems does not ensure good welfare which always depends upon excellent stockmanship (Marley and others 2010). The organic sector also has the potential for better welfare because of the genetic lines of livestock used, for example slower growing broiler birds with a lower prevalence of limb disorders (Castellini and others 2008). Slower growing genetic lines are also a requirement of the Freedom Food scheme (Cooper and Wrathall 2010).

The Farm Animal Welfare Council (FAWC) proposed that one way of assessing the effectiveness of farm assurance and organic certification schemes was to investigate whether certified farms were more likely to comply with welfare legislation and code when inspected by AH than non certified farms (FAWC 2001). It was also proposed that if this were the case certification status could be included in the risk model used by AH to select enterprises at higher risk of non compliance with legislation.

A preliminary analysis of AH records indicated that certified farms had a lower incidence of non compliance with welfare legislation and code, (Pritchard and others 2003) but this analysis was potentially compromised by the amount of missing data and lack of independence between repeat visits to the same enterprise or to several enterprises under the same management. A similar analysis of Swedish state animal welfare inspections indicated that while there were fewer reports of underweight animals or lameness on organic sheep and cattle farms, overall there was more non-compliance with welfare legislation on organic farms compared with conventional farms (Keeling 2009).

The aim of the current study was to establish whether membership of a farm assurance or organic certification scheme at the time of inspection by AH inspectors was associated with compliance with animal welfare legislation or code.

METHODS

Recruitment of farm assurance and organic certification schemes

Twelve farm assurance schemes and six organic certification schemes (here on referred to collectively as 'schemes' and compliance with standards set under either type of scheme referred to as 'certification') were invited to participate in the current project. This included all major schemes active in 2009.

Assured Food Standards (AFS) offered their support and agreed to provide data from their schemes. They also sent a letter on the research teams behalf to those schemes with Assured Food Standards (AFS) equivalence that use the 'Red tractor' logo, this included FAWL, QMS and GQA (see Table 1 for full names). All schemes were invited to participate by letter followed up with a telephone call within two weeks.

Animal Health and certification scheme data

Schemes were asked to provide data on their past and present members names, addresses, postcodes and CPH (county parish holding; a unique identifier) numbers (where held). For each member, they were also asked to provide the certification start date, any interim periods of time when a member was not certified and, where certification was no longer valid, the end date.

Animal Health provided data on animal welfare inspections to livestock enterprises (see Table 2 for definitions of an enterprise) in Scotland, England and Wales carried out between 2001 and 2008. Data prior to 2003 were incomplete and excluded from analysis because of the small number of inspection records. The data provided for each inspection were the name, address, postcode and CPH number of enterprises together with date of the visit, reason for the visit (known as visit type), type of enterprise, number of animals present, number of animals inspected and location of the enterprise (Table 2). Horses, ratites-ostriches, wild boar, mink and rabbits were not covered by any of the certification schemes, so these enterprise types and the 'other' category were excluded from analysis by certification status.

Under the requirements of legislation for farmed animals (including the EU directives 98/58, 91/629, 91/630, 99/74) AH inspected enterprises for compliance with animal welfare legislation and welfare codes in up to 12 areas; breeding, disease, environment, equipment, freedom of movement, feed and water, housing, inspections, mutilations, record keeping, space and staffing. Compliance was categorised as full compliance with legislation and code (A), compliance

with legislation but not code (B), non compliance with legislation but no pain, distress or suffering obvious in the animals (C) or evidence of unnecessary pain or unnecessary distress (D) in each area inspected. For the purposes of analysis the most severe non-compliance of the areas inspected was used as the outcome variable for the inspection of the enterprise.

With the exception of FF; all CPH numbers and postcodes in both the Animal Health and individual schemes' data were standardised (i.e. spaces standardised, zeros amended) using an algorithm. Exceptional values were corrected manually. After standardisation, the data for each scheme were matched with the Animal Health data by pairing CPH numbers. When this did not result in a match, or where CPH numbers were not available, standardised postcodes were used instead. All postcode-matched entries were checked by hand to ensure concordance of names and addresses, any mismatches were excluded. FF data were matched with AH inspection records by their data management company following the same protocol. To ensure confidentiality, no schemes were aware of which of their members had been inspected and AH were not aware of which enterprises were members of schemes.

Enterprises were categorised as eligible or not eligible for membership of a participating scheme e.g. only pig enterprises were eligible to be members of ABP. The certification dates were then used to identify whether an enterprise was certified at the time of an AH inspection. They were then coded as known to be a member of the scheme or not known to be a member. Some enterprises were members of more than one scheme. Enterprises that were not a member of a participating scheme were coded as not known to be certified (from here on referred to as 'not certified') this included enterprises in non-participating schemes.

Statistical analysis

The outcome variable was compliance with animal welfare legislation and code when inspected by AH. A binary outcome was used; with AH codes A and B compared with AH codes C and D. Descriptive summaries of the number and percent of inspections to enterprises were calculated by the outcome, year, visit type and enterprise type.

The data had a multilevel structure. To account for this clustering, 4-level hierarchical random effects models were used with inspection (level 1) nested within enterprise (level 2) nested within location (with ≥ 1 enterprise, level 3) nested within county (level 4). Models were built for each of four species groups; cattle, pigs, sheep and poultry. All cattle enterprises were combined in one model because the data provided on AH inspections to calf and growing cattle enterprises did not differentiate beef production from dairy, therefore these enterprises might be certified by beef or dairy production schemes.

The logistic binomial models took the form;

$$\text{Logit}(p_{ijkl}) = \beta_0 + \sum\beta x_{ijkl} + \sum\beta x_{ijk} + \sum\beta x_{jk} + \sum\beta x_k + f_l + v_{kl} + u_{jkl}$$

Where p_{ijkl} = the probability of code C/D at an AH inspection, β_0 = constant, βx is a vector of fixed effects varying at level 1 (ijkl), level 2 (jkl), level 3 (kl) or level 4 (l); i is inspection, j is enterprise, k is location and l is county, $f_l + v_{kl} + u_{jkl}$ are the residuals at county, location and enterprise level respectively. Level 1 variance (ijkl) was restrained to a binomial distribution. Where only one enterprise type was included in the model the random effect for enterprise was omitted. MLwiN version 2.01 (Rasbash and others 2000) was used for all multilevel analysis. A logit link was used as the proportion of the underlying population exposed was unknown.

Country, year and the number of animals examined at the AH inspection was included in all models. To check for a linear association between number of animals inspected or cattle mortality and the outcome variable, these exposures were tested in the model as quintile categorical variables. Non linear associations were left as categorical variables. Two of the poultry schemes were only able to provide 2008 data so additional analysis was carried out for this sector using data from only 2008. Confidence intervals that do not include one indicate that the factor is significantly different to the reference category at the $p<0.05$ level.

RESULTS

Summary statistics

Fifteen schemes provided data for analysis. The number of members of each scheme that were inspected by AH is listed in Table 1. Not all schemes were able to provide data from 2003 to 2008; GQA provided data for 2004 to 2008, ADF provided data for 2007 and 2008 and ACP and ABP provided data for 2008. LQ provided details of current members (at June 2009) and certification start dates were not available. Three certification schemes declined to provide data for this project; one organic scheme, one poultry assurance scheme and one retailer scheme that has UKAS accreditation for a small number of unusual enterprise types.

Records were provided for 40939 AH inspections, at 9790 locations which took place between 02/01/2003 and 31/12/2008. Missing or unusable values reduced the sample of complete records for analysis to 38659. The median number of animals present on an enterprise was 40 (IQR 11, 134; median number present 38, 120, 18 and 40 for cattle, sheep, pigs and poultry respectively). There were more animals present on certified enterprises (median 90, IQR 30, 278) than uncertified enterprises (median 32, IQR 30, 100). The median number of animals inspected on an enterprises was 35 (IQR 10, 110). At 89% of inspections all animals present on the enterprise were inspected. The most common reasons for inspection were complaint or targeted visits. The number of inspections per year was higher in 2007 and 2008 because of the introduction of inspections to check cross-compliance for the single farm payment (Table 3).

The percent of inspections coded A, B, C and D was 37.1, 35.6, 20.2 and 7.1% respectively. The percentage of each inspection code varied by year, country, visit type and enterprise type (Table 4). There was a trend for fewer codes C /D in non certified enterprises compared with assured or organic enterprises (Tables 4 and 5).

The areas inspected at each visit varied. The most frequently inspected area was food and water provision while the least frequently inspected was space allowance. The most frequent areas where enterprises failed an inspection were treatment of diseased animals, the animals' environment, food and water provision and record keeping. The percentage of non compliance in each inspection area was similar across assured, organic and not certified enterprises (Table 6).

Multivariable models

When all enterprise types were combined, there was a significantly reduced risk of assured and organic enterprises not complying with legislation (code C/D) compared with enterprises not certified by any of the participating schemes. There was little difference in the coefficients between organic and farm assured schemes (Table 7). There was a

significantly increased risk of non compliance in caged laying hens and a reduced risk in growing cattle, calves, dairy cattle, broilers / breeders, non caged laying hens, ducks, geese and turkey compared with breeding beef enterprises.

In cattle enterprises there was a significantly reduced risk of non compliance in assured and organic enterprises compared with enterprises not certified by any of the study schemes (Table 7). There was a significantly reduced risk of non compliance in calf and dairy cattle enterprises compared with breeding beef enterprises. In sheep enterprises there was a lower risk of non compliance in assured and organic enterprises compared with enterprises not certified by any of the participating schemes. The reduction in risk was similar for the organic and assured groups but was not statistically significant for organic enterprises, probably due to the small number of organic sheep farms that were inspected (Table 7). In pigs there was a non significant trend for a reduced risk of non compliance in inspections of assured and organic pig enterprises compared with pig enterprises not certified by any of the participating schemes (Table 7).

There was a lower risk of non compliance in assured and organic poultry enterprises compared with enterprises not certified by any of the study schemes in inspections between 2003 and 2008 (Table 7). This difference was statistically significant for assured enterprises, but did not reach significance for organic enterprises. There was a significantly increased risk of non compliance in inspections to caged laying hen enterprises compared with broiler /breeder enterprises (Table 7). When the poultry inspections from 2008 only were analysed there were just 27 inspections to organic poultry enterprises, all of which were compliant with welfare legislation (code A/B). Therefore assured and organic enterprises were combined. In this combined category there was a significantly reduced risk of non compliance in certified enterprises compared with enterprises not certified by any of the participating schemes (Table 7).

The association between the AH inspection outcome and inspection type, number of animals inspected and country was controlled for in all models. There was a pattern of increased risk of non compliance in early years, Scotland compared with England and when larger numbers of animals were inspected. These associations varied across the enterprise types, see Table 7 for details.

DISCUSSION

The current study provides evidence that enterprises that were in a farm assurance or organic certification scheme at the time that they were inspected by AH were more likely to be compliant with animal welfare legislation compared with enterprises that were not known to be certified at the time of inspection. Some assurance schemes did not or could not provide data for the analysis and others could not provide complete data, consequently, there are likely to be some enterprises misclassified as non certified when they were in a certification scheme at the time of inspection. Given the consistent pattern of higher compliance in enterprises known to be in a scheme (Table 7), it is likely that the difference in risk associated with certification status would have been greater than that estimated in the current analysis if all enterprises were correctly coded; that is, the difference in risk is underestimated in the current analysis.

Although certified enterprises were more likely to be compliant with welfare legislation, this does not necessarily imply a causal relationship between membership of a farm assurance or organic scheme and higher compliance with welfare legislation, merely an association. The association could be causal, that is, joining a scheme improved welfare e.g. because the extra inspections from the scheme improved compliance with legislation. The association could also occur because farmers who comply with welfare legislation are more likely to be a member of a scheme. To test whether membership of a scheme improves compliance with welfare legislation, a study of farms joining and leaving schemes and the results from AH inspections over time would be required. In practice these data would not be available as scheme membership is now relatively stable. The current analysis needs to be repeated in future to test whether enterprises in a farm assurance or organic certification scheme continue to be at lower risk of breaching welfare legislation.

There was no significant difference in the level of compliance between organic certification and farm assurance schemes (Table 7). This does not imply that animal welfare *per se* was the same in these two systems, rather, that compliance with animal welfare legislation monitored through inspections was not significantly different. Schemes that have higher welfare standards than those legally required would not be differentiated from those that have the minimum legal standards on the basis of AH inspections. To capture data to compare welfare across systems it would be necessary to take an approach similar to that used by Main and others (2003), where behaviour and physical condition of the animals were independently assessed. This is particularly relevant for organic poultry and pig production where extensive systems are one of the features that differentiate them from many farms in non-organic production. For example, the greater potential to express a larger repertoire of behaviour in non caged hens versus caged hens is not part of the assessment currently used by AH.

However, the importance of AH inspections is illustrated by the proportion that detected non compliance with welfare legislation; 31%, 19% and 13% of inspections to non certified, farm assured and organic enterprises respectively (Tables 4 and 5). The onus for compliance with legislation remains with the producer whether in a scheme or not, but the results raise the question how the schemes might improve compliance among their members further and to move closer to their aim of being able to assure the welfare of all animals certified under their schemes. As highlighted by the schemes themselves, feedback from AH inspections (even if aggregated to preserve anonymity of the individual farmer) would be useful for scheme providers to identify areas where their members need to improve standards so that further education and guidance could be given to all members.

The proportion of inspections to certified enterprises is considerably lower than the proportion of production that is reported to be certified. This may be explained by the fact that there are large numbers of small enterprises that are not certified. In this study certified enterprises had almost three times the number of animals present at the time of AH inspection than non certified enterprises. Drawing on data on number of holdings in England and Wales provided by Defra (Defra 2007) and using the pig industry as an example, in 2008 there were 10669 pig holdings of which approximately 2500 (23%) were assured. However, approximately 90% of finisher pigs produced in England and Wales are thought to be from a farm assured enterprise (Assured Food Standards, personal communication, 2011).

The accuracy of the data provided by the schemes is unknown but the authors did liaise closely with the schemes to ensure that the data provided was interpreted correctly. The data used in the current analysis are of the quality that would be available to AH for use in a risk-based selection of inspections to enterprises and so, whilst a complete dataset with all members of all schemes for all years would be a more robust statistical analysis, the results obtained from this analysis are useful.

There were other factors that were associated with compliance with welfare legislation. There was some indication that compliance improved in 2007 and 2008, however, this might be explained by the introduction of separate categorisation of random and risk based visits to fulfil EU regulations with cross compliance, both of which had higher compliance than the other visits types (Table 4). There were also significant differences in compliance with legislation between enterprise types. These differences may be linked to enterprise types where there is more legislation controlling production but this could also be due to an ascertainment bias because sheep and beef production systems are more often to the public and so complaints were more common. In future years the random inspections that AH carry out will provide a useful source of baseline data to investigate whether there is a real difference in farmer compliance with welfare legislation between enterprise types.

In conclusion, enterprises in a farm assurance or organic certification scheme at the time of an AH inspection between 2003 and 2008 were more likely to comply with animal welfare legislation. The associations were sufficiently robust

that membership of a scheme could be included in AH's risk based selection for inspections of enterprises as part of surveillance of animal welfare. Animal Health's welfare inspections are necessary as an indicator of welfare infringement and are likely to continue to be necessary given that there is non-compliance both certified and uncertified enterprises.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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359 Table 1. Number of scheme members matched to Animal Health inspection data

Scheme name	Scheme code	Number of members	Members inspected by AH		Matched on CPH number[2]	
			n	%	n	%
Assured British Meat[1]	ABM	29013	1309	4.5	1210	92
Assured British Pigs[1]	ABP	1390	24	1.7	21	88
Assured Chicken Production[1]	ACP	2782	6	0.2	0	0
Assured Dairy Farms[1]	ADF	19796	948	4.8	745	79
Farm Assured Welsh Livestock	FAWL	12626	451	3.6	422	94
Freedom Food	FF	Unknown[3]	298	Unknown	0	0
Genesis Quality Assurance	GQA	2159	115	5.3	108	94
Laid in Britain[4]	LIB	28	6	21.4	0	0
Quality Meat Scotland	QMS	13926	703	5.0	674	96
Lion Quality	LQ	943	17	1.8	0	0
Bio-Dynamic Agricultural Association	BDAA	170	9	5.3	8	89
Organic farmers and growers	OFG	2006	113	5.6	94	83
Quality Welsh food certification	QWF	544	12	2.2	12	100
Soil Association[5]	SO	1806	96	5.3	87	91
Scottish Organic Producers Association	SOPA	619	39	6.3	33	85

360 [1] Assured Food Standards (AFS) schemes, [2]Otherwise matched on postcode [3]Unknown as data matching completed
361 by FF [4] This scheme is not UKAS accredited. [5]Included enterprises certified under Asisco organic standards
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363 Table 2. Animal Health data

Variable	Levels	Definition
Visit date		The date the visit was carried out
Visit type	Complaint[1]	Allegation of unnecessary pain or unnecessary distress (UPUD)
	Targeted	Reason to believe that a non compliance with welfare legislation may be found, other than a complaint alleging possible UPUD
	Elective	No prior reason to suspect an increased risk of a non compliance with welfare legislation. Visit carried out when on the farm for another purpose e.g. TB test.
	Programmed	Visit which takes place either according to a random schedule (prior to 2007) or as part of a regular inspection e.g. city farms.
	Random	Randomly selected enterprises inspected for compliance with cross-compliance requirements. These are largely derived from EU Directives and are implemented by The Welfare of Farmed Animal Regulations (England) 2007 and the corresponding legislation in Wales and Scotland.
	Risk based	Selected to inspect for compliance with cross-compliance requirements using a risk model
Enterprise type		An enterprise was defined as a specific farm animal type and a single visit may include several separately recorded inspections of enterprises. Animal Health defines 20 separate enterprise types plus an 'other' category. See Table 4 for full list
Number present		Number of animals present on the enterprise at the time of inspection
Number inspected		Number of animals inspected on the enterprise
CPH number / address with postcode (location)		Used to match with scheme membership data

364 [1]Includes complaints on enterprises claiming single farm payment, termed cross-compliant targeted visits by AH
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Table 3. Number of Animal Health inspections by certification category, year, country, enterprise and visit type

		Assured		Organic		Not certified		
		n	%	n	%	n	%	Total[1]
Year	2008	3072	32.0	275	2.9	6384	66.4	9613
	2007	1924	25.7	153	2.0	5460	73.1	7473
	2006	1062	17.7	99	1.7	4873	81.3	5997
	2005	977	16.9	96	1.7	4735	82.0	5772
	2004	900	17.6	72	1.4	4169	81.6	5107
	2003	765	16.3	95	2.0	3867	82.3	4697
Country	England	5027	18.1	531	1.9	22335	80.5	27736
	Scotland	2270	37.0	165	2.7	3812	62.1	6141
	Wales	1403	29.3	94	2.0	3341	69.9	4782
Enterprise type[2]	Cattle							
	Breeding beef	1565	20.8	135	1.8	5899	78.2	7541
	Calves	1444	40.1	81	2.2	2125	59.0	3602
	Dairy cattle	803	36.3	47	2.1	1387	62.6	2215
	Growing cattle	1722	35.5	83	1.7	3085	63.7	4845
	Sheep	2569	26.6	190	2.0	6979	72.4	9641
	Pigs							
	Pig breeding	134	5.6	54	2.3	2212	92.3	2396
	Pig growing	199	9.4	40	1.9	1887	89.1	2118
	Poultry							
	Caged layers	10	2.3	*	*	417	97.7	427
	Broilers / breeders	56	5.6	41	4.1	906	90.7	999
	Ducks	6	0.8	6	0.8	732	98.4	744
	Geese	*		12	1.9	604	98.1	616
	Non caged laying hens	187	10.9	79	4.6	1481	86.4	1714
	Turkey	5	1.3	5	1.3	372	97.4	382
	Other species							
	Deer	*	*	3	2.2	132	97.8	135
	Goats	*	*	14	1.1	1270	98.9	1284
Visit type	Complaint	2235	22.5	200	2.0	7561	76.3	9915
	Elective	238	7.7	46	1.5	2809	91.0	3086
	Programmed	688	13.5	151	3.0	4286	84.1	5094
	Targeted	3069	20.4	191	1.3	11912	79.1	15065
	Random	644	50.8	34	2.7	608	47.9	1268
	Risk based	1826	43.2	168	4.0	2312	54.6	4231

[1]Sum of certified categories is greater than the total because some organic enterprises are also members of farm assurance schemes, [2]Mink, horses, wild boar and rabbits were not certified by any of the participating schemes therefore were excluded from analysis *No data

Table 4. Number and percent of Animal Health inspections coded A-D by certification category, year, country, visit and enterprise type

		A		B		C		D		
		n	%	n	%	n	%	n	%	Total[1]
Certification category	Not certified	9837	33.3	10466	35.5	6841	23.2	2355	8.0	29499
	Assured	3631	41.7	3397	39.0	1172	13.5	500	5.5	8700
	Organic	402	53.0	253	33.4	82	10.8	21	2.7	758
Year	2003	2007	40.1	1522	30.5	985	19.7	485	9.7	4999
	2004	1971	36.3	1642	30.3	1275	23.5	538	9.9	5426
	2005	2349	38.0	1974	31.9	1348	21.8	508	8.2	6179
	2006	2145	33.7	2380	37.4	1326	20.8	512	8.0	6363
	2007	3110	39.5	2822	35.8	1507	19.1	436	5.5	7875
	2008	3593	35.6	4252	42.1	1825	18.1	427	4.2	10097
Country	England	10286	37.1	9931	35.8	5673	20.4	1861	6.7	27751
	Scotland	1663	27.1	2523	41.1	1521	24.8	436	7.1	6143
	Wales	1782	37.3	1546	32.3	878	18.4	577	12.1	4783
Visit type	Complaint	2564	25.1	3729	36.6	2563	25.1	1343	13.2	10199
	Elective	2652	69.4	988	25.9	159	4.2	20	0.5	3819
	Programmed	3829	65.2	1478	25.1	512	8.7	58	1.0	5877
	Targeted	3083	20.0	6474	42.1	4438	28.8	1399	9.1	15394
	Random	807	62.0	387	29.7	104	8.0	4	0.3	1302
	Risk based	2236	51.6	1529	35.3	487	11.2	78	1.8	4330
Enterprise type	Breeding beef	2076	27.5	2892	38.3	1916	25.4	662	8.8	7546
	Caged laying hens	149	34.9	138	32.3	124	29.0	16	3.7	427
	Broilers / breeders	413	41.1	404	40.2	129	12.8	58	5.8	1004
	Calves	1474	40.9	1288	35.8	658	18.3	182	5.1	3602
	Dairy cattle	774	34.9	834	37.6	393	17.7	215	9.7	2216
	Deer	92	68.1	31	23.0	10	7.4	2	1.5	135
	Ducks	452	60.8	201	27.0	77	10.3	14	1.9	744
	Growing cattle	1573	32.5	1802	37.2	1125	23.2	345	7.1	4845
	Geese	389	63.1	172	27.9	50	8.1	5	0.8	616
	Goats	686	53.4	376	29.3	187	14.6	35	2.7	1284
	Horses	536	58.3	259	28.2	110	12.0	15	1.6	920
	Mink	1	50.0	1	50.0	*		*		2
	Non caged laying hens	869	50.7	567	33.1	241	14.1	37	2.2	1714
	Ratites - ostriches	38	52.1	23	31.5	9	12.3	3	4.1	73
	Pig breeding	916	38.2	779	32.5	591	24.6	112	4.7	2398
	Pig growing	738	34.8	743	35.1	532	25.1	106	5.0	2119
	Rabbits	368	74.8	102	20.7	20	4.1	2	0.4	492
	Sheep	2907	30.1	3662	38.0	1998	20.7	1078	11.2	9645
	Turkeys	223	58.4	111	29.1	41	10.7	7	1.8	382
	Wild Boar	30	46.2	23	35.4	10	15.4	2	3.1	65
	Other	471	66.3	184	25.9	45	6.3	10	1.4	710

[1] Sum of categories for each variable varies by the number of missing or unusable values

379

380 Table 5. Number and percent of Animal Health inspections to assured, organic and not certified enterprises coded C/D
381 by year, country, enterprise and visit type
382

		Assured		Organic		Not certified	
		n	%	n	%	n	%
Year	2008	356	11.6	32	11.6	1812	28.4
	2007	318	16.5	16	10.5	1568	28.7
	2006	277	26.1	20	20.2	1508	30.9
	2005	277	28.4	21	21.9	1548	32.7
	2004	225	25.0	6	8.3	1540	36.9
	2003	219	28.6	16	16.8	1218	31.5
Country	England	856	17.0	69	13.0	6613	29.6
	Scotland	509	22.4	30	18.2	1437	37.7
	Wales	307	21.9	12	12.8	1144	34.2
Enterprise type	Cattle						
	Breeding beef	287	18.3	17	12.6	2277	38.6
	Calves	165	11.4	4	4.9	674	31.7
	Dairy cattle	134	16.7	3	6.4	471	34.0
	Growing cattle	316	18.4	8	9.6	1148	37.2
	Sheep	671	26.1	41	21.6	2385	34.2
	Pigs						
	Pig breeding	27	20.1	11	20.4	665	30.1
	Pig growing	49	24.6	8	20.0	580	30.7
	Poultry						
	Caged laying hens	0	0.0	*	*	140	33.6
	Broilers / breeders	9	16.1	8	19.5	169	18.7
	Ducks	0	0.0	0	0.0	91	12.4
	Geese	*	*	1	8.3	54	8.9
	Non caged laying hens	14	7.5	9	11.4	259	17.5
	Turkey	0	0.0	0	0.0	48	12.9
	Other species						
	Goats	*	*	1	7.1	221	17.4
	Deer	*	*	0	0.0	12	9.1
Visit type	Complaint	710	31.8	60	30.0	3092	40.9
	Elective	16	6.7	1	2.2	152	5.4
	Programmed	52	7.6	10	6.6	480	11.2
	Targeted	774	25.2	31	16.2	4948	41.5
	Random	14	2.2	1	2.9	86	14.1
	Risk based	106	5.8	8	4.8	436	18.9

383 *No data
384

385 Table 6. Percent non compliance by total number inspected in that area (a) and percent of all non-compliances by
386 area (b) on assured, organic and not certified enterprises
387

Area	Assured			Organic			Not certified			Total		
	n	%		n	%		n	%		n	%	
		a	b		a	b		a	b		a	b
Breeding	*4650	1.4	1.9	387	0.9	2.1	15512	6.4	4.3	20441	5.2	4.0
Disease	7275	11.1	24.4	512	5.3	18.8	24977	15.5	16.5	32700	14.4	17.5
Environment	7649	6.0	13.9	554	2.8	12.0	27800	12.1	14.5	35923	10.7	14.4
Equipment	3504	1.9	2.0	335	0.3	0.5	13533	4.7	2.7	17306	4.1	2.6
Food and Water	7979	4.8	11.6	616	3.6	16.1	28903	10.7	13.2	37371	9.4	13.0
Freedom	7365	1.0	2.2	662	0.4	1.6	27048	2.2	2.5	34893	1.9	2.5
Housing	6578	5.5	10.9	504	3.4	13.0	24466	11.6	12.2	31485	10.3	12.0
Inspections	7664	4.1	9.6	597	1.7	6.8	27198	7.6	8.8	35335	6.7	8.9
Mutilations	5018	0.9	1.4	441	0.4	1.0	15435	1.4	0.9	20763	1.3	1.0
Records	5152	7.3	11.4	438	4.1	14.1	16492	18.3	12.9	22023	15.5	12.7
Space	472	0.4	0.1	48	0	0	2639	2.2	0.3	3151	1.9	0.2
Staffing	7490	4.7	10.6	574	3.3	14.1	27219	9.6	11.2	35187	8.5	11.1

388 *e.g. there were 4650 inspections of breeding facilities on assured enterprises, 1.4% were non-compliant with
389 legislation and this contributed 1.9% to the total non-compliances on assured enterprises
390

Table 7. Logistic binomial mixed effects models of the association between certification status and the proportion of AH inspection code C/D on pig, sheep, cattle and poultry enterprises adjusted by inspection year, country, enterprise type, number of animals inspected and visit type

		All species[2]			Cattle[3]			Sheep[4]			Pigs[5]			Poultry[6]			Poultry 2008		
		n=38659			n=18203			n=9641			n = 5414			n=4887			n=1018		
Intercept coefficient		-2.2			-2.2			-2.0			-2.4			-2.6			-3.8		
		OR	CI		OR	CI		OR	CI		OR	CI		OR	CI		OR	CI	
Certification status	Not certified	Ref			Ref			Ref			Ref			Ref			Ref		
	Assured	**0.54**	**0.49**	**0.59**	**0.53**	**0.47**	**0.59**	**0.59**	**0.51**	**0.67**	0.68	0.45	1.04	**0.44**	**0.24**	**0.82**			
	Organic	**0.53**	**0.38**	**0.73**	**0.34**	**0.21**	**0.56**	0.64	0.40	1.01	0.76	0.38	1.53	0.79	0.37	1.68			
	Any scheme																**0.22**	**0.06**	**0.86**
Inspection year	2008	Ref			Ref			Ref			Ref			Ref			Ref		
	2007	1.11	1.00	1.24	1.09	0.95	1.26	1.09	0.93	1.29	0.96	0.73	1.27	1.01	0.70	1.46			
	2006	**1.18**	**1.04**	**1.33**	1.04	0.89	1.22	**1.39**	**1.17**	**1.65**	0.93	0.69	1.27	1.03	0.70	1.53			
	2005	**1.32**	**1.17**	**1.50**	**1.32**	**1.12**	**1.55**	**1.42**	**1.19**	**1.70**	1.01	0.75	1.37	0.94	0.63	1.39			
	2004	**1.51**	**1.33**	**1.72**	**1.51**	**1.29**	**1.81**	**1.43**	**1.19**	**1.72**	1.25	0.93	1.69	1.27	0.85	1.89			
	2003	**1.31**	**1.15**	**1.49**	1.15	0.98	1.40	1.17	0.97	1.42	**1.51**	**1.10**	**2.07**	**1.65**	**1.09**	**2.48**			
Country	England	Ref			Ref			Ref			Ref			Ref			Ref		
	Scotland	**1.37**	**1.09**	**1.74**	1.04	0.79	1.35	**1.38**	**1.05**	**1.81**	**2.20**	**1.44**	**3.35**	**2.50**	**1.64**	**3.83**	1.47	0.56	3.89
	Wales	1.11	0.78	1.59	0.99	0.67	1.46	1.24	0.86	1.80	1.17	0.69	1.98	0.70	0.32	1.55	0.37	0.09	1.58
Enterprise type	Breeding beef	Ref			Ref														
	Growing cattle	**0.82**	**0.68**	**0.99**	0.94	0.85	1.04												
	Calves	**0.84**	**0.74**	**0.94**	**0.86**	**0.76**	**0.97**												
	Dairy cattle	**0.78**	**0.68**	**0.91**	**0.74**	**0.63**	**0.86**												
	Sheep	1.01	0.42	2.44															
	Breeding pigs	1.02	0.89	1.17							Ref								
	Growing pigs	1.04	0.90	1.20							1.08	0.92	1.27						
	Broilers / breeders	**0.64**	**0.50**	**0.81**										Ref			Ref		
	Caged laying hens	**1.78**	**1.31**	**2.43**										**2.41**	**1.55**	**3.74**	1.96	0.58	6.69
	Non caged laying hens	**0.66**	**0.56**	**0.79**										1.03	0.72	1.47	1.15	0.44	3.05
	Ducks	**0.60**	**0.46**	**0.77**										0.95	0.62	1.46	0.93	0.33	2.64
	Geese	**0.52**	**0.39**	**0.71**										0.80	0.50	1.29	0.89	0.29	2.69
	Turkeys	**0.60**	**0.42**	**0.86**										0.99	0.60	1.62	1.00	0.30	3.29
Number of animals inspected[1]	Category 1	Ref			Ref			Ref			Ref			Ref			Ref		
	Category 2	1.05	0.96	1.16	1.08	0.94	1.25	1.04	0.88	1.22	1.20	0.90	1.59	0.98	0.68	1.41	0.96	0.49	1.87
	Category 3	**1.20**	**1.08**	**1.32**	1.15	1.00	1.33	0.98	0.83	1.15	**1.42**	**1.08**	**1.89**	1.14	0.79	1.65	0.90	0.42	1.94
	Category 4	**1.29**	**1.16**	**1.43**	**1.40**	**1.21**	**1.62**	1.01	0.85	1.19	**1.63**	**1.23**	**2.17**	**1.49**	**1.01**	**2.20**	1.30	0.58	2.90
	Category 5	**1.25**	**1.12**	**1.40**	**1.28**	**1.07**	**1.46**	1.05	0.88	1.25	1.22	0.89	1.68	1.03	0.66	1.60	1.09	0.34	3.51
Visit type	Programmed	Ref			Ref			Ref			Ref			Ref			Ref		
	Elective	0.81	0.60	1.08	1.11	0.67	1.83	**0.45**	**0.29**	**0.71**	0.68	0.45	1.04	**0.37**	**0.23**	**0.60**	1.90	0.43	8.49
	Complaint	**3.59**	**3.12**	**4.13**	**4.04**	**3.24**	**5.04**	**3.92**	**3.00**	**5.11**	**4.09**	**3.11**	**5.37**	**2.45**	**1.69**	**3.54**	**12.99**	**3.35**	**50.32**
	Targeted	**2.42**	**2.10**	**2.78**	**2.92**	**2.35**	**3.64**	**2.27**	**1.73**	**2.97**	**3.27**	**2.51**	**4.26**	**2.36**	**1.69**	**3.30**	**11.01**	**3.12**	**38.91**
	Risk based	1.09	0.89	1.32	1.31	1.00	1.71	1.04	0.74	1.48	1.30	0.82	2.07	1.09	0.61	1.95	**5.30**	**1.43**	**19.60**
	Random	**0.76**	**0.62**	**0.95**	0.72	0.48	1.09	0.86	0.52	1.41	1.66	0.80	3.44	2.23	0.96	5.16	**5.80**	**3.35**	**74.61**
Random effects	County	0.18	0.04		0.19	0.05		0.17	0.04		0.23	0.08		0.46	0.13		0.24	0.26	
	Location	0.99	0.06		1.02	0.08		0.65	0.07		1.09	0.15		1.40	0.23		3.47	0.61	
	Enterprise	1.27	0.06		0.91	0.08					0.16	0.13		1.23	0.23		0.00	0.00	

Ref = reference category, Bold = statistically significantly different from the reference category at $p<0.05$ [1]Categorised into quintiles. All species; cat. 1=≤9, cat. 2=10-25, cat.3=26-60, cat. 4=61-170, cat. 5=>170 Cattle; cat. 1=≤10, cat. 2=11-24, cat. 3=25-49, cat. 4=50-97, cat. 5=>97 Sheep; cat. 1=≤24, cat. 2=25-60, cat. 3=61-150, cat. 4=151-300, cat. 5=>300 Pigs; cat. 1=≤3, cat. 2=4-10, cat. 3=11-30, cat. 4=31-200, cat. 5=>200 Poultry; cat.1=≤6, cat. 2=7-20, cat. 3=21-80, cat. 4=81-7000, cat. 5=>70000 Poultry 2008; cat. 1=≤5, cat. 2=6-14, cat. 3=15-30, cat. 4=31-170, cat. 5=>170