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SID 5 Research Project Final Report

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Project identification

1. Defra Project code: AW0510
2. Project title: Does membership of a Farm Assurance Scheme affect compliance with Animal Welfare Legislation and Codes
3. Contractor organisation(s): University of Warwick
   Gibbet Hill Road
   Coventry
   CV4 7AL
4. Total Defra project costs (agreed fixed price): £ 78602
5. Project: start date ..... 17 April 2009
   end date ..... 01 Oct 2010

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This report has been agreed by participating schemes before release into the public domain.

Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

All types of farmed food animals in Britain are in a population sampled by Animal Health (AH) to check compliance with animal welfare legislation and code. A proportion of the inspections are carried out to enterprises selected based on the risk of non compliance. Previous research has indicated that the risk of non compliance is associated with outcome of previous inspection and, for calves, mortality of cattle on the holding. Time since last inspection was also included in the model to account for farms where little is known about welfare legislation compliance as the farm has never or rarely been visited. The aim of this study was to investigate whether membership of farm assurance or organic certification schemes was associated with the prevalence of non compliance with animal welfare legislation and code and could be added to the risk model used to select enterprises for inspection.

All major UKAS accredited livestock farm assurance or organic certification schemes in Britain were invited to participate in this study. Schemes were asked to provide details of their members past and present. Data were included from Assured British Meat (ABM), Assured British Pigs (ABP), Assured Chicken Production (ACP), Assured Dairy Farms (ADF), Farm Assured Welsh Livestock (FAWL), Freedom Food (FF) Laid In Britain (LIB), Lion Quality (LQ), Genesis Quality Assurance (GQA) and Quality Meat Scotland (QMS) farm assurance schemes and Bio-dynamic Agriculture Association (BDAA), Organic Farmers and Growers (OFG), Quality Welsh Food (QWF), Soil Association (SA) and Scottish Organic Producers Association (SOPA) organic certification schemes. Certification histories were matched against inspection data from AH and each inspection was classified as certified by a specified scheme or not known to be certified by any schemes in the study at the time of inspection.

Four multivariable multilevel binomial models, one for each major species, were built comparing inspections where the enterprise was compliant with animal welfare legislation (AH code A and B) with inspections of non compliant enterprises (AH code C and D). Random effects were included to account for the repeated measures of inspection, enterprise, location and county. The models included year of inspection, reason for the visit, number of animals inspected, type of enterprise and country. Separate models were built for cattle, sheep, pigs and poultry.

The percent of inspections coded A, B, C and D was 37.1%, 35.6%, 20.2% and 7.1% respectively. The proportion of inspections coded A-D varied by year, country, visit and enterprise type. In all enterprise groups there was a pattern of reduced risk of code C/D compared with A/B in organic or assured enterprises compared with enterprises not known to be certified (Table 1). There were no significant differences between the assured and organic categories. We conclude that certified enterprises could be placed in a category that is at a lower risk of selection for random inspection by AH.

Table 1. Odds ratios (OR) and confidence intervals (CI) of the association between certification status and the AH codes C/D in pig, sheep, cattle and poultry enterprises in England, Wales and Scotland 2003-2008

	Pig			Sheep			Cattle			Poultry		
	OR	CI		OR	CI		OR	CI		OR	CI	
Not certified by participating schemes	Ref			Ref			Ref			Ref		
Assured	0.7	0.5	1.0	**0.6**	**0.5**	**0.7**	**0.5**	**0.5**	**0.6**	**0.4**	**0.2**	**0.8**
Organic	0.8	0.4	1.5	0.6	0.4	1.0	**0.3**	**0.2**	**0.6**	0.8	0.4	1.8

These OR and CI are sourced from separate binary logistic regression mixed models for each enterprise group and are adjusted for year of inspection, visit type, enterprise type, number of animals inspected and country. Ref= reference category. Bold = statistically significantly different from the reference category of not certified by any of the participating schemes, standard = not significant at 95%. OR <1 are a reduced risk compared with the baseline of not known to be certified. Where CI overlap there is no significant difference between categories.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:
   - the scientific objectives as set out in the contract;
   - the extent to which the objectives set out in the contract have been met;
   - details of methods used and the results obtained, including statistical analysis (if appropriate);
   - a discussion of the results and their reliability;
   - the main implications of the findings;
   - possible future work; and

- any action resulting from the research (e.g. IP, Knowledge Transfer).

Introduction

Certification under a farm assurance or organic scheme involves a farmer conforming to a set of standards, and compliance is regularly inspected. Schemes vary in their stated aims from animal welfare focused schemes (e.g. Freedom Foods) to those where animal welfare is one of a number of aims along with guaranteeing traceability and food safety (e.g. Assured British Pigs). There is still debate over the extent to which certification can 'assure' animal health and welfare. However, membership of farm assurance or organic schemes is more likely among motivated farmers with awareness and knowledge of animal welfare and the schemes motivation to uphold standards might enhance or encourage awareness and knowledge, and therefore have a positive effect on the welfare of the animals on certified farms.

Previous 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. Dairy cattle on farms that were compliant members of Freedom Foods, scored better on some, but not all, welfare measures when compared with dairy cattle on farms outside the scheme (Main et al., 2003).

All types of farmed food animals in Britain are in a population that is sampled for Animal Health (AH) inspections. The Farm Animal Welfare Council proposed that one way of assessing the effectiveness of farm assurance and organic certification schemes in improving farm animal welfare was to investigate whether certified farms were less likely to be in breach of animal welfare legislation and code when inspected by AH (Interim Report on the Animal Welfare Implications of Farm Assurance Scheme, 2001). It was also proposed that this variable could be incorporated into the risk model currently used by AH to determine which holdings to inspect to target non-compliance.

A preliminary analysis of AH records indicated that certified farms had a lower incidence of non compliance with welfare legislation and code, (Pritchard, et al., 2003) however, this analysis was 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 (Report on the Animal Welfare Implications of Farm Assurance Schemes, 2005).

The aim of the current project was to establish whether membership of farm assurance or organic certification schemes was associated with compliance with animal welfare legislation or code identified by AH inspectors.

Methods

Recruiting farm assurance and organic certification schemes

In total 12 farm assurance schemes and six organic certification schemes were invited to participate in the current project. This list was agreed between Warwick and Defra at the start of the project and was thought to include all major schemes active in 2009 providing certification accredited under the UK Accreditation Service (UKAS). From now on both farm assurance and organic certification schemes are referred to collectively as 'schemes'.

At the start of the project Assured Food Standards (AFS) offered their support and agreed to provide data from all their schemes. All other schemes were invited to participate by letter. Assured Food Standards sent this letter to the schemes that have AFS equivalence (FAWL, QMS, GQA, and QBT) on Warwick's behalf. The letter was followed up with a telephone call from Warwick within two weeks.

Scheme certification data

Schemes were asked to provide details of their members past and present. For each member, they were asked to provide a certification start date and, where certification was no longer valid, an end date. Full details of periods of non-continuous certification were also requested. Additionally, schemes were asked to provide the members name, address, postcode and CPH number (where known) to allow Warwick to match these data to AH inspection data. Schemes were asked to provide all historic data available. Schemes were also asked if they had made any major revisions to their standards during the time period covered in the data provided.

Animal Health data

Animal Health provided data on all animal welfare inspections on livestock enterprises in Scotland, England and Wales carried out between 2001 and 2008. Data prior to 2003 were excluded from analysis because of the small number of inspections recorded. The data provided for each inspection were; date of the visit, reason for the visit, (visit type), type of enterprise, number of animals present, number of animals inspected and the location of the enterprise (Table 2). Horses, ratites-ostriches, wild boar and rabbits were not covered by any of the certification schemes, so these enterprise types and the 'other' category were excluded from further analysis.

Table 2. Animal Health data

Variable	Levels	Description
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 or as part of a regular inspection e.g. city farms.
	XC Random	Randomly selected enterprises inspected for compliance with cross-compliance (XC) 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.
	XC Risk based	Selected to inspect for compliance with XC requirements using a risk model
Enterprise type		Nineteen categories plus an 'other' category
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		Used to match with scheme membership data

[1]Includes complaints on enterprises claiming single farm payment, termed XC targeted visits by AH

Animal health welfare code – the outcome of interest
Animal Health inspect livestock enterprises with regard to compliance with animal welfare legislation and relevant welfare codes in 12 areas; breeding, disease, environment, equipment, freedom of movement, feed and water, housing, inspections, mutilations, record keeping, space and staffing. Compliance for each area is recorded separately to facilitate reporting against the requirements of Directive 98/58EC. Compliance is categorised as full compliance with legislation and code (A), compliance with legislation but not code (B), non compliance with legislation but no adverse effect on the animals (C) or evidence of unnecessary pain or unnecessary distress (D). In addition the most severe non-compliance for each inspection of the enterprise is recorded as an overall score for the inspection. This overall inspection score was used as the outcome variable in all models in the current study.

Data security
At the University of Warwick confidential and non-confidential data were stored separately using a set of numeric identifiers to link the two datasets. Access to the datasets was only available after authentication; with confidential data stored on removable media and network drives encrypted using TrueCrypt. No scheme membership data were passed to AH or Defra.

Matching Animal Health and Certification Scheme data
Matching AH inspection and scheme membership records for all schemes apart from FF was carried out by the University of Warwick. The following protocol was used; CPH numbers and postcodes were normalised to standard formats using automated methods with only exceptional values checked by hand. After normalisation, the data for each scheme were matched with the AH data. This was done by matching normalised (standardised) CPH numbers between AH and certification scheme data and, where the first step did not result in a match, matching normalised postcodes. In this case, a further manual check was performed to filter out entries where the postcode matched but not the name and address. Once the data were matched, the certification dates were used to extract "start" and "end" dates for all certified periods for each member and an enterprise was defined as certified if the AH inspection occurred within these periods.

At FF's request their data was matched with AH inspection records by their data management company. Warwick provided FF with a data set of enterprise names and addresses and associated inspection dates. This data set included enterprises that had not been inspected by AH for which inspection dates were generated to mimic the

distribution of the genuine inspections. In this way, FF was unaware which of their members had been inspected by AH. No data on inspection outcome was passed to FF. FF's data management company followed the data matching protocol defined above, however, CPH numbers were not present in FF records, therefore match was made only on post code, which was then checked by hand to ensure farmers name and address matched between the FF and AH records.

For all schemes, Warwick coded the inspection data by those eligible for membership of each scheme by enterprise type, geographical location and inspection year, e.g. inspections to pig enterprises in England 2008 were considered with respect to ABP certification status. No individual scheme's data are presented in this report. Certification status of the inspected enterprises was defined as assured, organic, or not certified. We were unable to identify members of schemes that chose not to participate in this study therefore these enterprises and enterprises certified by participating schemes for years where they were unable to provide data, are included in the 'not certified' group in this analysis.

Statistical analysis
The outcome variable analysed was compliance with animal welfare legislation and code when inspected by AH. A binary outcome was used; with AH code A and B, compared with AH code C and D.

Descriptive summaries of the number and percent of inspections to enterprises certified by each certification group was calculated by AH code outcome, year, visit type and enterprise type as follows:

$$\frac{\text{Number of inspections to eligible enterprises by certification category} \times 100}{\text{Number of inspections to eligible enterprises}}$$

Descriptive summaries of the number and percent of inspections to certified enterprises with code C/D were calculated by year and visit type as follows:

$$\frac{\text{Number of inspections to eligible certified enterprises with a code C/D outcome} \times 100}{\text{Number of inspections to certified eligible enterprises}}$$

This preliminary analysis informed the development of the multivariable models.

Multivariable multilevel models
The data had a multilevel structure. That is, inspections of the same enterprises over time, different enterprises at the same location (farm) and within the same geographical location (county), were likely to be dependent / correlated. To account for this clustering a 4-level random effects model was used with inspection (level 1) nested within enterprise (level 2) nested within location (level 3) nested within county (level 4). MLwiN version 2.01 (Rasbash *et al*., 2000) was used for all multilevel analysis. Models were built by enterprise group, cattle, pigs, sheep and poultry. It was necessary to combine all cattle enterprises 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 number of animals examined on the AH inspection was included in all models. To check for a linear association with the outcome, the number of animals inspected was tested in the model as a quintile categorical variable and examined for a pattern of increasing or decreasing coefficients. Non linear associations were left as categorical variables.

The logistic models took the form;
$\text{Logit}\,(p_{ijkl}) = \beta_0 + \sum\beta x_{ijkl} + \sum\beta x_{ijk} + \sum\beta x_{jk} + \sum\beta x_k + fl + vl_k + ul_{jk}$

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) h is inspections, i is inspection, j is enterprise, k is location and l is county, $fl + vl_k + ul_{jk}$ are the residuals at county, location and enterprise level respectively. Level 1 variance (ijkl) was restrained to a binomial distribution with a mean of zero and variance of 1. Where only one enterprise type was included in the model (e.g sheep) the enterprise random effect was omitted.

Odds ratios (OR) and 95% confidence intervals (CI) are presented throughout. Confidence intervals are presented as two values, which indicate the lower and upper boundary of the 95% range. The OR provides a measure of how much more or less likely an event (AH code C/D in the present analysis) is to occur in one category compared with a reference category. Odds ratios less than one indicate a reduction in risk, odds ratios greater than one indicate an increase in risk. Confidence intervals that do not include one indicate that we can be 95% confident that there is a difference in risk between the two categories. In the risk model tables below statistically significant differences are highlighted in bold.

Risk model for selection of holdings for inspection by Animal Health

Animal Health uses a model (known as the Anderson model) to select holdings on a risk basis for some inspections (Table 3). To reproduce this model time since last inspection and previous compliance score were calculated from the AH data provided. Mortality (cattle of all ages recorded as dying on the holding) data were extracted from the RADAR database for inspected holdings (matched by CPH number). The number of cattle deaths per 1000 animal days alive was calculated to create a mortality rate.

Table 3. Risk criteria and risk scores in the Anderson model currently used by AH to select enterprises for inspection[1]

Risk criteria	Levels	Risk score
Recorded welfare score	A (compliance with law and code)	-100
	B (compliance with law)	0
	C (non-compliance)	50
	D (unnecessary pain, distress	100
	No data available	0
Time since last inspection (years)	1	0
	2	20
	3	40
	4	80
	5	100
	No data available	100
Mortality rate	Lowest 25% of the dataset	-30
	Other	0
	No data available	0

[1]Taken from the report 'The selection of holdings for inspection under cross compliance SMRs 16-18: Summary of project group conclusions'

Results

Farm assurance and organic certification schemes
In total 15 schemes provided data for analysis in this study (Table 4).

Table 4. Farm assurance and organic certification schemes that participated in the study

Farm assurance schemes	
Assured British Meat[1]	ABM
Assured British Pigs[1]	ABP
Assured Chicken Production[1]	ACP
Assured Dairy Farms[1]	ADF
Farm Assured Welsh Livestock	FAWL
Freedom Food	FF
Genesis Quality Assurance	GQA
Laid in Britain	LIB
Quality Meat Scotland	QMS
Lion Quality	LQ
Organic certification schemes	
Bio-Dynamic Agricultural Association	BDAA
Organic farmers and growers	OFG
Quality Welsh food certification	QWF
Soil association [2]	SO
Scottish Organics Producers Association	SOPA

[1] Assured Food Standards (AFS) schemes, [2] Included enterprises certified under Asisco organic standards.

Not all schemes were able to provide data from 2003 to 2008, GQA data were not available for 2003, ADF data were only available from 2007 to 2008 and ACP and ABP data were available for 2008. LQ was only able to provide details of current members (at June 2009) and certification start dates were not available. A decision was made to assume that the current members had been in the scheme for at least 18 months therefore allowing inspections to current members in 2008 to be included in the analysis. This would have resulted in some misclassification but allowed trends in the data to be identified. Because only 2008 data were available for two of the major poultry schemes additional analysis was carried out for this sector using data from 2008 only.

The number of members of each scheme that were inspected by AH is listed in Table 5. However, as the majority of AH inspections are not random, these values do not necessary accurately reflect the coverage of the scheme, scheme members might be over or under represented in the sample of AH inspections.

Table 5. Number of scheme members matched to AH inspection data

		Number of members in data provided	Members inspected by AH		Matched on CPH number[1]	
			n	%	n	%
Assured	ABM	29013	1309	4.5	1210	92
	ABP	1390	24	1.7	21	88
	ACP	2782	6	0.2	0	0
	ADF	19796	948	4.8	745	79
	FAWL	12626	451	3.6	422	94
	GQA	2159	115	5.3	108	94
	LIB	28	6	21.4	0	0
	QMS	13926	703	5.0	674	96
	LQ	943	17	1.8	0	0
Organic	BDAA	170	9	5.3	8	89
	OFG	2006	113	5.6	94	83
	QWF	544	12	2.2	12	100
	SO	1806	96	5.3	87	91
	SOPA	619	39	6.3	33	85

[1]Otherwise matched on postcode

Note: FF are not presented in this table as data were matched with AH inspections by FF's data management company

Animal Health data

Records were provided for 40,939 AH inspections, to 9790 locations that took place between 02/01/2003 – 31/12/2008 (Table 6). Missing or unusable values reduced the sample of complete records for analysis to 38,659.

Table 6. Number of locations, visits and inspections by country

	England	Wales	Scotland	Total
Number of locations	6886	1343	1561	9790
Number of visits	14735	2925	3542	21202
Number of inspections	29645	5042	6252	40939

The median number of animals present on each enterprise was 40 (IQR 11, 134) and the median number of animals inspected on each enterprise was 35 (IQR 10, 110). On 89% of inspections all animals present on the enterprise were inspected.

Number of AH inspections by certification category

The most common types of visits were complaint and 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 7).

Table 7. Number of AH inspections by certification category, year, country, enterprise and visit type

		Assured	Organic	Not certified	Total[1]
Year	2008	3072	275	6384	9613
	2007	1924	153	5460	7473
	2006	1062	99	4873	5997
	2005	977	96	4735	5772
	2004	900	72	4169	5107
	2003	765	95	3867	4697
Country	England	5027	531	22335	27736
	Scotland	2270	165	3812	6141
	Wales	1403	94	3341	4782
	Cattle				
Enterprise type[2]	Breeding beef	1565	135	5899	7541
	Calves	1444	81	2125	3602
	Dairy Cattle	803	47	1387	2215
	Growing cattle	1722	83	3085	4845
	Sheep	2569	190	6979	9641
	Pigs				
	Pig breeding	134	54	2212	2396
	Pig growing	199	40	1887	2118
	Poultry				
	Caged layers	10	*	417	427
	Broilers / breeders	56	41	906	999
	Ducks	6	6	732	744
	Geese	*	12	604	616
	Non caged laying hens	187	79	1481	1714
	Turkey	5	5	372	382
	Other species				
	Deer	*	3	132	135
	Goats	*	14	1270	1284
Visit type	Complaint	2235	200	7561	9915
	Elective	238	46	2809	3086
	Programmed	688	151	4286	5094
	Targeted	3069	191	11912	15065
	XC random	644	34	608	1268
	XC risk based	1826	168	2312	4231

[1] Sum of certified categories is greater than the total because many 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

The percent of inspections coded A, B, C and D was 37.1%, 35.6%, 20.2% and 7.1% respectively. The proportion of inspections coded A-D varied by year, country, visit and enterprise type with a trend for a higher prevalence in 2003-2006, Scotland and Wales, complaint or targeted visits, sheep, dairy cattle and breeding beef enterprises (Table 8). There was a trend for a higher prevalence of codes B, C and D in non certified enterprises compared with assured or organic enterprises (Tables 8 and 9).

Table 8. Number and percent of AH 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[2]	Complaint	2564	46.0	3729	67.4	2563	60.2	1343	26.4	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
	XC random	807	62.0	387	29.7	104	8.0	4	0.3	1302
	XC 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 [2]A small number of visits classified 'OTMS' (n=4) and 'Special'(n=14) were excluded from analysis of visit type due to the small numbers

Table 9. Number and percent of AH inspections to assured, organic and not certified enterprises coded C/D by year, country, enterprise and visit type

		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
	XC random	14	2.2	1	2.9	86	14.1
	XC risk based	106	5.8	8	4.8	436	18.9

*No data

Risk factor analysis

Pigs
There was a non significant trend for a reduced risk of code C/D in inspections to assured and organic pig enterprises compared with enterprises not certified by any of the participating schemes (Table 10). The reduction in risk was similar for the organic and assured groups; the confidence interval was smaller for the assured category due to the larger sample size.

Table 10. Four level logistic binomial model of the association between certification status and the proportion of AH inspection code C/D on pig enterprises adjusted by, inspection year, country, enterprise type, number of animals inspected and visit type

		OR	CI	
Certification status	Not certified	Ref		
	Assured	0.68	0.45	1.04
	Organic	0.76	0.38	1.53
Inspection year	2008	Ref		
	2007	0.96	0.73	1.27
	2006	0.93	0.69	1.27
	2005	1.01	0.75	1.37
	2004	1.25	0.93	1.69
	2003	**1.51**	**1.10**	**2.07**
Country	England	Ref		
	Scotland	**2.20**	**1.44**	**3.35**
	Wales	1.17	0.69	1.98
Enterprise type	Breeding pigs	Ref		
	Growing pigs	1.08	0.92	1.27
Number of animals inspected[1]	Category 1	Ref		
	Category 2	1.20	0.90	1.59
	Category 3	**1.42**	**1.08**	**1.89**
	Category 4	**1.63**	**1.23**	**2.17**
	Category 5	1.22	0.89	1.68
Visit type	Programmed	Ref		
	Elective	0.68	0.45	1.04
	Complaint	**4.09**	**3.11**	**5.37**
	Targeted	**3.27**	**2.51**	**4.26**
	XC risk based	1.30	0.82	2.07
	XC random	1.66	0.80	3.44
Random effects	County	0.23	0.08	
	Location	1.09	0.15	
	Enterprise	0.16	0.13	

Ref = reference category, Intercept = -2.4, [1]Categorised into quintiles.
Bold = certification scheme significantly different from the reference. n = 5414

Sheep

There was a reduced risk of code C/D in assured and organic sheep enterprises compared with enterprises not certified by any of the participating schemes (Table 11). The reduction in risk was very similar for both groups but was not statistically significant for the organic category probably due to the smaller sample size.

Table 11. Three level logistic binomial model of the association between certification status and the prevalence of AH inspection code C/D on sheep enterprises adjusted by inspection year, country, number of animals inspected and visit type

		OR	CI	
Certification status	Not certified	Ref		
	Assured	**0.59**	**0.51**	**0.67**
	Organic	0.64	0.40	1.01
Inspection year	2008	Ref		
	2007	1.09	0.93	1.29
	2006	**1.39**	**1.17**	**1.65**
	2005	**1.42**	**1.19**	**1.70**
	2004	**1.43**	**1.19**	**1.72**
	2003	1.17	0.97	1.42
Country	England	Ref		
	Scotland	**1.38**	**1.05**	**1.81**
	Wales	1.24	0.86	1.80
Number of animals inspected[1]	Category 1	Ref		
	Category 2	1.04	0.88	1.22
	Category 3	0.98	0.83	1.15
	Category 4	1.01	0.85	1.19
	Category 5	1.05	0.88	1.25
Visit type	Programmed	Ref		
	Elective	**0.45**	**0.29**	**0.71**
	Complaint	**3.92**	**3.00**	**5.11**
	Targeted	**2.27**	**1.73**	**2.97**
	XC risk based	1.04	0.74	1.48
	XC random	0.86	0.52	1.41
Random effects	County	0.17	0.04	
	Locations	0.65	0.07	

Ref = reference category, Intercept = -2.0, [1]Categorised into quintiles.
Bold = certification scheme significantly different from the reference. n=9641

Cattle

There was a significantly reduced risk of code C/D in assured and organic cattle enterprises compared with enterprises not certified by any of the study schemes (Table 12).

Table 12. Four level logistic binomial model of the association between certification status and the prevalence of AH inspection code C/D on cattle enterprises in England, Wales and Scotland adjusted by inspection year, country, enterprise type, number of animals inspected and visit type

		OR	CI	
Certification status	Not certified	Ref		
	Assured	**0.53**	**0.47**	**0.59**
	Organic	**0.34**	**0.21**	**0.56**
Inspection year	2008	Ref		
	2007	1.09	0.95	1.26
	2006	1.04	0.89	1.22
	2005	**1.32**	**1.12**	**1.55**
	2004	**1.51**	**1.29**	**1.81**
	2003	1.15	0.98	1.40
Country	England	Ref		
	Scotland	1.04	0.79	1.35
	Wales	0.99	0.67	1.46
Enterprise type	Breeding beef	Ref		
	Growing cattle	0.94	0.85	1.04
	Calves	**0.86**	**0.76**	**0.97**
	Dairy	**0.74**	**0.63**	**0.86**
Number of animals inspected[1]	Category 1	Ref		
	Category 2	1.08	0.94	1.25
	Category 3	1.15	1.00	1.33
	Category 4	**1.40**	**1.21**	**1.62**
	Category 5	**1.28**	**1.07**	**1.46**
Visit type	Programmed	Ref		
	Elective	1.11	0.67	1.83
	Complaint	**4.04**	**3.24**	**5.04**
	Targeted	**2.92**	**2.35**	**3.64**
	XC risk based	1.31	1.00	1.71
	XC random	0.72	0.48	1.09
Random effects	County	0.19	0.05	
	Locations	1.02	0.08	
	Enterprises	0.91	0.08	

Ref = reference category, Intercept = -2.2, [1]Categorised into quintiles. Bold = certification scheme significantly different from the reference. n=18203

Poultry

There was a reduced risk of code C/D in assured and organic poultry enterprises compared with enterprises not certified by any of the study schemes. The difference was statistically significant for assured enterprises in 2003-2008, but did not reach significance for organic enterprises. When only the data from 2008 were analysed there were just 27 inspections to organic poultry enterprises, all of which were compliant with welfare legislation. Therefore it was necessary to combine assured and organic enterprises in order to be able to calculate an odds ratio. In this combined category there was a significantly reduced risk of code C/D in certified enterprises compared with enterprises not certified by any of the participating schemes (Table 13).

Table 13. Four level logistic binomial models of the association between certification status and the prevalence of AH inspection code C/D on poultry enterprises in Britain from 2003-2008 and 2008 only adjusted by inspection year, country, enterprise type, number of animals inspected and visit type

		2003-2008[1] n=4887			2008[2] n=1018		
		OR	CI		OR	CI	
Certification status	Not certified	Ref			Ref		
	Assured	**0.44**	**0.24**	**0.82**			
	Organic	0.79	0.37	1.68			
	Any certification scheme[3]				**0.22**	**0.06**	**0.86**
Inspection year	2008	Ref			Ref		
	2007	1.01	0.70	1.46			
	2006	1.03	0.70	1.53			
	2005	0.94	0.63	1.39			
	2004	1.27	0.85	1.89			
	2003	**1.65**	**1.09**	**2.48**			
Country	England	Ref			Ref		
	Scotland	**2.50**	**1.64**	**3.83**	1.47	0.56	3.89
	Wales	0.70	0.32	1.55	0.37	0.09	1.58
Enterprise type	Broilers / breeders	Ref			Ref		
	Caged laying hens	**2.41**	**1.55**	**3.74**	1.96	0.58	6.69
	Non caged laying hens	1.03	0.72	1.47	1.15	0.44	3.05
	Ducks	0.95	0.62	1.46	0.93	0.33	2.64
	Geese	0.80	0.50	1.29	0.89	0.29	2.69
	Turkeys	0.99	0.60	1.62	1.00	0.30	3.29
Number of animals inspected[4]	Category 1	Ref			Ref		
	Category 2	0.98	0.68	1.41	0.96	0.49	1.87
	Category 3	1.14	0.79	1.65	0.90	0.42	1.94
	Category 4	**1.49**	**1.01**	**2.20**	1.30	0.58	2.90
	Category 5	1.03	0.66	1.60	1.09	0.34	3.51
Visit type	Programmed	Ref			Ref		
	Elective	**0.37**	**0.23**	**0.60**	1.90	0.43	8.49
	Complaint	**2.45**	**1.69**	**3.54**	**12.99**	**3.35**	**50.32**
	Targeted	**2.36**	**1.69**	**3.30**	**11.01**	**3.12**	**38.91**
	XC risk based	1.09	0.61	1.95	**5.30**	**1.43**	**19.60**
	XC random	2.23	0.96	5.16	**15.80**	**3.35**	**74.61**
Random effects	County	0.46	0.13		0.24	0.26	
	Locations	1.40	0.23		3.47	0.61	
	Enterprises	1.23	0.23		0.00	0.00	

Ref = reference category, [1] Intercept = -2.6, [2] Intercept = -3.8, [3] All participating poultry certification schemes grouped into one category, [4]Categorised into quintiles. Bold = certification scheme significantly different from the reference category

Selection of holdings for inspection
The certification status of an enterprise was added to the Anderson model (Table 3) used by AH to select holdings for inspection.

Having controlled for time since last inspection, welfare code on the last three inspections, and for calves, mortality, there was a significantly lower risk of code C/D on assured or organic calf or pig and general livestock enterprises compared with enterprises not certified by any of the participating schemes (Table 14).

Table 14. Four level logistic binomial models of the factors included in the Anderson model plus certification status and the association with AH inspection code C/D on calf and pig and general livestock enterprises

		Calf[1] n=3602			Pig and general livestock[2] n=35057		
		OR	CI		OR	CI	
Certification status	Not certified	Ref			Ref		
	Assured	**0.40**	**0.32**	**0.50**	**0.57**	**0.52**	**0.62**
	Organic	**0.29**	**0.10**	**0.91**	**0.50**	**0.37**	**0.67**
Time since last inspection (years)	1	Ref			Ref		
	2	1.31	0.76	2.27	1.03	0.90	1.18
	3	0.66	0.30	1.46	1.10	0.89	1.35
	4	0.26	0.07	1.02	**0.67**	**0.49**	**0.91**
	5+ or never	0.58	0.21	1.61	**0.56**	**0.40**	**0.79**
Worst recorded welfare score on last three inspections	A	Ref			Ref		
	B	2.79	0.90	8.67	**1.49**	**1.28**	**1.74**
	C	1.53	0.80	2.93	**2.20**	**1.90**	**2.55**
	D	**2.43**	**1.36**	**4.34**	**3.16**	**2.70**	**3.71**
	No data available	**3.56**	**1.88**	**6.73**	**3.29**	**2.31**	**4.67**
Mortality rate[3]		**1.27**	**1.13**	**1.43**			
Random effects	County	0.23	0.08		0.18	0.04	
	Location	0.68	0.15		0.71	0.05	

Ref = reference category, [1]Intercept = -1.9, [2]Intercept = -1.8, [3]Tested for a linear relationship in quintiles. Bold = certification scheme significantly different from the reference

When the assured and organic categories combined were added to the Anderson model, there was a significant overall reduction in risk of code C/D for pigs and other livestock (OR 0.6, CI 0.5-0.6) and for calves (OR 0.4, CI 0.3-0.5), compared with inspections to enterprises not certified by any of the schemes (models not shown).

All schemes were also asked if they had made any major revisions to their standards during the time period covered in the data provided. However, no scheme provide answers to this query that could be included in the analysis perhaps because most schemes change their requirements by small increments.

Discussion
We conclude that once adjusted for other risks (enterprise type, visit type, year and country) membership of a farm assurance or organic certification scheme reduced the risk of non compliance with animal welfare legislation. The reduction in risk was similar for the organic and assured groups. We recommend that certification status could be included in the Anderson model.

It must be stressed that these results do not indicate that membership of a farm assurance or organic certification scheme improves animal welfare, rather that those farms within a scheme at the time of inspection were more likely to comply with welfare legislation. This could be because farmers who comply with the law are more likely to join a scheme or because the extra inspections improve compliance with legislation. To test whether membership of a scheme improves compliance with welfare legislation a study of farms joining and leaving schemes over time would be required. These results are retrospective and to be sure that scheme members are at continued lower risk of breaching welfare legislation a similar analysis will be needed in the future.

Assessment for compliance with welfare legislation and code does not provide a full picture of the welfare of the animals on the enterprise. Schemes that target higher welfare standards than those legally required are not differentiated by this analysis. For example, two laying hen enterprises, one using cages, one using a non caged system could both be assessed as compliant with animal welfare legislation and code (outcome A) by AH. The greater potential to express natural behaviour and experience higher welfare the non caged hens might experience is not captured within welfare legislation. This is particularly relevant for organic poultry and pig

production. Therefore when quoting results from this study it should be stated as ‘compliance with welfare legislation is greater’ not ‘welfare is better’.

Data on certification were provided by 15 / 18 of the targeted schemes. We do not know the accuracy of the data used in the current analysis but it will be of similar quality to that which AH would receive if these data were used in future risk models. We liaised closely with the schemes to ensure that we interpreted the data they provided us with correctly. The results from this analysis need to be interpreted in the knowledge that some schemes did not provide data for this research. Consequently, the reference category includes some enterprises that were certified by one of the non-participating schemes. If all certified enterprise could be identified, and if enterprises in these schemes followed a similar pattern to those in the participating schemes, it is likely that the differences in risk associated with certification status would be greater. However, it might be that the schemes that declined to participate in this study would also be unable to provide a list of certified members to AH to permit their classification in the risk based model therefore the models presented in this report might provide a good estimate of the likely effect that AH might expect in future.

Several of the large assurance schemes were only able to provide data for one or two of the six years of the study period. Animal health inspections that took place to members of schemes in years where membership data was not available will have been misclassified as not certified. Because the data were missing from the earlier years (2003-2007), when non compliance was higher overall, this misclassification might have resulted in the risk of non compliance associated with these schemes being underestimated.

Anderson risk model

Currently risk of non compliance with animal welfare legislation is calculated on time since last inspection, previous animal welfare outcome and for calves, mortality rate (Table 3). The results of our analysis indicate that the Anderson model could be improved by taking the certification status of the enterprise into account. To do this it would be necessary to assign a numerical value to certification status. Based on comparison of the odds ratios associated with the other factors in the model (Table 14) we would suggest a coding of certified = -50 and not certified = 0 might be appropriate. We would be happy to discuss this area further with AH if the decision is made to include this variable in the risk model.

It should also be noted that in the models we present (Table 14) the risk of non compliance tends to reduce with increasing time since last inspection while, in the Anderson model, risk increases as time since last inspection increases (Table 3). It may be that inclusion of this variable in the Anderson model also requires further scrutiny.

Feedback from participating schemes

All participating schemes were contacted by letter, followed up with a phone call offering them a visit from The University to present results from this study. Two schemes declined a visit and preferred to receive the results as a report followed up with a phone conversation. Warwick visited all other schemes at their premises. Each scheme was provided with a presentation explaining the background to the project and presenting aggregate results by certification category and confidential results for their individual scheme.

These meetings / phone discussions provided an opportunity to raise with the schemes the possibility of AH using scheme membership in the future in the Anderson risk model. All schemes were made aware that the inclusion of certification membership within the risk model would not mean that none of their members were inspected, rather that it would reduce the risk. All participating scheme representatives were extremely positive about this AH proposal and keen to work with AH to take this forward. Schemes are already sharing their membership details with other agencies in a number of ways. Reuse of these data or using data in the same or a similar format would reduce the potential administrative burden for schemes and scheme representatives were keen that these avenues should be explored. Organic scheme representatives drew attention to the membership data they provide for Defra on a monthly basis. Scottish schemes are involved in a project with the Food Standards Agency (FSA), where enterprise certification is used in the risk model to select farms for inspection each month. This works by FSA providing the scheme with a list of CPH numbers which the scheme sorts into ‘assured’ or ‘not assured’ and returns. Additionally current ABP, ACP, ABM, ADF, FAWL, GQA and LQ membership records are available on online certification checkers (not all data freely available to the public). Expanding one of these databases to encompass other schemes might provide a route for compiling the data AH requires.

We would recommend that all schemes ensure they record CPH number with their membership records as this is likely to substantially reduce the difficulty of matching membership records to AH inspection records.

Issues around the data confidentially agreement schemes hold with their members were discussed. Several scheme representatives indicated they would need to check exact details with their data managers, but none thought data protection restrictions were likely to pose a significant problem as they were at liberty to pass on membership details if it is in their members best interests.

No scheme was complacent regarding the proportion of their members that had not complied with welfare law and most commented that the information this study had provided was beneficial in targeting areas where their members needed to improve. As highlighted above there will be a need to repeat this analysis to determine if certification continues to be associated with a lower risk of non compliance in future years. It was suggested by several of the scheme representatives that it would be beneficial if results from these future analyses (aggregated to prevent individual members being identified) were fed back to scheme providers.

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References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.

A paper will be submitted for publication, interested parties are recommended to contact Laura Green laura.green@warwick.ac.uk for progress on this article

This report was presented to the cost and responsibility sharing group