

Farm membership of voluntary welfare schemes results in better compliance with animal welfare legislation in Great Britain

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Abstract

The Action Plan of the European Commission 2006–2010 proposed a move towards more private and less state regulation of animal welfare and Great British (GB) Governments made a commitment to reduce the burden of inspection of farms by targeting high-risk enterprises. In previous research in GB, farmers in private, voluntary regulated schemes were more compliant with GB legislation and code at statutory welfare inspections made by the Animal and Plant Health Agency (APHA) than farmers not in such schemes. The current study investigated whether membership of other private voluntary regulators and national data sources were associated with greater compliance with welfare at APHA inspections and whether the previous association between greater compliance and membership of private schemes persisted. Compliance at APHA inspections remained higher on farms in the private schemes previously investigated. It was also higher in the one retailer and seven herd health schemes investigated. There was no association between non-welfare EU cross-compliance inspections and compliance at APHA inspections. Approximately 90% of farmers in a scheme passed animal welfare inspections compared with 80% of non-scheme members. We conclude that farms in private schemes are more likely to pass APHA inspections and so this criterion can be used in selection of farms for risk-based inspection. We hypothesise that private regulation with regular inspection of all farms could raise compliance with animal welfare legislation to at least the minimum legal standards, however, it could result in animals with low welfare being concealed; consequently, this hypothesis requires testing.

Keywords: animal welfare, farm animals, government legislation, herd health scheme, inspections, private regulation

Introduction

In the European Union, the welfare of farmed animals is regulated by legislation at EU and region levels (Lundmark *et al* 2014). In Great Britain, the welfare of farm animals is legislated by the Animal Welfare Act 2006 (and Animal Health and Welfare [Scotland] Act 2006), supplemented in England, Scotland and Wales by The Welfare of Farmed Animals Regulations (with amendments) and codes. The Animal and Plant Health Agency (APHA, formerly AHVLA) carries out animal welfare inspections in GB on behalf of English, Scottish and Welsh Governments and in compliance with the EU, to investigate compliance with animal legislation and code. Approximately 2,000 farms (1%) are inspected per annum. The reasons for inspection vary and include, for example, targeted inspections (eg after stocking a farm), because of a complaint from the public, where there was a previous non-compliant inspection and random inspections (Table 1). Those that fail inspections can be prosecuted or given time to rectify an infringement.

A proportion of farmers (claimants) receive payments from the rural payment schemes in GB because of compliance with statutory management requirements (SMR) and good agricultural and environmental conditions (GAEC).

Payment for these schemes comes via the EU and since 2007 the EU has required that 1% of claimants under these schemes are inspected to monitor cross-compliance (Defra 2015). Claimants that breach regulations have reduced payments, and may also be prosecuted.

In many countries, farm animal welfare is partly privately regulated by voluntary schemes where members have to adhere to standards to retain membership. These are typically farm assurance and organic certification schemes, for example: Red Tractor, Neuland, Global Gap, Ecocert and The Soil Association (Bock & Huik 2007; Lundmark *et al* 2014). In GB, all farms within such a scheme are inspected regularly, typically annually, and by an independent certification body to ensure that members comply with scheme standards. Some farms are also in a retailer scheme. The standards are typically not published and auditing of these schemes is internal to the company.

The Action Plan of the European Commission 2006–2010 has proposed a vision of a move towards more private and less state regulation of animal welfare (Lundmark *et al* 2014). In GB, there is evidence that compliance with animal welfare legislation, as assessed by APHA inspection, was almost two-fold higher on farms regulated by private assurance schemes or organic certification standards with

Table 1 Animal and Plant Health Agency reasons for inspection of farms for compliance with animal welfare legislation.

Visit type	Definition
Complaint	Any complaint or allegation where a veterinary risk assessment indicates there may be unnecessary suffering
Targeted	Any inspection where there is reason to believe that an offence may be found, other than a complaint. Can include follow up to a previous visit where a problem was found, or as a result of information received from a reliable source, abattoir tracing (Food Standards Agency), or market tracing, which indicates a problem on-farm
Programmed	Any visit requested centrally by the Specialist Service
<i>Cross compliance (XC) visit types (to subsidy claimants)</i>	
XC Random	Cross-compliance random selection
XC Risk-based	Cross-compliance selection using risk model
XC Targeted	Any other reason for visiting a XC location (other than complaints which may be classed as a complaint rather than XC targeted)
<i>Other visit types</i>	
Elective/OTMS/ Special	Any other visit when there was no prior reason to suspect an offence. For example, visits can be carried out when inspectors are on the farm for another purpose, eg TB test. Visits can also be requested by the farm. OTMS - originally this was triggered by the over thirty month scheme under the bovine spongiform encephalopathy legislation, now used as an other code

external auditors and published standards than farms not known to be in such schemes (KilBride *et al* 2012).

The European Commission regulation EC No. 882/2004 states that risk-based methods should be used to determine the frequency of official inspections at a farm. In addition, GB Governments have stated a commitment to reduce the burden on farmers from government-led inspections (Defra 2014). One method to achieve this is to use risk-based methods to target a proportion of inspections to farms most at risk of non-compliance, thus reducing the number of inspections to farmers who are more likely to be compliant. Membership of a private scheme was added to the risk model from 2012 as a result of KilBride *et al* (2012). The outcome of previous APHA welfare inspection and on-farm cattle mortality (for calf inspections only), calculated from the national database of cattle movements, have been included in the algorithm to select farms for risk-based APHA inspections since 2006.

Farm assurance and organic schemes only sometimes have a specific focus on animal welfare, and yet membership of such schemes was associated with greater compliance at APHA inspections. It is, therefore, possible that other schemes or sources of data, not specifically related to welfare, are associated with greater compliance at APHA welfare inspections and could therefore be included in selection of farms for risk-based inspections (Defra 2011). As a result of a public consultation, Defra initiated research to investigate whether more private regulators might be associated with compliance with animal welfare and code at APHA inspections (Defra 2011). After public consultation and discussion between Defra and researchers at Warwick, UK it was agreed that more schemes and data sources should be investigated for association with APHA welfare

inspections. Eligible private regulators could include any scheme with published standards and external audit, retailer schemes or herd health schemes where farmers are paying for testing to improve animal health. Other national data sources available included non-welfare related data from the Rural Paying Agencies (Defra 2011) who inspect for statutory management requirements (SMRs) and good agricultural and environmental conditions (GAECs) that cover farm and land management compliance. These could be an indicator of overall conscientiousness (Gambelli *et al* 2014) of a farmer and thus also related to compliance with welfare legislation while data from the Food Standards Agency on abnormalities in animals recorded in abattoirs could provide a direct animal-based measure of on-farm welfare.

The aims of the current study were therefore to investigate whether other voluntary, privately regulated schemes and other sources of national data were associated with increased compliance at AHPA welfare inspections and to investigate whether the greater compliance with APHA inspections observed with membership of farm assurance and organic certification schemes persisted from 2008.

Materials and methods

Ethical approval was granted by the Biomedical and Scientific Research Ethics Committee, University of Warwick, UK (REGO-2014-617). A data-sharing agreement was made with all participating schemes, the paying agencies and Defra. The agreement covered data confidentiality and security. All data were held at the University of Warwick and datasets were protected by password authentication and data encryption, and names, addresses and CPH numbers used to match datasets were replaced with unique identification codes to anonymise the data before analysis.

Sources of data

Animal and Plant Health Agency welfare inspections

Animal and Plant Health Agency (APHA) inspect enterprises to assess compliance with welfare legislation and code. Reasons for inspection are described in Table 1. For each enterprise up to 12 areas of inspection (AoI) are made. These are breeding, disease, environment, equipment, freedom of movement, feed and water, housing, inspections, mutilations, record-keeping, space and staffing. The number of AoI assessed varies by reason for inspection; typically all enterprises and all AoI are assessed during cross-compliance, risk-based and random inspections. Compliance with animal welfare legislation and code is scored for each AoI as (A) full compliance with legislation and code, (B) compliance with legislation but not code, (C) failure to comply with legislation but no unnecessary suffering seen and (D) unnecessary suffering seen. The worst score across all AoIs at a visit to an enterprise is used as the overall score for that visit to that enterprise. Inspections that score A or B are classed as compliant with legislation and C or D as non-compliant.

APHA provided inspection records for all animal welfare inspections to enterprises in England, Scotland and Wales between 2007 and 2013. The data contained the date of inspection, enterprise type, farm (name, address, and county parish holding [CPH] number), reason for inspection, number of animals present and inspected and the score for each AoI inspected.

Farm assurance, organic certification, herd health and retailer schemes

Known schemes were contacted. These were ten farm assurance and six organic certification schemes with published standards, ten retailers thought to have farms in their buying scheme, seven herd health and three milk recording schemes. There were no eligible herd health schemes active for pig or poultry enterprises. All schemes, and preferably a named contact, were contacted by email or telephone. The eligibility criteria for inclusion in the study were that they had external standards or activities (eg milk quality, testing for disease) that members actively engaged in which could be associated with good animal welfare, that all enterprises in the scheme were inspected or tested at least biennially, ie every two years, and that the scheme was willing to provide a list of all members. After an initial discussion on the project and eligibility, schemes were contacted at approximately 14-day intervals until they decided whether to participate.

Schemes were asked to provide membership records from 2006–2013, including: name, address, postcode, CPH number, joining date, leaving date and any periods of non-continuous certification (eg temporary suspension) of members.

Cross-compliance inspections under rural paying agencies

Farmers can claim grants and payments from one of the three rural paying agencies in England, Scotland or Wales when they comply with various conditions under the basic payment scheme, stewardship scheme or rural development scheme (Defra 2015). To be eligible for payment a farmer

has to comply with a long list of rules (see the 80+ page document; Defra 2015). Each year, 1% of cross-compliance inspections conducted concern animal management (eg animal identification and registration), including the management of wild animals (Supplementary Table 1 [see supplementary material to papers published in *Animal Welfare* on the UFAW website: <http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material>]). Each paying agency provided inspection records from 2006 to 2013. A list of all claimants' farm locations from 2007 to 2013 was also supplied. Breaches are recorded by intent (negligent, intentional), extent (on or off farm), severity (minimum to very high), permanence (rectifiable, permanent) and repetition within the previous three years (first offence, second offence etc). These are used by the agencies to calculate any penalty. The data were coded as: inspected and no breach, inspected and at least one breach or not inspected (no match for farm identity within one year prior to an APHA inspection). A single measure to capture the most severe breaches was created, defined as intentional, off-farm, medium to high severity, permanent, and second occurrence or more.

All data were available for England. For Scottish and Welsh Governments' data, breaches were recorded but not all non-breaches. It was assumed that when a farm was inspected, all GAECs were inspected.

Abnormalities detected at abattoirs

The Food Standards Agency (FSA) provided data on ante and post mortem conditions. No data were available for sheep by farm. Data were available for cattle from July 2012 to July 2013 for the date of slaughter, producer name and CPH number, number of animals slaughtered, number of each abnormal condition and number of carcasses rejected. Data were available for pigs from January 2011 to December 2013. The pig data were by week rather than date of slaughter. Data were available for poultry from July 2010 to December 2013 by week of slaughter, species (broiler, duck, geese, guinea fowl, hen, quail, rabbit, turkey, and 'other'), number dead on arrival, number slaughtered, number with condition, producer name and postcode (and sometimes CPH). There were 443, 218 and 126 possible abnormalities for pigs, cattle, and poultry, respectively.

Cattle mortality

Records of all cattle movements were obtained from the British Cattle Movement Service from 2006 to 2013. On-farm cattle mortality was defined as cattle coded as dead whose last movement was onto a farm. Mortality was calculated per farm per 1,000 live cattle days in the 12 months preceding a welfare inspection.

Data matching with APHA welfare inspections

Data from all sources were cleaned and screened for errors and inconsistencies to maximise the information available whilst maintaining accuracy. CPH numbers and postcodes were normalised to standard formats using automated methods. CPH numbers were the preferred method of matching between data but where CPH did not result in a match (or where CPH was missing), postcodes and

addresses were used. To avoid mismatching neighbouring farms with the same postcode, the postcode had to match with the first line of the farm address within two edits. Data were matched at farm level rather than enterprise level.

Membership joining and leaving dates were used to determine whether a farm was a member of a scheme at the time of APHA inspection. Herd health schemes that did not use joining and leaving dates provided test dates and farms were considered active in a herd health scheme when a test was within two years before the APHA inspection.

Statistical analysis

Data were screened and descriptive analysis was used to summarise the data. Farms were coded as known to be in a participating scheme or not known to be in that scheme. Where schemes did not participate all farms were not known to be in the scheme. Schemes were coded into farm assurance and retailer (F), organic certification (O), and herd health and milk quality (H) and the number of scheme types (maximum three: F, O and H) that a farm was known to be a member of at the time of inspection was calculated. The number of animals inspected within an enterprise was categorised by quintile (Supplementary Table 2 [see supplementary material to papers published in *Animal Welfare* on the UFAW website: <http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material>]). The least frequently inspected enterprises were combined to an 'other' category.

Multivariable multilevel binomial logistic regression models

For each inspection to an enterprise, the overall score was coded into a binary outcome variable of compliant (AB) or non-compliant (CD). This was the outcome variable for all models. A 4-level mixed effects binomial logistic regression model was used to investigate associations with compliance with APHA inspection at a visit to an enterprise from 2007 to 2013 using MLwiN 2.34 (Rasbash *et al* 2009). The model took the form:

$$\text{Logit}(p_{ijkl}) = \beta_0 + \sum \beta x_{ijkl} + \sum \beta x_{ijk} + \sum \beta x_{jk} + \sum \beta x_k + f_1 + v_{lk} + u_{ijk}$$

Where p_{ijkl} is the probability of CD at an inspection, β_0 is a 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 farm and l is county, with $f_1 + v_{lk} + u_{ijk}$ being the residuals at county, farm and enterprise level, respectively. Level 1 variance (ijkl) was constrained to a binomial distribution. Significance was defined as $P \leq 0.05$ using Wald's statistic.

Separate models were built for England, Wales and Scotland, claimant and non-claimant farms, risk-based inspections only and inspections from 2010 to 2013. The model fits were explored using Hosmer-Lemeshow goodness-of-fit tests.

Results

Descriptive analysis

Records were provided for 55,025 APHA inspections from 2007–2013. Missing, duplicated or unusable values reduced the number of complete records to 54,201 inspections to 32,945 enterprises on 11,800 farms. There were 20,174 (37%), 23,439 (43%), 8,364 (15%) and 2,224 (4%) inspections that scored A, B, C and D, respectively. Of the 32,945 enterprises, 73.8% were inspected once only and 94.6% of one-off inspections were compliant; this accounted for 42.4% of all inspections. The number and percentage of inspections by score is presented in Table 2. The proportion of non-compliant inspections by explanatory variables is presented in Supplementary Table 3 (see supplementary material to papers published in *Animal Welfare* on the UFAW website: <http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material>). A higher percentage of farms in schemes scored A for AoI staffing, inspection of livestock, disease, records, housing, environment, freedom of movement, breeding (Supplementary Table 4 [see supplementary material to papers published in *Animal Welfare* on the UFAW website: <http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material>]). The visit type to claimants and non-claimants of rural payments varied from 2008, eg non-claimants had proportionally fewer random visit types.

Scheme membership

Data were provided by 9/10 farm assurance schemes, 5/6 organic certification schemes, 5/7 herd health schemes, 2/3 milk-recording schemes, and 1/10 retailer scheme. Data quality from most of these eligible schemes was good; most were missing a small number of CPH identifiers and dates when farmers joined the scheme. Discussion with scheme managers was used to determine whether farms with missing joining dates had been in the scheme since 2006 or had joined at a later date that was identified by the scheme. Where this assumption could not be reasonably made, farms were considered non-members. Two schemes provided lists of members by calendar year rather than joining and leaving dates. Three schemes could not provide any dates before 2009 and two could only provide data from 2011. Almost all farm assurance and organic certification schemes did not keep, or could not extract, historical records of temporary suspensions. Of the farms in farm assurance schemes (F), 4.1% were also in organic schemes (O) and 15.1% were in a health scheme (H); whilst 51.0% of O members were in F schemes, and 19.0% were in an H scheme; and 60.7% and 6.1% of H members were also in F and O schemes, respectively.

Paying agencies cross-compliance inspections

The most common reason for non-welfare animal cross-compliance inspections were ear-tag identification for cattle and sheep in England, Scotland and Wales, data not shown, with 15–65% inspections coded as a breach in compliance with these SMRs.

Table 2 Number (N) and percentage (%) of 54,201 overall score for welfare inspections by the Animal and Plant Health Agency between 2007 and 2013 by explanatory variables.

Scheme membership		A	B	C	D	Total
		N (%)	N (%)	N (%)	N (%)	N
Farm assurance	No	13,643 (34.0)	17,466 (43.6)	7,197 (17.9)	1,798 (4.5)	40,104
	Yes	6,531 (46.3)	5,973 (42.4)	1,167 (8.3)	426 (3.0)	14,097
Organic certification	No	19,578 (36.9)	22,935 (43.3)	8,299 (15.7)	2,201 (4.2)	53,013
	Yes	596 (50.2)	504 (42.4)	65 (5.5)	23 (1.9)	1,188
Herd health	No	18,325 (36.3)	21,874 (43.3)	8,124 (16.1)	2,162 (4.3)	50,485
	Yes	1,849 (49.8)	1,565 (42.1)	240 (6.5)	62 (1.7)	3,716
Year	2007	3,100 (39.6)	2,806 (35.8)	1,498 (19.1)	433 (5.5)	7,837
	2008	3,575 (35.5)	4,246 (42.1)	1,829 (18.1)	430 (4.3)	10,080
	2009	3,331 (33.8)	4,660 (47.3)	1,485 (15.1)	368 (3.7)	9,844
	2010	2,949 (40.1)	3,252 (44.2)	875 (11.9)	286 (3.9)	7,362
	2011	2,201 (37.5)	2,622 (44.6)	839 (14.3)	213 (3.6)	5,875
	2012	2,488 (39.8)	2,798 (44.8)	775 (12.4)	186 (3.0)	6,247
	2013	2,530 (36.4)	3,055 (43.9)	1,063 (15.3)	308 (4.4)	6,956
Country	England	13,136 (35.7)	16,521 (44.9)	5,725 (15.6)	1,419 (3.9)	36,801
	Scotland	3,484 (35.3)	4,356 (44.1)	1,710 (17.3)	333 (3.4)	9,883
	Wales	3,554 (47.3)	2,562 (34.1)	929 (12.4)	472 (6.3)	7,517
Reason for visit	XC random	2,849 (60.0)	1,657 (34.9)	235 (5.0)	6 (0.1)	4,747
	XC risk-based	8,058 (49.2)	6,748 (41.2)	1,384 (8.4)	193 (1.2)	16,383
	XC targeted	497 (14.3)	1,113 (32.0)	1,346 (38.7)	526 (15.1)	3,482
	Compliant	1,514 (21.2)	3,479 (48.7)	1,524 (21.3)	625 (8.8)	7,142
	Targeted	3,243 (20.6)	8,069 (51.2)	3,591 (22.8)	849 (5.4)	15,752
	Programmed	2,685 (61.6)	1,500 (34.4)	170 (3.9)	5 (0.1)	4,360
	Elective	1,072 (62.4)	585 (34.1)	47 (2.7)	13 (0.8)	1,717
	OTMS	254 (43.4)	258 (44.1)	66 (11.3)	7 (1.2)	585
	Special	2 (6.1)	30 (90.9)	1 (3.0)	0 (0.0)	33
SPS claimant	No	5,376 (35.6)	5,931 (39.3)	3,031 (20.1)	755 (5.0)	15,093
	Yes	14,798 (37.8)	17,508 (44.8)	5,333 (13.6)	1,469 (3.8)	39,108
Enterprise	Calves	2,890 (39.8)	3,183 (43.9)	988 (13.6)	194 (2.7)	7,255
	Cattle growing	2,886 (35.9)	3,637 (45.2)	1,278 (15.9)	249 (3.1)	8,050
	Dairy cattle	1,093 (38.4)	1,278 (44.9)	304 (10.7)	174 (6.1)	2,849
	Beef breeding	3,203 (32.8)	4,301 (44.1)	1,753 (18.0)	497 (5.1)	9,754
	Sheep	3,680 (33.5)	4,946 (45.0)	1,681 (15.3)	691 (6.3)	10,998
	Caged hens	26 (19.5)	58 (43.6)	38 (28.6)	11 (8.3)	133
	Broiler breeder	204 (33.3)	295 (48.1)	92 (15.0)	22 (3.6)	613
	Ducks	451 (45.9)	395 (40.2)	125 (12.7)	12 (1.2)	983
	Geese	391 (46.4)	349 (41.4)	93 (11.0)	9 (1.1)	842
	Other layers	968 (45.5)	832 (39.1)	304 (14.3)	24 (1.1)	2,128
	Turkeys	233 (47.1)	197 (39.8)	58 (11.7)	7 (1.4)	495
	Pigs: breeding	887 (32.5)	1,120 (41.1)	586 (21.5)	133 (4.9)	2,726
	Pigs: growing	1,038 (34.0)	1,287 (42.2)	617 (20.2)	111 (3.6)	3,053
	Wild boar	17 (63.0)	6 (22.2)	4 (14.8)	0 (0.0)	27
	Rabbits	310 (65.5)	147 (31.1)	15 (3.2)	1 (0.2)	473
	Ratites: ostriches	56 (60.2)	27 (29.0)	10 (10.8)	0 (0.0)	93
	Deer	80 (52.3)	64 (41.8)	9 (5.9)	0 (0.0)	153
	Goats	699 (45.1)	595 (38.4)	210 (13.5)	47 (3.0)	1,551
	Horses	561 (48.7)	428 (37.2)	138 (12.0)	25 (2.2)	1,152
	Other	501 (57.4)	294 (33.7)	61 (7.0)	17 (1.9)	873
Enterprise size (quintile)	≤ 20%	3,981 (40.1)	4,180 (42.1)	1,467 (14.8)	295 (3.0)	9,923
	> 20–40%	4,062 (37.1)	4,764 (43.5)	1,736 (15.9)	382 (3.5)	10,944
	> 40–60%	3,810 (35.5)	4,682 (43.7)	1,791 (16.7)	437 (4.1)	10,720
	> 60–80%	3,974 (34.7)	4,923 (43.0)	1,939 (16.9)	622 (5.4)	11,458
	> 80–100%	4,298 (39.0)	4,819 (43.7)	1,413 (12.8)	486 (4.4)	11,016

Score A = compliance with legislation and code, B = compliance with legislation but not code, C = non-compliance, no animal suffering seen, D = non-compliance, animal suffering seen.

Table 3 Mixed effects binomial logistic regression model of non-compliance (score C or D) at 54,201 inspections by the Animal and Plant Health Agency between 2007 and 2013.

		Odds Ratio	Lower and upper 95% Confidence Intervals	
Scheme membership	Not a member	Ref*		
	Farm assurance**	0.57	0.51	0.63
	Organic certification	0.49	0.34	0.70
	Herd health	0.55	0.45	0.67
Year	2007	1.81	1.60	2.05
	2008	1.60	1.41	1.80
	2009	1.20	1.06	1.35
	2010	Ref		
	2011	0.91	0.79	1.05
	2012	0.82	0.71	0.95
	2013	0.95	0.83	1.10
Country	England	Ref		
	Wales	1.03	0.70	1.54
	Scotland	1.20	0.92	1.55
Visit reason	XC random	Ref		
	XC risk	1.45	1.22	1.71
	XC targeted	6.14	5.10	7.40
	Complaint	3.72	3.13	4.42
	Targeted	2.12	1.79	2.51
	Programmed	0.81	0.63	1.03
	Elective/special	0.73	0.54	0.98
Claimant	OTMS	2.61	1.84	3.71
	No	Ref		
Enterprise	Yes	0.69	0.62	0.76
	Cattle: growing	Ref		
	Calves	0.89	0.80	0.99
	Beef: breeding	1.09	0.99	1.20
	Dairy cattle	1.03	0.88	1.21
	Sheep	1.14	1.04	1.26
	Battery hens	2.00	1.16	3.44
	Broilers/breeders	1.03	0.76	1.38
	Ducks	0.86	0.68	1.09
	Geese	0.78	0.60	1.02
	Turkeys	0.78	0.55	1.10
	Other layers	0.85	0.72	1.01
	Pigs: breeding	1.24	1.08	1.44
	Pigs: growing	1.20	1.04	1.38
	Wild boar	0.78	0.20	2.96
	Goats	0.93	0.77	1.13
	Horses	0.79	0.63	0.99
	Rabbits	0.55	0.36	0.84
	Deer	0.64	0.33	1.25
	Ratites/ostriches	0.94	0.44	2.00
	Other species	0.81	0.62	1.05
Enterprise size (quintile)	≤ 20%	Ref		
	> 20–40%	1.08	0.99	1.19
	> 40–60%	1.17	1.06	1.28
	> 60–80%	1.25	1.13	1.38
	> 80–100%	1.22	1.09	1.35
Random effects (Mean, SD)	Intercept	–2.60	0.13	
	County	0.21	0.05	
	Location	2.59	0.07	
	Enterprise	0.00	0.00	
	N	54,061		

Ref*, reference category with OR = 1. Bold text indicates significant difference (Wald test; $P < 0.05$) between category and reference.
 ** Each membership category added independently to model with reference category not being a member of that type of scheme.

Table 4 Number of scheme types (farm assurance, organic certification, health scheme) and compliance at Animal and Plant Health Agency inspections.

Number of scheme types	A N (%)	B N (%)	C N (%)	D N (%)	Total	OR*	Lower and upper 95% CI	
One	6,099 (45.9)	5,661 (42.6)	1,125 (8.5)	412 (3.1)	13,297	0.53	0.47	0.58
Two	1,311 (50.1)	1,087 (41.6)	172 (6.6)	45 (1.7)	2,615	0.36	0.29	0.46
Three	85 (53.8)	69 (43.7)	1 (0.6)	3 (1.9)	158	0.14	0.04	0.51
None	12,679 (33.3)	16,622 (43.6)	7,066 (18.5)	1,764 (4.6)	38,131		Baseline	

* Odds ratio and 95% confidence intervals (CI), from logistic binomial mixed effect model with outcome compliant (AB) non-compliant (CD) adjusted for inspection year, country, visit reason, claimant status, enterprise type and size, and accounting for repeated inspections within enterprises, within farms, and within county. Bold text indicates significant difference (Wald test; $P < 0.05$) from baseline, not known to be in a scheme.

Abattoir data

There were 15,239 cattle, 10,993 pigs and 7,733 poultry producers in the FSA data. Only 2.5, 0.9 and 2.5%, respectively, matched to APHA animal welfare inspection data. The small number of matches indicated that the data were not representative and so these were not tested in the model.

Multivariable model of variables associated with compliance with animal welfare legislation

In the multivariable model there was a significantly reduced risk of non-compliance if a farm was a member of any scheme type at the time of inspection compared with farms not known to be in a scheme (Table 3). Non-claimants had a higher risk of non-compliance compared with claimants. Non-compliance was higher when more animals were inspected than the smallest quintile of animals. There was an increased risk of non-compliance before 2010, and for risk-based, targeted and complaint visit types (Table 3). There was no association between non-welfare EU cross-compliance inspections and compliance at APHA inspections. Sub-models did not vary from the main model, with the exception of loss of power, and are not presented. The model fits were good. After adjustment for all other variables in the model (Table 3), members of more than one scheme type had a greater reduced risk of non-compliance (Table 4).

Discussion

As hypothesised, membership of voluntary, privately regulated schemes other than quality assurance and organic certification was associated with an increased compliance with APHA welfare inspections. In addition, farmers in farm assurance (including one retailer) and organic schemes continued to be more compliant with APHA inspections as first reported by KilBride *et al* (2012). Non-compliance halved from approximately 20 to 10% of inspections for farms in at least one scheme and, in particular, animal suffering was recorded at less than 2% of inspections. For farms in several scheme-types compliance was even greater (Table 4). It is worth noting that the baseline category 'not known to be a member of the scheme' is likely to include

some farmers that were scheme members, both in schemes that participated in the current study and in schemes that did not participate, consequently, the odds ratios are likely to be even more protective for scheme members than those presented. These findings are discussed below.

Our findings suggest that the vision of a move towards more private regulation of animal welfare (Lundmark *et al* 2014) is possible, at least in part. One explanation for greater compliance with APHA inspections for farmers within F and O scheme types is that farmers already complying with scheme codes become members of such schemes. For farmers where there is a financial incentive to be in a scheme to gain market access, then the scheme might be driving farmer behaviour; farmers have referred to such scheme membership as a 'necessary evil' (Hubbard *et al* 2007). However, many farmers report that a commitment to improved welfare and stewardship is their main reason for scheme membership, particularly schemes with standards that are more rigorous than government legislation and organic schemes (Bock & Huik 2007; Lundmark *et al* 2014). Such farmers might be compliant with government legislation and seek out membership of private schemes that match their ethos.

Greater compliance with welfare codes in farms in schemes persisted from the first study (KilBride *et al* 2012) to the current analysis. Again, this might be because of market forces or farmer ethos and management, but it might also be explained by the relatively short interval between inspections (typically all members are inspected annually for schemes that participated in the current study) that assist in maintaining welfare standards. In addition, private schemes included in the current analysis have clear guidelines for compliance. The recent discussion on whether to change statutory farm animal welfare codes to industry-led, non-statutory guidance (Defra 2015) so that codes can be written 'in a way which [farmers] can relate to', might lead to clear guidance so that farmers understand their responsibility for their livestock and implement welfare codes more easily. This, in turn, might raise compliance at APHA welfare inspections.

If more compliant farmers choose to be in private schemes then they are a valuable indicator for risk-based inspection of farms. If there is a causal relationship and all farms inspected annually raise/maintain animal welfare standards then this raises the hypothesis that if all farms were provided with clear guidance for compliance and inspected annually by independent auditors, similar to that required for F and O schemes, compliance at welfare inspections by APHA might be even greater. This hypothesis would have to be tested, but it might suggest some form of licensing and inspection of all livestock farms would remove the few farmers that repeatedly fail APHA inspections; something that many farmers and industry would welcome (L Green, personal communication from sheep farmers 2011). Alternatively, compulsory licensing might drive farmers to conceal poor welfare, eg by keeping animals they do not want inspected on land away from the farm if an inspection is planned, and so impact animal welfare negatively.

One hypothesis for greater compliance with welfare inspections on farms in herd health schemes is that these farmers are interested in the control of specific diseases or whole herd/flock health-planning. Farmers are paying to receive data on, eg blood tests for disease prevalence or milk quality tests and so farmers are, presumably, acting on the results of tests and so raise the standard of animal health (Statham 2011a,b). This is a growing sector in cattle farming, with recent estimates of 14% of cattle holdings in a herd health scheme (Brigstocke 2012). Neglected disease is one of the AoI at APHA inspections and farms in herd health schemes were more likely to score A than C or D in this AoI (Supplementary Table 4; <http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material>).

Membership of multiple scheme types (F, O and H) led to even greater compliance with welfare legislation. This dose-effect adds weight to the proposal that membership of schemes can be used to identify farmers likely to be compliant at APHA inspections. Most schemes with higher than legislation standards require their members to be in basic-regulation schemes as well, or to show evidence of herd health planning, and it could be that the analysis is distinguishing this subset of farmers, although APHA inspections only target compliance with legislation and code and so it cannot be inferred that these inspections are able to identify schemes with higher welfare standards. It could also be a reflection of highly compliant farmers that are actively engaging in improving the health and welfare of their animals through all means available to them. One issue raised in the introduction was reducing the burden of AHPA inspection through targeted, risk-based inspection. It is important that farms are not receiving several inspections from other agencies in order to reduce the risk of an APHA inspection. Membership of F and O scheme types does not necessarily indicate more inspections. The auditors are trained to assess both F and O compliance at one inspection. Farmers in the one retailer scheme had two inspections per year from that retailer. These were additional inspections to the F and O inspection. The retailer schemes in GB are not

externally auditable; membership of retailer schemes was identified by stakeholders as a possible correlate to identify farmers more compliant with legislation and code because these schemes are positively marketed by retailers as indicative of good welfare. Ultimately, only one retailer participated in the study and the farms in this scheme did have greater compliance at APHA inspections. The other retailers did not reply to emails or telephone calls after 14 days. The reason for not participating is not known.

The lack of association between non-welfare animal-related SMRs and GAECs and compliance at APHA inspections might indicate that attention to detail (conscientiousness of farmers) to comply with non-welfare related regulations is not linked to greater compliance with welfare legislation. However, over 50% of matched records had a non-compliance with an SMR or GAEC, this high percentage might make these data too sensitive and insufficiently specific to detect an association with compliance with animal welfare where the average annual non-compliance was < 20%.

From 2008, the types of inspections to farms between claimants of government payments and non-claimants has differed. Whilst inspection type and other variables, eg number of animals inspected, were included in the model it is likely that other factors that distinguish claimant and non-claimant farms are present and so this variable might act as a marker for different farm types rather than different welfare standards.

The results from participating schemes indicate that, if membership changes behaviour, there is potential for private regulation, eg licensing of farms, to improve animal welfare (Albersmeier *et al* 2009). Private regulation and regular inspection of all farms is unlikely to reduce the burden on APHA to inspect some farms each year because there will always be a need for inspection from a government body; some farms in schemes still fail APHA welfare inspections (Tables 2 and 3), however, targeting of high-risk farms can be further improved using the new results from the current analysis (Table 3). To ensure that the national average level of compliance with animal welfare legislation and code is known, random visits to benchmark compliance with welfare legislation is still needed; indeed, it is vital information to benchmark GB and assess whether welfare standards are improving generally.

Animal welfare implications

The study demonstrates that compliance with GB on-farm welfare regulations is greater for farmers who are members of farm assurance (including one retailer), organic certification or herd health schemes compared with farmers not known to be in a scheme; and greater when farms are in more than one scheme. Whilst market forces, ethos and farm management might contribute to compliance, the participating schemes have clear guidelines and farms are inspected regularly at approximately one-year intervals and these facts might incentivise farmers to remain compliant. This raises two hypotheses; one: that voluntary membership of private schemes is improving animal welfare and should be further encouraged or; the alternative hypothesis:

that licensing of all livestock farms with private regulation and annual independent inspection might raise compliance with welfare legislation and codes. Given the small number of farms that can be inspected by APHA each year, exploration of both hypotheses would be useful to raise the welfare of livestock in GB. We conclude that the current risk-based model for APHA can be improved further by adding membership of herd health schemes and membership of multiple schemes.

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