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How do Flemish Laying Hen Farmers and Private Bird Keepers Comply with and Think about Measures to Control Avian Influenza?

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Simple Summary: Avian Influenza (AI) is an infectious disease and could lead to death, health problems, and economic losses. Therefore, this study aimed to gather information about the compliance with, and perceived effectiveness of, AI control measures (applicable during high-risk periods in Flanders, North of Belgium, in 2021) by professional laying hen farmers and private bird keepers. Overall, compliance was high among professional laying hen farmers, but much less so among private bird keepers. Among private bird keepers compliance and perceived effectiveness were lowest for confining the birds indoors, whereas for farmers it was lowest for placing nets over the free-range. This study highlights the need for information campaigns explaining to private bird keepers in particular the need for the various AI control measures imposed, for alternative control measures that have broader support, or for implementing stricter enforcement of the control measures.

Abstract: Competent authorities of many countries, including Belgium, impose control measures (preventing wild bird access to feeders and water facilities, indoor confinement of captive birds, or fencing off outdoor ranges with nets) to professional and non-professional keepers of birds to prevent the spread of avian influenza (AI). Flemish laying hen farmers (FAR, n = 33) and private keepers of captive birds (PRI, n = 263) were surveyed about their opinion on, and compliance with, AI-measures legally imposed during the most recent high-risk period before this survey in 2021. Participants answered questions on a 5-point Likert scale (1 = the worst, 3 = neutral, and 5 = the best). FAR indicated better compliance with the AI-measures compared to PRI, except for confinement with nets. PRI and FAR perceived the level of compliance with AI-measures by other private bird keepers to be lower compared to themselves. FAR regarded the AI-measures as more effective than PRI. To prevent the spread of AI more effectively, national authorities could focus on information campaigns explaining to private bird keepers, in particular, the need for the various control measures that they impose, implement alternative control measures that have broader support or implement stricter enforcement of the control measures.

Keywords: avian influenza; nets; confinement; poultry; self-evaluation

1. Introduction

Avian influenza (AI) is a contagious viral disease to which nearly all poultry species are susceptible, including chickens, ducks, geese, turkeys, pheasants, guinea fowl, quail, and partridges, but also mammals and carnivores 7. The most highly pathogenic subtypes of the AI virus cause severe

 doi:10.20944/preprints202407.1617.v1

disease symptoms (nasal and eye discharge, coughing, dyspnea, severe drowsiness, and diarrhea) and can be responsible for a mortality rate of up to 100% in infected poultry flocks [1,3,6]. Captive bird flocks can get contaminated with the AI virus through direct contact with contaminated wild birds, by consuming feed and water contaminated with the feces of wild birds, or by indirect transmission through human activity [7–9]. Especially wild migratory (water)birds seem to be the primary source of AI virus introduction in captive flocks [10–12]. Furthermore, to avoid the potential transmission of diseases between animals caused by human contact it is advisable to use hygiene measures known as hygiene locks [13]. This involves visitors who interact with farm animals wearing specialized clothing and footwear. Additionally, disinfectant footbaths are placed at the entrance of barns, handwashing is enforced, and access to the barns is restricted.

Infected poultry flocks cause substantial economic losses and are detrimental to the welfare of infected birds. Prevention of AI infection is, therefore, a priority during high-risk periods (e.g. wild bird migrations). The Belgian Government, like many other national authorities worldwide, stipulates preventive measures during such high-risk periods which (depending on the situation) apply to both non-professional and professional (e.g. farmers) bird keepers. These measures include indoor confinement of captive birds to avoid contact with wild birds, shielding off feed and water facilities from wild birds, prohibition of exhibitions, competitions, public markets of poultry and birds, establishment of safety zones in the perimeter of infected farms, and obligatory reporting of infected birds [14].

The effectiveness of measures to prevent the spread of AI, however, depends on how well they are implemented by bird keepers and farmers. It is crucial, therefore, to investigate how well bird keepers implement these measures in practice, and whether they believe these measures are effective. This kind of information is often gathered by means of surveys, specifically a quantitative survey [15,16]. The authors of a research were Italian broiler and turkey farmers who were questioned on how well they complied with biosecurity measures, stating that the mere presence of e.g. disinfecting materials, did not guarantee that farmers use them appropriately [16]. This seems to be in line with the following study [17] arguing that Danish broiler farmers were more focused on compliance and proper application of biosecurity measures at the time of an audit visit than when there was no audit visit. The need for an audit to better comply with biosecurity measures raises questions on the reliability of self-assessment by farmers on sensitive issues such as compliance with legally imposed norms. When people are asked to provide a self-assessment, the answer may be biased in a positive direction and they may be motivated to give an answer that is most desired, also known as the better-than-average effect [18]. For example, in surveys in which a presumably representative sample of people is asked to self-evaluate socially valued traits (e.g. intelligence, attractiveness, and sociability), often more than half of the respondents believe to score above the average for such traits [19,20]. If the importance of social traits can push self-assessment in a desired direction, the same may be true for the self-reporting on compliance with imposed AI control measures.

The support and compliance of bird keepers and farmers are valuable for evaluating and understanding the effectiveness of the current Belgian AI control measures. This study investigated, through an online survey, how effective these control measures are perceived to be by both professional and non-professional bird keepers and how well they comply with those measures themselves. Because the sample of respondents cannot be claimed to be random and because the possibility cannot be excluded that respondents may give a socially desirable (instead of a truthful) answer, the participants were not only asked to report compliance by themselves but also by their peers (i.e. other bird keepers or poultry farmers).

2. Materials and Methods

Two different groups of people were contacted to complete a survey on AI preventive measures: private keepers of poultry and/or other captive birds (**PRI**) and professional laying hen farmers (**FAR**). The survey was open from 31 July 2021 until 30 September 2021.

 doi:10.20944/preprints202407.1617.v1

2.1. Survey Procedure

An online survey link was distributed to PRI through social media (Facebook and LinkedIn), e-mail, and newsletters of Flemish bird associations (Vlaams Neerhof, Steunpunt Levend Erfgoed vzw, and Nationale Raad voor Dierenliefhebbers). Flemish FAR (n = 186) were contacted by e-mail obtained via the Department of Agriculture and Fisheries (Flanders). After two weeks, FAR were contacted by phone with the request to complete the survey if they had not already done so.

2.2. Survey

The survey was created and accessible with the LimeSurvey software (www.LimeSurvey.org) and could be completed anonymously by participants. In the first part of the survey, both PRI and FAR were questioned on the type of poultry/birds they kept, housing conditions, and whether their birds had access to an outdoor range. Additionally, FAR were asked to give their age. In the second part of the survey, PRI and FAR were questioned on their level of compliance with four general nationwide AI control measures: (1) compulsory confinement of poultry or other captive birds to prevent contact with wild birds by keeping them indoors or by (2) covering outdoor ranges with nets (mesh size of max. 10 cm), (3) obligation to feed and water poultry and other captive birds indoors or by other means which prevent contact with wild birds, (4) a ban on feeding or providing water to poultry and other captive birds from surface water supplies or rainwater to which wild birds have access unless the water has been treated to inactivate viruses. These general measures had been imposed by the Belgian government during the most recent AI high-risk period before the survey [14], namely between 15 November 2020 and 6 April 2021 for PRI, and between 1 November 2020 and 12 May 2021 PRI and FAR were asked to evaluate how well they complied with the general measures themselves but also how well they thought their fellow bird keepers, both of the PRI and FAR groups, complied. In the third part of the survey, PRI and FAR were asked to give their opinion on the effectiveness of these four general AI-measures. In the fourth and last part, FAR were questioned on additional biosecurity measures specific for professional poultry farmers. They were asked to indicate to what extent they had complied with each measure, how effective they considered these to be, and how well they thought other laying hen farmers complied with each measure. The questions from part four were not asked at PRI.

All questions of the survey, except for those in the first part, could be answered with a 5-point Likert scale. The scale ranged from 1 (no compliance/not effective) to 5 (full compliance/most effective). For each question, the option 'not applicable' was available as well.

2.3. Statistical Analysis

Response data were analyzed using R (version 4.2.1). Responses to each question of parts two to four (scores between 1 and 5) were analyzed with linear mixed models. For the models about the level of compliance with a certain AI-measure (Part 2), the group of respondents (PRI vs. FAR), the group for which they scored the level of compliance (themselves vs. peers of the same group vs. peers of the other group), and the interaction between these two variables (if significant) were included as fixed effects. To compare the level of compliance between AI control measures, the group of respondents, the AI control measure, and their interaction (if significant) were included as fixed effects in the models. For the models about the perceived effectiveness of the AI control measures (Part 3), the group of respondents (PRI vs. FAR) and the various AI control measures were included as fixed effects A Tukey-correction was used to correct the P-values for multiple testing. A value of $P<0.05$ was considered significant.

3. Results

3.1. Response Rate and Respondent Demographics

The survey was filled out by 263 PRI and 33 FAR respondents. For FAR, this corresponds to a response rate of 18% of the contacted laying hen farmers. 64% of them had a free-range area for their laying hens. The majority (83.5%) were aged between 35 and 65 years, whereas 14% were younger than 35 years, and 2.5% were older than 65 years. For PRI, neither the response rate nor their age

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distribution is known. Birds owned by PRI respondents were chickens (86%), pigeons (24%), water birds (24%), songbirds (8%), pheasants (7%), turkeys (6%) and other bird species (5%). Of the PRI respondents, 86% had a free-range area for their birds.

3.2. Self-Evaluated Compliance with General AI Control Measures

Overall, PRI and especially FAR self-reported to comply rather well with the nationwide general AI control measures themselves (Figure 1A,B). Mean compliance scores by PRI ranged between 3.2 ± 0.08 for 'Indoor confinement' and 4.2 ± 0.08 for 'Separation of feed and water from wild birds' (Figure 1A). Mean self-compliance scores for FAR ranged from 4.1 ± 0.21 for 'Net confinement' to 4.7 ± 0.20 for 'Indoor confinement' and 'Separation of feed and water from wild birds' (Figure 1B). These scores are all significantly higher than the self-compliance scores given by PRI, except for 'Net confinement' ('Separation of feed and water from wild birds' P = 0.04 and 'Prohibition to use feed and water from resources accessible by wild birds' P = 0.01). The difference in the level of self-compliance reported by PRI versus FAR was largest for 'Indoor confinement' (3.2 vs 4.7, P < 0.0001).

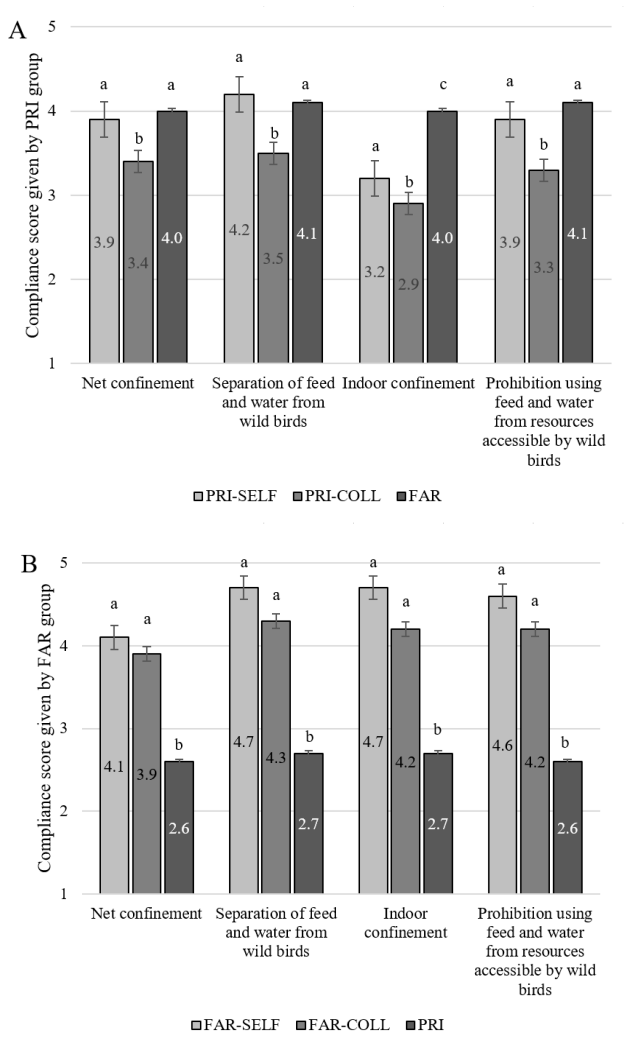

Figure 1. (**A**) Compliance scores on the general AI control measures given by the private bird keepers (PRI, N = 263) to themselves (PRI-SELF), towards colleagues (PRI-COLL), and towards laying hen farmers (FAR). (**B**) Compliance scores on the general AI control measures given by the FAR group (N = 33) to themselves (FAR-SELF), towards colleagues (FAR-COLL), and towards the PRI group. Scores range from 1 (no compliance) to 5 (most compliance). Numbers within bars represent the mean compliance score. Significant differences (P < 0.05) between bars in a specific measure are indicated with a,b,c scripts. Not applicable answers were omitted from the figures and analysis.

 doi:10.20944/preprints202407.1617.v1

3.3. Compliance with General AI Control Measures by Others

PRI reported better compliance with each AI control themselves as compared to other private bird owners (all $P < 0.05$) (Figure 1A). Remarkably, when PRI were asked to evaluate also the level of compliance by FAR, these scores were significantly higher than the scores they had given to fellow private bird keepers (all $P < 0.05$). For one of the four general AI control measures (namely 'Indoor confinement') the compliance score given to FAR was even higher than the self-compliance score given by PRI to themselves ($P < 0.0001$) (Figure 1A). In summary, PRI respondents did not seem to think other private bird owners had the same level of compliance as themselves or those of FAR.

This negative opinion about the level of compliance by private bird owners was even more pronounced among the FAR respondents (Figure 1B). The mean compliance score FAR gave to PRI was below the neutral point of the scale (score = 3) for all four general AI control measures. These scores were also much lower than the level of compliance FAR reported for themselves (all $P < 0.0001$) or for their fellow FAR (all $P < 0.0001$). FAR respondents believed that the level of compliance by FAR colleagues was only slightly lower than the level of self-compliance although the differences were never statistically significant (all $P > 0.05$) (Figure 1B). Compliance level by FAR was lower (although still high) for 'Net confinement' than for the three other general AI control measures.

3.4. Opinion on the Effectiveness of General and Specific AI Measures

All four general AI control measures were found more effective by FAR than PRI (all $P < 0.0004$) (Figure 2). The difference was most pronounced for 'Indoor confinement' which was given the lowest effectiveness score by PRI (2.5 ± 0.08) but a very high score by FAR (4.5 ± 0.18) ($P < 0.0001$). 'Separation of feed and water from wild birds' was given the highest effectiveness score both by PRI (3.6 ± 0.08) and by FAR (4.7 ± 0.18) (Figure 2). The 'Prohibition to use feed and water from resources accessible by wild birds' was also given a relatively high score by both groups of respondents. 'Net confinement', however, was given a relatively low effectiveness score by both PRI (2.7 ± 0.08) and FAR (3.5 ± 0.18).

FAR respondents were also asked to evaluate the effectiveness of seven additional biosecurity measures specific to the poultry industry. The mean scores for these additional measures ranged between 3.9 ('Registration of visitors') to 4.3 ('Cleaning vehicle') which are numerically lower than the FAR effectiveness scores for the general AI control measures except 'Net confinement' (compare Figures 2 and 3).

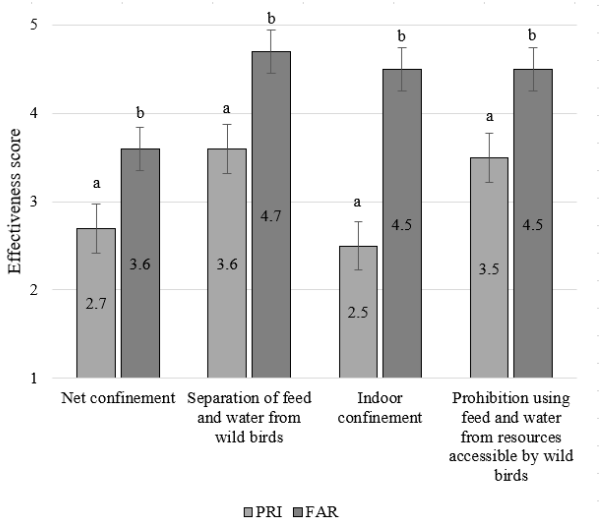

Figure 2. Comparison of the opinion of private bird keepers (PRI, n = 263) and laying hen farmers (FAR, n = 33) about the effectiveness of the general AI control measures. Scores range from 1 (not effective) to 5 (very effective). Numbers within bars represent the mean compliance score. Significant differences between FAR and PRI are indicated with a,b superscripts. Not applicable answers were omitted from the figure and analyses.

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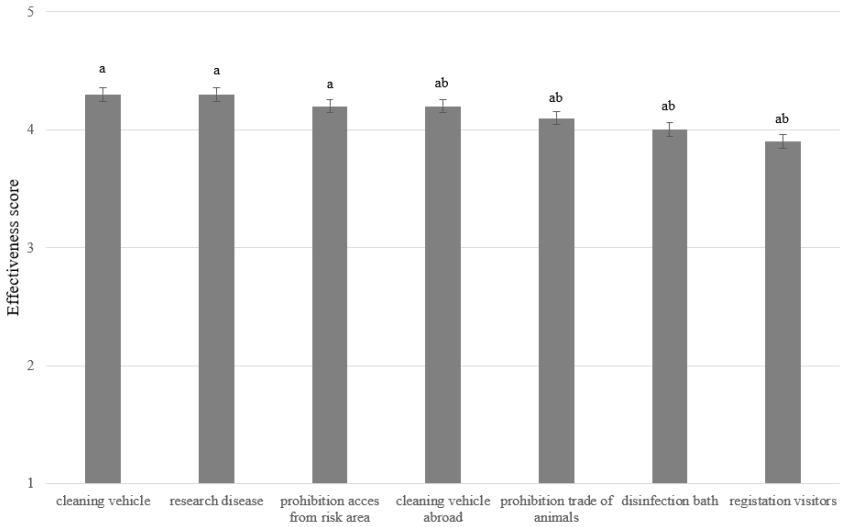

Figure 3. The opinion of laying hen farmers (n = 33) on the effectiveness of specific AI control measures. Scores range from 1 (not effective) to 5 (very effective). Numbers within bars represent the mean effectiveness score. Significant differences between bars are indicated with a,b superscripts. Not applicable answers were omitted from the figure and analyses.

4. Discussion

This survey is unique in providing information about the level of compliance with, and the opinion on the effectiveness of, the measures against bird flu in Belgium by two key stakeholder groups, namely professional laying hen farmers (FAR) and private keepers of birds (PRI). The outcomes of this study are important as the success of AI control measures imposed by the authorities may greatly depend on the level of support and compliance by those who are expected to implement them.

The number of respondents was higher for PRI (n=263) than for FAR (n=33), despite extra efforts to recruit FAR. Persuading poultry farmers to participate proved challenging, and personal outreach was needed by contacting them via phone resulting in more willingness to fill out the survey. As our FAR respondents account for only 9% of all laying hen farmers in Flanders (368 are registered laying hen farmers in Flanders in 2022) [21], we cannot assume representativeness. Indeed, laying hen farmers with a free-range system seem to be over-represented, possibly because some of the AI control measures affect them most. Moreover, our client and financer instructed us not to include poultry farmers other than laying hen farmers.

We opted to use an anonymous online survey method to map out information about the level of compliance and perceived effectiveness of the AI control measures by laying hen farmers and private bird keepers because it allows obtaining data relatively fast and inexpensively. Moreover, such data are more difficult to obtain by interviews in which the risk of the interviewer influencing the responses is expected to be greater especially if it concerns sensitive issues such as compliance with legislation [22]. Nevertheless, even in anonymous online surveys, the possibility cannot be excluded that the respondents' answers are not entirely truthful, e.g. because respondents may lack an unbiased view about their actions and/or wish to make a favorable impression, i.e. socially desirable responding [23,24]. As this may lead to misreporting and in particular about the level of non-compliance with biosecurity measures which may be met with disapproval by peers and society at large, we asked the respondents not only to evaluate compliance by themselves but also by their colleagues or peers. Perceived level of compliance by fellow bird keepers may thus better reflect reality than self-reported level of compliance as it reduces socially desirable reporting and the better-than-average effect [25]. These psychological mechanisms likely contribute to the higher level of self-reported compliance with the AI-measures as compared with the perceived level of compliance by fellow bird keepers.

Intriguingly and in contrast with the PRI respondents, the level of self-compliance reported by FAR respondents did not differ with how well they thought fellow laying hen farmers complied with

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the general AI-measures. This strengthens the conclusion that the level of compliance by FAR is truly higher than by PRI. This may not come as a surprise given that the financial and other consequences of an AI outbreak tend to be much bigger for FAR than PRI [14,26–28]. Consequently, awareness about and support for the control measures can be expected to be higher among FAR than PRI, as well as the checks of compliance by local authorities and peers.

'Indoor confinement' stood out as a general AI control measure for which compliance among private bird keepers (contrary to laying hen farmers) appears very low. A possible explanation is that private bird keepers may be less likely to have suitable facilities to keep their birds indoors for a prolonged period as compared to professional farmers. Moreover, the use of outdoor ranges (if these are provided) by laying hens on commercial farms can be rather poor, and often much lower as compared to the use of outdoor facilities by birds kept by private owners. Consequently, long-term indoor confinement may have a more detrimental impact on the behavior and welfare of privately kept birds as compared to chickens on commercial farms. The resistance to keeping birds indoors may thus be expected to be greater among private bird keepers versus chicken farmers. The lower compliance with 'Indoor confinement' by PRI compared to FAR could also be related to the fact that an AI outbreak can have dramatic economic consequences for the poultry farmer such as the depopulation of the entire flock of thousands of birds and even financial ruin [26,27].

Placing nets over the free-range area or using a roof or canvas cover has also been suggested as a protective measure against AI infection in a poultry flock [29–31]. However, the level of compliance by laying hen farmers was the lowest for this measure, and considerably lower than for the three other general AI control measures. As flock sizes on commercial farms are much larger than is the case for the modal private bird keeper, the total outdoor area that would need to be netted makes this option logistically and financially very hard. For professional laying hen farmers, keeping the hens indoors is often a much easier option to comply with AI control measures. In addition to the level of compliance, the perceived effectiveness of placing nets over the free-range area was also investigated. PRI found placing nets over the free-range area less effective compared to FAR.

In general, FAR better complied with all other general AI control measures ('Indoor confinement', 'Prohibition on using feed and water from resources accessible by wild birds', and 'Separation of feed and water from wild birds') compared to PRI. FAR also thought very negatively about the level of compliance by PRI. This could be linked to the fact that it is easier to check compliance among laying hen farmers than private bird keepers due to the registration of their farms and the higher concentration of animals at fewer locations. Hobby bird keepers need to be registered only if they have more than 199 birds not destined for the food chain, or if they regularly buy or sell birds [32].

Especially when the level of supervision by peers or local authorities is low, the level of compliance with AI control measures can be expected to be linked to how effective they are perceived to be. It is not surprising, therefore, that for PRI there seemed to be such a negative association between the level of compliance with the various AI control measures and how effective they believed these to be. Ensuring proper implementation of these AI-measures is crucial to prevent the spread of AI. This could in part be achieved by informing the private bird keepers about the AI-measures and by emphasizing the importance of compliance with these measures by reaching them through a campaign or by placing informative posters with clear guidelines in the stores where they buy their birds.

5. Conclusions

In conclusion, based on this survey it seems that compliance with AI-measures applicable in Belgium was high among professional laying hen farmers, but much less so among private bird keepers. The level of compliance generally mirrored how effective the respondents considered these measures to be. Among private bird keepers compliance and perceived effectiveness were lowest for keeping the birds indoors, whereas for farmers it was lowest for placing nets over the free-range. To combat the spread of AI more effectively national authorities could focus on information campaigns explaining to private bird keepers, in particular, the need for the various control measures that they impose.

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