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The awareness and behaviour's farmer towards highly pathogenic avian influenza prevention in Tra Vinh, Vietnam

N. H. Qui*, N. T. Anh Thu, and N. T. Linh
Department of Animal Science and Veterinary Medicine, School of Agriculture and Aquaculture, Tra Vinh University, No. 126 Nguyen Thien Thanh Street, Ward 4, District 5, Tra Vinh 87000, Vietnam.
**Corresponding E-mail: nhqui@tvu.edu.vn*

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ABSTRACT

Disease outbreaks are partly the direct result of the expansion of poultry flocks. To understand farmers' behaviours, their awareness of highly pathogenic avian influenza (HPAI), the study was conducted. A total of 150 farms in three districts of Tra Vinh Province were included. Purposive sampling was used to choose respondents who have at least 20 poultry heads and a three-year operation. Descriptive and multiple regression analyses were used to analyze data. The findings indicated that most farmers (65.3%) were males with an average age of 50 years. Farmers received < $100/month from poultry production. The farm scale of poultry business was less than 100 heads per farmer, and birds were reared traditionally, using by-products, floor feeding, and no automatic watering systems. Selling broilers dominated, whereas egg sales were uncommon and were generally reserved for domestic use. In addition, farmers were aware of HPAI prevention (>90% were, poor knowledge that was not validated). Additionally, farmers' awareness significantly increased by the enhancement in education, training, income, and full-time employment at poultry farms. It can be concluded that the small-scale poultry farming employs traditional practices with a keen awareness of infectious diseases. However, to raise farmers' awareness, strategies should concentrate on profession, education, training, and income.

Keywords: Poultry system, Prevention, Small farm, Zoonosis

INTRODUCTION

Although productivity has increased, the poultry sector in Vietnam has several shortcomings. For example, production costs are still high and not very competitive, which can occasionally make poultry production unprofitable. Although the disease has been largely controlled, the epidemic situation in the chicken industry remains complex. As previously indicated, the most common poultry diseases in Vietnam are highly pathogenic avian influenza (HPAI), Newcastle disease, fowl pox, infectious bursal disease, coccidiosis, and bronchitis, especially in the Mekong Delta (Carrique-Mas *et al.*, 2019; Delabouglise *et al.*, 2020).

As one of developing countries affected by HPAI, Vietnam served some serious problems, especially on farms that practice multispecies poultry production, disease and bird death continue to be significant production and productivity constraints (Delabouglise *et al.*, 2020). The production, trade, and consumption of poultry in the nation have been seriously threatened by

HPAI (Figué and Desvaux, 2015). Owing to the high virulence of HPAI, small-scale farms carry a significant risk of disease transmission from animals to humans (Whelan *et al.*, 2021). Coughing, decreased appetite, vague neurological symptoms, and unexpected mortality are only a few clinical indicators of HPAI in birds (Whelan *et al.*, 2021). According to a recent study by Carrique-Mas *et al.* (2019), the average weekly mortality rate of small-scale poultry flocks in the area was 2.5%. The frequency of the disease burden in these flocks is a result of inadequate hygiene and biosecurity standards typical of small-scale chicken farms in the area (Van *et al.*, 2019). One of the regions in Vietnam with the highest incidence of HPAI is the Mekong River Delta, located in the southern part of the country (Carrique-Mas *et al.*, 2019). A large number of farmers raise poultry on a small scale, and the majority of them put only a minimal amount of their own money into disease prevention practices, such as vaccination or sanitation. It is unclear how the beginning of an outbreak could cause a change in behaviour among farmers (Delabouglise *et al.*, 2020). It is possible that the guidelines for biosecurity will not be compatible with the management approaches that are utilized by small-scale Vietnamese farms; the perceived relevance of a behaviour may be a major mediating factor (Whelan *et al.*, 2021). Recent studies have shown that there are barriers preventing the adoption of biotechnology and innovative methods for controlling animal diseases. These barriers include a lack of confidence in biotechnology or the entities promoting it, a perception of insufficient long-term benefits, unintentional encouragement of inappropriate market activity, a lack of belief in one's own ability to implement these innovations, a lack of social norms supporting their adoption, and farmers' reluctance to share disease information due to concerns about their reputation (Naylor *et al.*, 2018; Whelan *et al.*, 2021). Guntoro *et al.* (2023) also showed that to determine prevention practices against a disease, social profiles should be taken into account.

Changes in farm management caused by variations in epidemiological risk have not been quantified for any livestock system. This is partially due to the paucity of combined epidemiological and behavioural data in longitudinal studies of livestock diseases (Hidano *et al.*, 2018). A major contributor to the spread of zoonoses is a lack of knowledge and awareness of the disease (Kiffner *et al.*, 2019). In addition, there is a concern among livestock producers over the occupational dangers associated with exposure to zoonotic infections (Singh *et al.*, 2019) and the spread of disease. Changes in the outbreak risk or mortality risk may have an effect on the understanding and behaviour of poultry farmers; however, it is not yet apparent how or to what extent this will happen. Cui *et al.* (2019) employed several variables such as gender, age, education, training, experience, business network, chicken's revenue, and organizational media to examine the behaviours of farmers. In a similar manner, Qui *et al.* (2021) collected data on gender, age, family composition, experience, farm size, education, and income in order to analyze farmer behaviour. Furthermore, the age, education level, and farm size of farmers have an impact on their choice of agricultural information sources, as demonstrated by Mittal and Mehar (2016). These factors, in turn, influence farmer behaviour. Research indicates that individuals' views regarding the dangers associated with diseases, including transmission and health repercussions, have a significant impact on their attitudes and actions towards seeking healthcare for those diseases (Swai *et al.*, 2010). Furthermore, perceptions can be shaped by factors such as knowledge, cultural and religious customs, and personal experiences. These perceptions, in turn, can serve as indicators or predictors of subsequent actions or behaviours (Majiwa *et al.*, 2024).

Moreover, it is unknown whether poultry breeders react to disease outbreaks in their flocks by increasing the amount of HPAI preventative practices they used or not. Thus, this study was aimed to evaluate social profiles, poultry production behaviours, and the interaction between social profiles, poultry production behaviours, and farmers' awareness of HPAI prevention management.

MATERIALS AND METHODS

Location

The research was conducted in Tra Vinh Province, one of the provinces in the Mekong Delta, Vietnam, consisting of three districts, namely Cang Long, Tra Cu, and Cau Ngang dis-

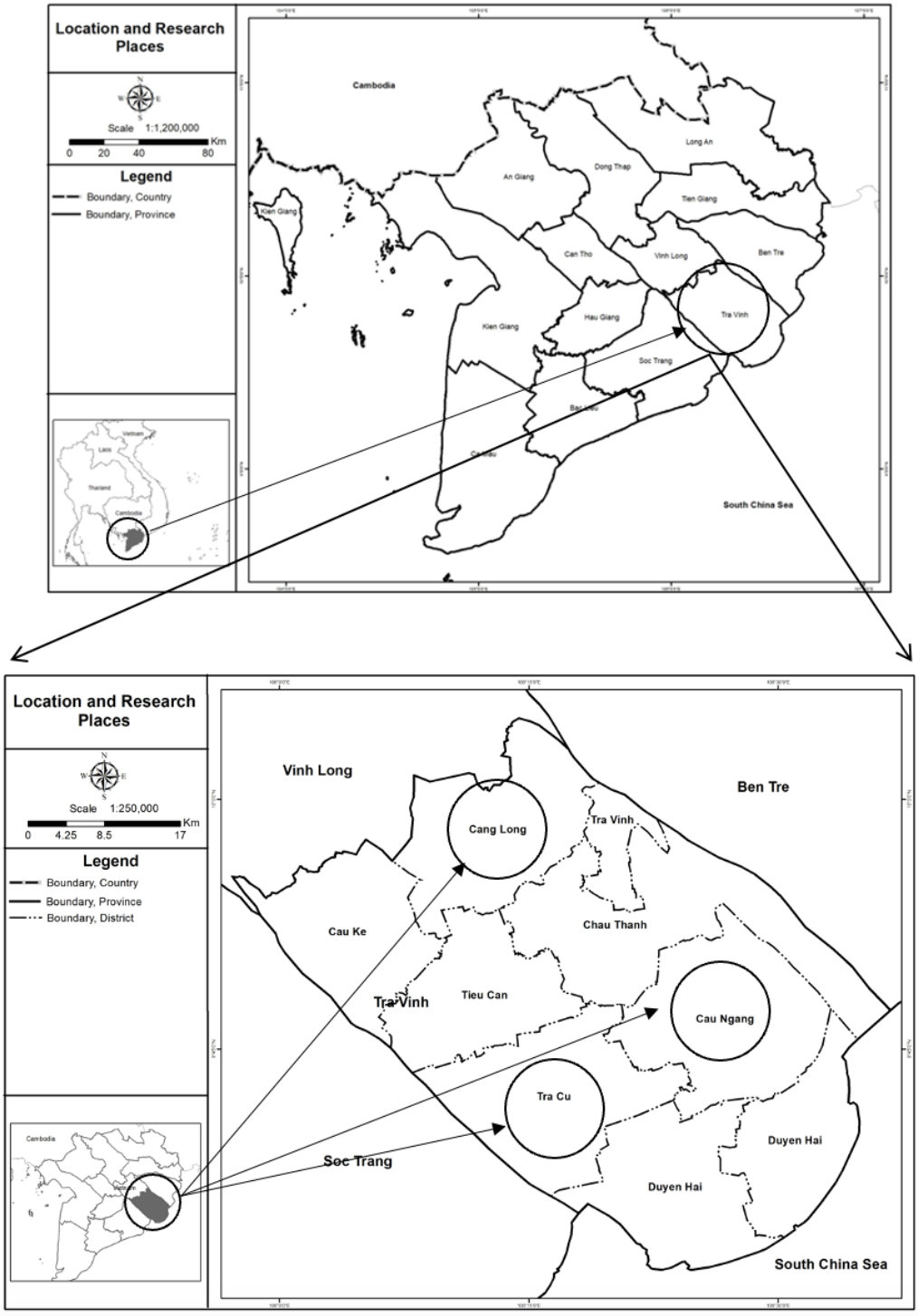

Figure 1. Location and research places

tricts (Figure 1). The study was conducted from March 2023 to June 2023, as the transmission period between the dry and rainy seasons.

Data Collection

As one of the provinces includes most small farmers working in poultry farming in the Mekong Delta, Vietnam, Tra Vinh was purposively selected. Besides, three districts were selected based on the availability of small poultry farmers. Because of the unknown population of small poultry farmers, the respondents were randomly chosen from the list provided by veterinary officers. A total of 150 small farms met the standard

of respondents (50 farms per district). The districts of this study were chosen basing on a simple random sampling. According to the study of Hidano *et al.* (2018), for unknown population, the number of respondents at least 30 is large enough. The questionnaires were sent to the farms by officers and collected after completing the answers. The respondents had the right to check all the questions before giving their answers, and the questionnaire was answered by themselves.

The questionnaire was first developed in English and then translated into Vietnamese, including three sections. First, the social profiles of poultry farmers, including age, gender, family members, labour, main occupation, education, training participation, and income, were collected (Qui *et al.*, 2021). Social profiles included information about farm owners. Second, farming activities and behaviours were recorded. The information included the number of poultry at the farms, poultry sources, feed, water, raising purpose, and selling channels. Third, the farmers were asked nine statements related to their awareness. The answers to the awareness statements were rated on 5 points of Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). The minimum and maximum points were 9 and 45, respectively. All respondents were chosen according to the following criteria: there were poultry available at the time of survey, owners had at least 3 years of working time at poultry farms, and their farms were operated for 3 years. The number of poultry was at least 20 heads for all farms. The criteria for respondents were established to ensure that farmers were aware of any diseases that might be present on their farms. This is because farmers who have experience in running their own businesses are more likely to detect changes in their farms and work to increase their knowledge of any diseases that may be there. The definitions of the dependent and independent variables are listed in Table 1. As following the study of Cui *et al.* (2019) and Qui *et al.* (2021), the variables from social profiles and farmer's behaviours in selling chickens were used for this study. However, the relationship between social profiles, farmer's selling behaviours and awareness toward HPAI prevention practice were not clearly determined from previous research.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (IBM SPSS 26.0, IBM Corp, Armonk, NY, USA). Descriptive analysis was used to describe social profiles and production behaviours by means and frequencies. The hypothesis was that awareness is expected to be significantly changed by a certain factor if any independent variable increases by one unit. The reliability and validity of the results were verified to ensure that the questions were valid and reliable. The reliability of 0.884 was checked using Cronbach's alpha statistical analysis (Hair *et al.*, 2020), and the validity was 0.62-0.73 with significance for all questions showing a strong relationship between questions.

Farmers' awareness of HPAI was recorded using a Likert scale. As mentioned above, awareness ranged from 9 to 45 for a total of 9 statements. Thus, farmers scored 9-20 points were determined as low awareness, 21-32 points were determined as medium awareness and high awareness was from 33-45 points.

Multiple regression analysis (MRA) was the most widely used statistical technique for determining the link between a dependent variable and several factors acting as independent predictors. In this study, MRA was used to examine how social profiles, farming behaviours (independent variables), and farmers' awareness of HPAI (dependent variable) were related to one another. This method assumed that awareness, social profiles, and farming behaviours have a linear relationship. The formulation of MRA used in this study was equation 1:

$$Y = \ln(p/1-p) = \beta_0 + \beta_1 X_1,\ i = 1,..,\ I\text{-}1$$

where:
p refers to the probability of a farmer's high awareness; 1-p is the probability of low/medium awareness of farmers towards HPAI; (p/1-p) refers to the odd ratio of farmers' awareness; β0 refers to a constant; X0 refers to the vector of independent variables; and βi refers to the parameter estimate for the i^{th} independent variable. The independent variables were age, gender, labor, education, occupation; training, income, number of poultry, poultry source, egg selling place, broiler selling place, kind of feed, watering, feeding. It is expected that the changes in

Table 1. Variable definitions and types

No	Definitions	Categories/Variable type
1	The "**age**" of a farm owner is calculated by adding the year they were born to the present year	Years; Continuous variable
2	The term "**gender**" relates to the sexual orientation of the respondent	1 = male, 0 = female; Nominal variable
3	The collective group of people who share a home is referred to as the "family members"	People; Continuous variable
4	The term "**labour**" refers to the number of members of their family who participate in farming activities	People; Continuous variable
5	The term "**education**" refers to the highest level of schooling that a farm owner has completed	1= Primary school, 2= Secondary school, 3= High school, 4= Bachelor, 5= Higher education; Nominal variable
6	"**Occupation**" is a term used to describe the tasks that farmers spend most of their time doing	1=Animal husbandry, 2= Horticulture, 3= Businessman, 4= Officer; Nominal variable
7	The term "**training**" is used to describe the educational activities that farmers participate in that are related to the livestock industry or the prevention of diseases	1=yes, 0=no; Nominal variable
8	"**Income**" refers to the amount of money that one receives monthly from poultry farming activities	1= >$100, 0= <$100; Continuous variable
9	"**The number of poultry**" refers to the number of available heads at the time of the survey	Head; Continuous variable
10	"**Poultry sources**" refers to the location of the chick purchase	1= Poultry produced at farm, 2= Hatchery, 3= From other farms, 4= From companies; Nominal variable
11	"**Egg selling place**" is the location where eggs will be sold	1= No selling eggs, 2= Middleman, 3= Neighbour consumer, 4= Hatchery; Nominal variable.
12	Where chickens will be sold is known as their "**broiler selling place**"	1= No selling broilers, 2= Middleman, 3= Neighbour consumer, 3= Slaughterhouse; Nominal variable
13	The term "**kind of feed**" refers to the components that were utilized to feed the chickens	1= Concentrate feed, 2= Formulated feed, 3= Agricultural by-products, 4= Mixed; Nominal variable
14	**"Feeding"** describes the manner and location of feeding poultry	1= By feeders, 2= Feeding in floor; Nominal variable
15	The term "**watering**" describes the equipment used to provide water to chickens	1=Automatic drinkers, 2= Others; Nominal variable
16	The extent of farmers' awareness of methods for preventing HPAI is referred to as "**awareness**"	Point; Continuous variable

social demographic profiles and farmer behaviours in raising and selling poultry would change the awareness of farmers toward HPAI prevention practice.

RESULTS AND DISCUSSION

Social Profiles of Poultry Farmers

Table 2 shows that farm owners are an average of 50 years old, with the youngest farmer being 27 years old and the oldest 74 years old.

Most farm owners were male and working at animal husbandry as their main job. There are approximately four family members, but only around two people work at the farm. All farmers were educated (>80% had finished primary school), but no higher education was recorded in this study. A large proportion of farmers did not participate in training, and more than 80% of farmers received less than $100 per month from raising poultry. As the same statement, Qui *et al.* (2021) and Guntoro *et al.* (2023) showed that farmers' social profiles are the most important criteria for determining how they can prevent disease. That is the reason why these criteria were determined. The findings were in line with the study of Qui *et al.* (2020) and Qui *et al.* (2021). Male was dominant than female, most of swine farmers and their families in the study were young, and it proved that Tra Vinh Province owned high potential laborers to work on the farm (Qui *et al.*, 2020).

Farmer's Behaviour

In small-scale farming, farmers own less than 90 heads per farm, on average (Table 3). Some farmers owned only 20 heads on their farms. Table 2 also shows that farmers usually produce chicks on their farms (>80%) instead of buying outside. There are three channels in which farmers sell their eggs and broilers, including middlemen, neighbours, and slaughterhouses/hatcheries. The findings also revealed that farmers raising poultry meat were dominant. By their traditional behaviours, most poultry are fed agricultural by-products, which sometimes combine with commercial feed. In this study, farmers appear to allocate fewer resources towards implementing technologies such as automated feeders or waterers for poultry farming. The utilization of integrated agriculture and aquaculture systems has been extensively implemented in Vietnam, yielding substantial advantages as the most proficient and successful models for small-scale farmers (Van Huong *et al.*, 2018). By this method, farmers utilized its by-products for poultry feed to reduce feed cost.

HPAI Prevention Implementation

According to statements provided by farm owners, Table 4 and 5 show that farmers had a high awareness of HPAI. The lower the points are, the higher awareness is. In particular, farmers knew what HPAI is (Q1), how the disease spread (Q2), and how it can be controlled (Q3, Q4, Q6, Q8) with more than 4 points (minimal is 3), and the marketing behaviour (Q9) also rec-

Table 2. Social characteristics of poultry farmers in Tra Vinh province[1]

Criteria	Categories	Min.	Max.	N	Results	
					Mean	Percent (%)
Age	Years	27	74	150	50.16	-
Family member	People	1	7	150	3.49	-
Labor	People	1	5	150	2.44	-
Gender	Male			98	-	65.3
	Female			52	-	34.7
Occupation	Animal husbandry			84	-	56.0
	Horticulture			49	-	32.7
	Businessman			13	-	8.6
	Officer			4	-	2.7
Education	Higher education			-	-	-
	Bachelor			7	-	4.7
	High school			22	-	14.6
	Secondary school			63	-	42.0
	Primary school			58	-	38.7
Training	No			81	-	54.0
	Yes			69	-	46.0
Income	< 100$			129	-	86.0
	> 100$			21	-	14.0

[1]Primary data from the author. The conversion rate of 1 USD ($) was approximately equal to 23.000 VND.

Table 3. Farming activities and behaviours of small-scale poultry farmers[1]

Criteria	Categories	Min	Max	N	Results	
					Mean	Percent (%)
Number of poultry	Heads	20	2002	150	91.58	-
	Number of rosters	0	140	139	-	5.18
	Number of layers	0	500	136	-	11.79
	Broilers	0	2000	135	-	56.61
	Chicks	0	100	134	-	26.40
Poultry sources	Poultry produced at farm			126	-	84.0
	Hatchery			17	-	11.3
	From other farms			6	-	4.0
	From companies			1	-	0.7
Egg selling place*	No selling eggs			125	-	83.3
	Middleman			7	-	4.7
	Neighbour consumer			13	-	8.7
	Hatchery			5	-	3.3
Broiler selling place*	No selling broilers			58	-	38.7
	Middleman			76	-	50.7
	Neighbour consumer			14	-	9.3
	Slaughterhouse			2	-	1.3
Kind of feed	Concentrate feed			14	-	9.3
	Formulated feed			6	-	4.0
	Rice, rice bran, by-products			60	-	40.0
	Mixed			70	-	46.7
Feeding	By feeders			30	-	20.0
	Feeding in floor			120	-	80.0
Watering	Automatic drinkers			4	-	2.7
	Others			146	-	97.3

[1]Primary data; *: Some farms sold eggs and broilers. N: population; Min: minimal point; Max: maximal point.

orded a good point. The statement of the health checking certificate before selling (Q5) and control interaction with wild animals (Q7) reached 4.00 and 3.79 points. Overall, the average awareness score was more than 37 points. This indicates that farmers in the research area were highly aware of HPAI prevention. More clearly, more than 90% of farm owners had good awareness, and only approximately 9% of farmers had medium awareness. The study did not record any cases with low awareness. As mentioned in Robertson (2020), controlling and preventing infectious diseases requires taking a multipronged strategy, as well as having an in-depth understanding of the current disease condition inside a farm, the potential dangers posed by the disease, and the ways in which the risk of introduction can be reduced. A comprehensive understanding of the field of veterinary epidemiology, including an awareness of how diseases are spread, the variables that put people at risk for contracting diseases, and the preventative measures that may be taken, is required for this strategy.

Effects of Farmer's Profiles on HPAI Awareness

Table 6 shows the relationship between independent variables, including age, occupation, education, family members, labours, training, income, number of poultry, chick source, egg selling place, kind of feed, feed sources, feeding and watering behaviours, and farmers' awareness of HPAI. A value of 0.355 showed that the independent variables explained 35.5% of the variability of the dependent variable, awareness. The variables were chosen following the study of Qui *et al.* (2021) on ASF disease and of Cui *et al.* (2019) on HPAI disease, however, the results only explained 35.5% of the model, it might be due to this study conducted in one area (one

Table 4. Awareness of poultry farmers on HPAI prevention implementation

No	Statements	N	Min	Max	Results		Likert scores (%)				
					Mean	SD	1	2	3	4	5
Q1	HPAI is a zoonotic disease.	150	2	5	4.20	0.777	-	6.7	2.0	56.0	35.3
Q2	The HPAI virus can be spread through sick or dead chickens as well as through faeces.	150	3	5	4.34	0.516	-	-	2.0	62.0	36.0
Q3	Before and after contacting with chickens, clean and disinfect footwear, protective clothing, and equipment.	150	3	5	4.11	0.550	-	-	10.0	68.7	21.3
Q4	Imposing restrictions for people, vehicles on access to and exit from areas used for raising poultry.	150	3	5	4.07	0.592	-	-	14.0	64.7	21.3
Q5	Limit interactions between domestic and wild birds.	150	2	5	4.00	0.751	-	2.0	22.0	50.0	26.0
Q6	To stop the spread of infections, dead or suspected HPAI-infected poultry must be destroyed.	150	3	5	4.33	0.573	-	-	5.3	56.7	38.0
Q7	Before selling poultry, farmers must have a regulatory agency's certificate of animal health inspection.	150	2	5	3.79	0.824	-	4.0	34.7	40.0	21.3
Q8	When birds are discovered to exhibit uncommon symptoms or died from sickness, a declaration should be issued.	150	2	5	4.11	0.619	-	0.7	12.0	62.7	24.7
Q9	Marketing of infected or deceased poultry is prohibited.	150	3	5	4.34	0.503	-	-	1.3	63.3	35.3

[1]Primary data; Q: question; N: population; Min: minimal point; Max: maximal point; SD: standard deviation.

Table 5. Levels of awareness in poultry farms towards HPAI prevention practice[1]

Statements		N	Min	Max	Results		Percent (%)
					Mean	SD	
Total score of Likert scale		150	30	45	37.29	4.236	-
Levels of awareness (%)	High awareness	136					90.7
	Medium awareness	14					9.3
	Low awareness	0					0

[1]Primary data; N: population; Min: minimal point; Max: maximal point; SD: standard deviation.

province) and there are other factors that affected the prediction including culture, policy, etc. The equation 2 was used to predict it:

Farmer's awareness = 35.242 + (1.242 × occupation) + (-1.116 × education) + (-1.676 × training) + (-3.406 × income)

According to the findings of this study, the occupation, level of education, training participation, and income of farmers and farm owners had a substantial impact on farmers' awareness of HPAI prevention practices ($p < 0.05$). All other variables in the model were held constant. It has been reported that workers, owners, and managers on livestock farms, industry bodies, and rural and urban communities are examples of the types of stakeholders, and education, training, and the participation of all stakeholders are necessary for

the achievement of biosecurity goals at the farm, regional, and country levels (Wolff *et al.*, 2017; Millman *et al.*, 2017). For the education variable, a one-unit increase in education (from 1 to 5, variable definitions) expects a 1.116 increase in log odds of being at a higher level of awareness, or farmers have high awareness if they receive high education. Similarly, a one-unit increase in training (from 0 to 1, variable definitions) expects a 1.146 increase in log odds of being in a higher level of awareness, or farmers have high awareness if they join in training. Likewise, an increase in income also leads to an increase in farmers' awareness of HPAI prevention. Specifically, a one-unit increase in income expects a 3.406 increase in the log odds of a higher level of awareness. Farmers who have completed a higher level of education have a greater depth of knowledge and a greater level of awareness regarding infectious diseases. It was noted that having knowledge of risk factors enables the development of recommendations to control disease outbreaks, and that this knowledge is then incorporated into biosecurity programs designed for the relevant livestock species (Robertson, 2020). The acquisition of biosecurity-related information is a primary factor in shaping behaviour (Cui and Liu, 2016). For example, the persistent spread of African swine fever has been attributed, in part, to farmers' lack of biosecurity awareness, adoption of high-risk practices, and noncompliance with regulations, according to a study of smallholder pig systems in Uganda (Nantima *et al.*, 2016). In order to meet with the demands of adopting biosecurity measures, farmers need to be knowledgeable about a variety of infectious diseases and be able to apply biosecurity processes. As a result, the measures are always simple to adopt when needed (Dione *et al.*, 2020). The best strategy to reduce knowledge gaps is through training (Dione *et al.*, 2020). If farmers take part in training on various poultry farming techniques, their awareness might increase. Awareness among farmers will increase proportionately with the number of farmers who participate in any training activities related to disease prevention. This finding was consistent with the findings of an earlier study that demonstrated that training is a useful strategy for improving knowledge, particularly in reducing individuals' levels of subjective doubt regarding protocols or technologies (Nejadrezaei *et al.*, 2018; Dione *et al.*, 2020).

Effects of Farming Behaviours on HPAI Awareness

Farmers' awareness was substantially affected by the nature of their occupations. A one-

Table 6. The relationship between farmer's profiles and farming behaviours on HPAI awareness[1]

Criteria	Regression results				
	B	Std. Error	Beta	t	Sig.
Age	0.033	0.029	0.090	1.106	0.271
Gender	0.546	0.674	0.062	0.810	0.420
Occupation	-1.242*	0.518	-0.205	-2.398	0.018
Education	1.116*	0.446	0.221	2.499	0.014
Family member	0.348	0.278	0.100	1.250	0.213
Labor	-0.750	0.409	-0.155	-1.834	0.069
Training	1.676*	0.672	0.198	2.496	0.014
Income	3.406**	0.958	0.280	3.554	0.001
Number of poultry	0.001	0.002	0.040	0.479	0.633
Chick sources	-0.179	0.625	-0.023	-0.286	0.775
Egg selling place	-0.529	0.450	-0.096	-1.174	0.242
Broiler selling place	1.024	0.550	0.165	1.861	0.065
Kind of feed	0.369	0.350	0.079	1.055	0.293
Feeding	-1.970	2.000	0.098	-0.985	0.326
Watering	0.033	0.029	-0.075	1.106	0.271
Constant	35.242	5.455	-	6.460	0.000

[1]Primary data; *: $p < 0.05$, **: $p < 0.01$; $F(16, 133) = 4.923$, $p < 0.000$, $R^2 = 0.355$; total points from awareness of farm owners were the baseline outcome. Std Error: Standard Error; Sig.: significance.

unit decrease in occupation (from 4 to 1, variable definitions) expects a 1.242 increase in log odds of being in a higher level of awareness or when farmers were not fully working at farm, their awareness was lower. The fact that animal husbandry was the primary activity of farm owners indicates that they were engaged in poultry production on a full-time basis, which is likely to have increased their level of awareness of HPAI preventive practices. It is possible that the increased awareness is the result of the experience that farm owners gain when they work on their farms full-time. The knowledge that was obtained from previous epidemics of disease could have an effect on consciousness (Sadiq *et al.*, 2021). As a result, working full-time in the poultry industry may provide additional value to cultural practices, such as routine preventative management. Financial and cultural obstacles have been cited as the primary impediments to implementing biosecurity measures (Wolff *et al.*, 2019). It was also mentioned in our findings that an increase in income could increase awareness of HPAI prevention practices. This is partly because farmers use the money, they save to make additional investments in their equipment, obtain more access to information and knowledge, pay for routine veterinary examinations, and so on. According to the findings of a study carried out in Uganda, farmers stated that implementing biosecurity measures resulted in healthier livestock, but that doing so resulted in additional financial burden (Wolff *et al.*, 2019). In addition, the implementation of disease prevention measures was hampered solely by financial considerations, and concerns regarding costs, practicability, and social acceptability were also somewhat comparable to those raised by some farmers in countries with higher incomes (Nöremark *et al.*, 2016).

CONCLUSION

Farmers were men who had spent the most of their careers working on poultry farms. In addition, as a small-scale farming system, farmers did not invest much money in the development of new technologies and instead relied on more traditional methods to produce poultry. A high level of awareness towards highly pathogenic avian influenza was present among farmers. Attention should be paid to farmers' occupations, education, training, and income to increase their awareness of highly pathogenic avian influenza prevention practices. It is recommended that increasing training frequency is an excellent strategy to raise farmers' awareness of zoonotic diseases.

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