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Factors Determining Farmers' Decision on Highly Pathogenic Avian Influenza Vaccination at the Small Poultry Farms in Western Java

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ABSTRAK

Vaksinasi adalah salah satu cara pengendalian penyakit flu burung pada usaha peternakan unggas. Terdapat beberapa faktor yang menentukan keputusan peternak dalam implementasi vaksinasi, yaitu: jenis unggas, pengalaman peternak dalam usaha peternakan unggas, pola pengelolaan usaha peternakan unggas, peran usaha peternakan unggas terhadap pendapatan rumah tangga, skala usaha peternakan unggas, tingkat kematian unggas, biaya kesehatan unggas, dan kasus penyakit flu burung. Hasil analisis menunjukkan bahwa jenis unggas dan peran usaha peternakan unggas terhadap pendapatan rumah tangga berpengaruh nyata terhadap keputusan peternak dalam implementasi vaksinasi flu burung. Kenyataannya, implementasi vaksinasi flu burung lebih efektif pada usaha peternakan unggas mandiri karena risiko penyakit ditanggung sendiri oleh peternak. Selain itu, implementasi vaksinasi flu burung juga lebih efektif pada usaha peternakan unggas yang belum pernah terkena penyakit flu burung, khususnya usaha peternakan unggas petelur. Hal yang harus diperhatikan adalah bahwa implementasi vaksinasi flu burung lebih efektif jika didukung penerapan biosekuriti pada usaha peternakan unggas.

Kata kunci: flu burung, vaksinasi, unggas komersial, Jawa bagian barat

ABSTRACT

Vaccination of highly pathogenic avian influenza (HPAI) is one of the control measures in poultry farm. There are several factors determining farmer's decision on the implementation of this vaccination. They are the type of poultry, the experience of farmers in the poultry farm, the pattern of poultry farm management, the role of poultry farm on household income, the scale of poultry farm, the mortality rate of poultry, the cost of medication, and the case of HPAI. The analysis result showed that two factors namely type of poultry and the role of poultry farm on household income had significant influence on farmer's decision to implement HPAI vaccination. In fact, the implementation of HPAI vaccination would be more effective in independent farms since the risk of this disease was single-handedly borne by farmers. Apart from that, the implementation of HPAI vaccination would also be more effective in farms that had never been infected by HPAI, particularly layer farms. Overall, HPAI vaccination would be more effectively implemented through supporting biosecurity measures in poultry farms.

Key words: avian influenza, vaccination, commercial poultry, Western Java

INTRODUCTION

One of Indonesian government's efforts to control HPAI (Highly Pathogenic Avian Influenza) adversely affecting poultry farm and deadly harming human is through vaccinating the domesticated poultry (Ditjennak, 2008). However, there is a need to identify the structure of national poultry industry in line with controlling this disease.

According to the type of domesticated poultry, the structure of the poultry industry in Indonesia comprises broiler chickens, layer chickens, kampong chickens, ducks, quails, pigeons, and geese. Meanwhile, FAO (2004) classified the poultry industry based on the level of biosecurity in controlling HPAI outbreaks, namely: (1) sector-1 with high biosecurity standard; (2) sector-2 with medium to high biosecurity standard; (3) sector-3 with medium to low biosecurity standard; and (4) sector-4 with low biosecurity standard.

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Regardless of the motivation, vaccination is unlikely to succeed as the only control measure against HPAI and will always have to be supported by other measures such as biosecurity of individual premises, management of movement, and stamping out when outbreaks occur (McLeod *et al*, 2008). In other words, vaccination is critical that other tools, such as farm biosecurity, movement control, sanitation along the market chain, rapid outbreak control, and depopulation, are implemented appropriately to enable more effective in controlling HPAI (FAO-ID, 2009).

Where the risk of outbreaks is high, therefore, vaccination becomes economically attractive. This condition occurred in Vietnam by which in the first wave of outbreaks, approximately 45 million birds died or were culled. Subsequently, following changes to the culling policy and the introduction of vaccination, no more than four million birds per wave have died (Agrifood, 2007)

In Indonesia, the problems faced in order to achieve successful implementation of HPAI vaccination is related to the ability of government funds in the procurement of facilities, provision of field operations, the creation of institutional control systems, and the behavior of poultry community. Controlling HPAI outbreaks with vaccination has been responded variously by poultry producers particularly the small-scale commercial broilers and layers as an integral part of the national poultry industry.

The different responses to vaccination could be caused by the diverse of domesticated poultry, the pattern of poultry business, the experience of farmers, and the role of poultry farm on household economy, the poultry farm management as well as the differences in business operations of the small-scale commercial poultry farms. So far, HPAI cases are still happening in Indonesia, even in Gorontalo province that had been exposed free of HPAI. This indicates that the HPAI control program with the nine strategies including vaccination has not been effectively implemented at the level of farmers. Hence, analysis on the decision of farmers to implement HPAI vaccination can be used to identify the important factors supporting the effective HPAI vaccination program in Indonesia.

This article aims at analyzing factors determining the decision of farmers to implement HPAI vaccination on poultry farms. Based on the understanding of these factors, policy makers are expected to improve the effectiveness of vaccination as an effort to prevent and to control the HPAI outbreaks at the small-scale commercial poultry farms, especially in Western Java area.

METHODS

Conceptual Framework

The outbreaks of HPAI can cause high mortality rate in various poultry farms affecting on decrease national poultry production. The losses due to mortality during the HPAI outbreak have been concentrated in the provinces of West Java, Central Java, East Java, Lampung, and Bali. They were particularly severe in Central Java and Bali where it is estimated that nearly a quarter of the flock were killed (Rushton *et al*, 2008). Since HPAI is a disease caused by virus, one of efforts to control this disease is through vaccination.

The government of Indonesia has conducted HPAI control measure through the activities of biosecurity, vaccination, disease surveillance, poultry replacement, increased public awareness, and monitoring (Ditjennak, 2008). Nevertheless, according to Yusdja *et al* (2009), farmers did not wholly respond to the efforts made by the government in relation to the HPAI control measure.

In fact, certain technology such as poultry vaccination could not be adopted promptly. The adoption of technology usually anchors in the needs of adopter. It is also related to the considerations of cost and benefit of implementing the technology. Vaccination is likely required by farmers who have ever experience in HPAI.

Vaccination would be useful if the achievement of the effectiveness of vaccines in poultry were advance comparing to poultry production cycle. In Western Java area, the average production cycle of broiler was about 33.8 days while the maximum production cycle of layer was 105.4 weeks (ICASEPS, 2010). If the effectiveness of vaccine on broiler were detected 40 days after vaccination, there would not be benefit for this poultry. Otherwise, vaccination would be effectively implemented in layer.

The benefit of vaccination is related to the extent of risks. In the large-scale poultry farms that have relatively large contribution to household economy as well, the risks would be high if the prevention of poultry deaths were not taken appropriately. Concerning the HPAI has adversely affected on poultry, therefore, farmers tended to prevent the risks in poultry farms with high contribution on their household economy.

Cost of vaccine is part of animal health costs. Other animal health costs are : (1) feed additive, vitamins, and anti stress; (2) drugs and medicines including antibiotics; and (3) disinfectants. Farmers, based on their knowledge and experience, actually are able to prevent the certain poultry diseases through applying feed additive, vitamins, and anti stress as well as keeping the clean farm and feed and drink equipment using disinfectants. The capability of smallholder poultry farmers to manage a better poultry farm can be achieved through the accumulation of partnership experiences with the large-scale poultry farms. Hence, the conceptual framework of this article can be seen in Figure 1.

Study Location

The study was conducted in 13 districts/cities in the provinces of West Java and Banten, namely Tangerang district, Depok city, Bogor district, Bogor city, Sukabumi district, Sukabumi city, Cianjur district, West Bandung district, Bandung district, Bandung city, Tasikmalaya district, Tasikmalaya city, and Ciamis district. Data were collected in February 2010.

Data Sources

The study employing survey method to collect primary data from farmer respondents through interview using structured questionnaires. Price data were also collected from poultry farm input and output traders and other institutions related to poultry farm and HPAI control such as nucleus enterprises and respective offices of livestock/animal health in the study location.

Respondents were a sub-sample of "Poultry Profiling Study in Western Java Area" conducted by FAO in 2007. The respondents were smallholder commercial poultry farmers including 155 broiler farmers and 56 layer farmers. The number of broiler respondents was higher comparing to layer respondents since the existing number of broiler farmers in the study location was also higher as compared to layer farmers. The respondents were selected randomly whether they implemented or did not implement HPAI vaccination. The number of respondents by types of poultry and farm management pattern is presented in Table 1.

Data Analysis

The study employing econometric model approach, descriptive analysis, and cross tabulation technique. The econometric model is formulated as follows :

$$VC_i = a_0 + a_1TP_i + a_2XP_i + a_3SB_i + a_4CP_i + a_5SZ_i + a_6MT_i + a_7HC_i + a_8AC_i + e_i$$

where:

VC : farmer's decision on vaccination D_1: 1= yes and 0= no
TP : poultry type; D_2: 1= broiler; 0 = layer
XP : farmer's experience in poultry farm (year)
SB : farm management; D_3: 1= independent; 0= partnership/*maklun*
CP : role of poultry on household income; D_4: 1= primary and 0= non-primary

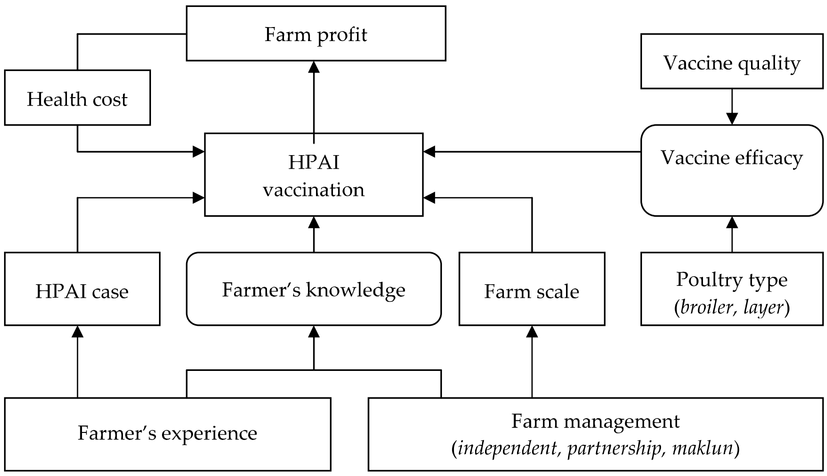

Figure 1. Factors affecting farmer's decision to implement highly pathogenic avian influenza vaccination

Table 1. Number of poultry respondents by types of poultry and farm management in Banten and West Java, 2010

Location	Broiler			Layer			Total			
	1	2	3	1	2	3	1	2	3	Total
Tangerang district	20	0	0	11	0	0	31	0	0	31
Depok city	6	0	0	0	0	0	6	0	0	6
Sukabumi district	20	0	0	7	0	0	27	0	0	27
Sukabumi city	4	0	0	0	0	0	4	0	0	4
Bogor district	3	13	8	10	0	0	13	13	8	35
Bogor city	0	0	2	0	0	0	0	0	2	2
Cianjur district	0	2	1	0	0	0	0	2	1	3
West Bandung district	25	0	0	0	0	0	25	0	0	25
Bandung regency	0	0	0	9	0	0	9	0	0	9
Tasikmalaya district	10	13	0	9	0	0	20	11	0	31
Tasikmalaya city	0	4	0	1	0	0	1	4	0	5
Bandung city	0	0	2	1	0	0	1	1	1	3
Ciamis district	3	11	8	8	0	0	12	11	8	31
Total	91	43	21	56	0	0	149	42	20	211
Total by poultry type		155			56			211		

Note: 1= independent; 2= partnership; 3= *maklun*. Source: primary data, 2010.

SZ : farm scale (bird)
MT : mortality rate (percent/cycle)
HC : poultry health cost (IDR/cycle)
AC : HPAI case; D_5: 1= exist and 0= does not exist
i : respondents 1, 2, ...i
Expected sign: $a_1 > 0$; $a_2 < 0$; $a_3 > 0$; $a_4 > 0$; $a_5 > 0$; $a_6 > 0$; $a_7 < 0$; $a_8 > 0_i$

The analysis using a binary logit model since the dependent variable is an opportunity of farmers to decide vaccination or not (Allison, 1999). There are three kinds of logistic models namely binary logistic, ordinal (ordered) logistic, and nominal (unordered) logistic (SAS, 1976). The logit model is more popular because of several reasons. ***Firstly***, it has coefficient with a simple interpretation in terms of odds ratio (p= O/1+O), where p= probability and O= odds ratio). ***Secondly***, it is intimately related to the log linier model. ***Thirdly***, it has desirable sampling properties. ***Fourthly***, it can be easily generalized to allow for multiple and unordered categories for the dependent variable. Hence, the logit model is used an estimation model of the Maximum Likelihood (LM) method.

RESULTS AND DISCUSSION

Estimation Model

One respondent out of 211 respondents was not analyzed while 210 respondents were eligible to be analyzed using the logit model. The fit statistics -2 log L with intercept model shows the result of 237.273. After having added with eight variables, the result became 78.431 in which there was decreasing result of about 158.842 (237.273-78.431). This indicates that the added variables changing the fit model of about 158.842. The proportion of suitability prediction results with observational data showing good figure namely 94.6. All regression coefficients of odds ratio were between the upper and the lower of 95 percent confidential level. Completely, the results of estimation model are presented in Table 2.

Poultry Type

Data were collected from two types of poultry, namely broiler and layer. The average production cycle of broiler in Western Java area was about 33.8 days or 4.8 weeks per cycle. Therefore, there were about 5-6 production cycles of broiler per year. Meanwhile, the length of layer production cycle was 95.1 weeks namely from DOC (day old chicken) phase up to spent hen phase. On average, layer starts laying eggs at the age of 20.2 weeks.

The divergent period of production cycle implies the extent of diseases including HPAI. The longer the production cycle, the higher would be the extent of diseases during the period of poultry life. To avoid the failure of production due to diseases, therefore, layer farmers should do more protection against the diseases, including vaccination.

The result of estimation model analysis shows that the type of poultry was highly determining farmer's decision on HPAI vaccination. However, the statistical analysis indicated low expectation (-4.0018). The estimation results indicate that layer farmers did not much vaccinate their poultry comparing to broiler farmers with the probability of about only 0.018. The discrepancy of this statistical analysis was due to unequal number of broiler and layer respondents. The number of broiler respondents (155 farmers) was higher as compared to layer respondents (56 farmers).

On the other hand, the results of descriptive analysis in Table 3 and Table 4 indicate that layer farmers more frequently applying HPAI vaccine comparing to broiler farmers. It is consistent with the study result of Ilham & Yusdja (2010) in which layer chickens were more resistant towards HPAI comparing to broiler chickens. This is because layer chickens with long production

Table 2. Results of parameter estimation and statistical test on farmer's decision to implement highly pathogenic avian influenza vaccination in Banten and West Java, 2010

Item	Parameter estimation	Standard error	Wald chi-square	Pr > ChiSq	Odds ratio estimation	95% Wald confidence limits	
Intercept	48.366	12.763	143.606	0.0002			
TP: poultry type	-40.018**	0.9108	193.053	<0.0001	0.018	0.003	0.109
XP: farmer's experience	-0.0616	0.0527	13.662	0.2425	0.940	0.848	1.043
SB: farm management	0.0244	0.8549	0.0008	0.9772	1.025	0.192	5.474
CP: role of poultry	-21.816*	0.8758	62.050	0.0127	0.113	0.020	0.628
SZ: farm scale	0.0003	0.0003	14.572	0.2274	1.000	1.000	1.001
MT: mortality rate	0.0562	0.0736	0.5833	0.4450	1.058	0.916	1.222
HC: health cost	2.42E-7	2,69E-4	0.8135	0.3671	1.000	1.000	1.000
AC: HPAI case	-140.988	338.3	0.0017	0.9668	<0.001	<0.001	>999.99

Note: ** Highly significant at 95 percent level; * Significant at 95 percent level
Criterion-2 Log L: Intercept only = 237.273; intercept and covariates = 78.431
Percent concordant = 94.6
Interpretation: Pr > ChiSq: < 0.0001 (statistically significant or differ from zero)
Ln p/1-p= 4.837 – 4.002TP** – 0.062XP + 0.024SB – 2.182CP* + 3.0E-4SZ + 0.056MT – 2.42E-7HC – 14.099AC

cycle were carefully managed including the implementation of HPAI vaccine. Moreover, both broiler and layer farmers commonly applying ND (Newcastle Disease) and Gumboro (Infectious Bursal Disease/IBD) vaccines as well as provide vitamins and antibiotics to maintain the healthy poultry.

At least, there are three reasons of farmers to implement vaccination on layer farms. ***Firstly***, the production cycle of layer farms is relatively longer (95 weeks), which increases the time window for HPAI infection compared to broiler farms. ***Secondly***, the scale of production and financial losses of layer farms are higher due to high value of hens and the potential income loss from not producing eggs over a long time. Consequently, farmers tend to avoid the risks through allocating vaccination cost rather than getting high mortality risk such as caused by HPAI. ***Thirdly***, since layer farms are operated by independent management pattern (small-scale represents limited capital with average flock size of less than 3,000 birds), farmers tend to protect their farms from HPAI, particularly small-scale farmers with limited owned farm capital.

Broiler, on the other hand, has a short production cycle namely about 34 days. The observable fact indicated that the impact of HPAI vaccine to the blood titer would be occurred 28 days after vaccination. Obviously, vaccine has not effectively protected the HPAI virus at this period. Based on this evidence, it should be underlined that HPAI vaccination is not effectively implemented on broilers. In case HPAI occurs, farmers would be able to sell the broiler chicken at least at the age of 20 days.

Some broiler and layer farmers did not implement HPAI vaccination since they had no experience with this disease. On the other hand, their poultry farms were located in the areas that are not susceptible HPAI outbreaks. Within this condition, farmers had not recognized the risks and HPAI control measures. Yet, farm-

Table 3. Frequency application and supplier of medicines and vaccines on layer farms in Banten and West Java, 2010 (n=56)

Item	Frequency per cycle *)				Supplier				Cost (IDR/bird/ cycle)
	1	2	3	4	GO	PW	PD	OPD	
Medicines	0	1	36	19	1	13	6	1	94.3
Vaccines:									
ND	0	2	0	54	0	17	35	3	224.2
IBD	2	4	12	38	0	16	25	3	94.2
HPAI	6	7	15	28	12	2	25	3	101.9
Coryza	7	7	41	1	0	4	10	0	63.6
Pox	4	0	52	0	0	0	5	0	7.6
Antibiotic	3	2	8	43	0	17	26	3	273.1
Vitamin	0	2	8	46	0	17	27	3	216.7
Disinfectant	23	1	17	15	1	13	23	1	101.3

*) Note: 1-once per cycle; 2-twice per cycle; 3-never; 4-more than twice per cycle; GO-government office; PW-private worker; PD-provincial distributor; OPD-outer provincial distributor. Source: primary data, 2010

Table 4. Frequency application and supplier of medicines and vaccines on broiler farms in Banten and West Java, 2010 (n =155)

Item	Frequency per cycle *)				Supplier				Cost (IDR/bird/ cycle)
	1	2	3	4	GO	PW	PD	OPD	
Medicines	32	13	81	29	2	45	27	1	45
Vaccines:									
ND	72	40	37	6	1	49	63	10	53.4
IBD	94	17	43	1	2	48	60	2	43.9
HPAI	3	1	151	0	3	1	0	0	0
Coryza	2	4	148	1	1	1	5	0	0.6
Pox	13	2	149	1	2	2	12	0	2.8
Antibiotic	49	22	57	27	0	31	56	11	37.7
Vitamin	33	60	13	49	0	42	89	11	66
Disinfectant	53	9	84	9	1	24	45	1	18.3

*) Note: 1-once per cycle; 2-twice per cycle; 3-never; 4-more than twice per cycle; GO-government office; PW-private worker; PD-provincial distributor; OPD-outer provincial distributor. Source: primary data, 2010

ers had not been implementing HPAI in their poultry farms. This situation could be caused by a lack of HPAI control measure campaign. It was noted that HPAI is a new disease while the number of animal health officers including PDSR (Participatory Disease Surveillance and Response) who are responsible in HPAI control measure were still limited as compared to their working areas.

Farmer's Experience in Poultry Farm

The result of estimation model analysis (with coefficient of -0.0616 in Table 2) shows that farmers that had a longer experience in poultry farms were unlikely to implement HPAI vaccination. The length of experience had not significantly influenced farmer's decision on HPAI vaccination. This is because the extent of variation of farmers' experience in poultry farm was relatively low. The probability of experienced farmers implementing the HPAI vaccination was 0.485.

Table 5 shows the experience of farmers on broiler and layer farms in the study location. All broiler and layer respondents had an experience in poultry farm for 10 years, on average. The majority of respondent (92.9%) continually operated while the rest (7.1%) dynamically (discontinue) managed poultry farms. The partnership broiler farmers had longer experience comparing to independent and *maklun* farmers.

It was noted that the current existing partnership farmers were previously independent farmers. Likewise, *maklun* farmers were formerly independent or partnership farmers. This dynamic pattern was due to the impact of economic crises, HPAI outbreaks, and unbalanced input and output ratio.

Farmers have a minimum experience of about 8.7 years. This indicates that they started to operate poultry farms in 2002 at which the HPAI outbreaks had not occurred in Indonesia yet. Farmers kept operating poultry farms during the outbreaks (2004-2005) and after outbreaks (up to present). Due to economic losses of HPAI outbreaks, some poultry farms particularly broilers had been shifting from independent to partnership patterns. Some independent small-scale farms had been altering from independent pattern to *maklun* pattern.

The experience during the time before and after HPAI outbreaks is a valuable basis for farmers to decide whether they implement or do not implement vaccination to control HPAI. Obviously, many broiler farmers did not implement HPAI vaccination. This is because broiler farmers had been implementing health management through applying vitamins, disinfectants, and antibiotics that were able to prevent HPAI. Based on farmers' experience, HPAI is a seasonal disease that mainly occurs during the transition period. Fachrudin (2011) reported that the peak incidence of HPAI in Indonesia occurs between January to April (rainy and flooding phenomena). Yet, the case of HPAI can occur anytime throughout sporadically.

Table 5. Farmers' experience on broiler and layer farms in Banten and West Java, 2010

Farm type	Farmer's experience (year)		
	Continued	Discontinued	Total
Broiler:	10.3 (67.8)	11.5 (5.7)	10.4 (73.5)
Independent	9.8 (41.3)	12.0 (1.9)	9.9 (43.1)
Partnership	11.9 (19.9)	16.0 (0.9)	12.1 (20.9)
Maklun	8.7 (6.6)	9.7 (2.8)	9.0 (9.5)
Independent layer	10.2 (25.1)	9.3 (1.4)	10.2 (26.5)
Total	10.3 (92.9)	11.1 (7.1)	10.4 (100.0)

Note: ( ) = percent. Source: primary data, 2010.

Poultry Farm Management Pattern

The operation of poultry farms in the study location was relatively quite diverse. There were three primary patterns of poultry farm management, namely independent, partnership, and *maklun*. The independent management pattern was mainly found at layer farms while partnership and *maklun* management patterns were predominantly implemented by broiler farmers.

The majority of the entire capital of independent poultry farm management derived from farmers owned investment. The independent poultry farms are individually managed by poultry farmers and its development are decided by poultry farmers themselves without intervention of other parties. So that, the risks of poultry farm management and production were carried out under the responsibility of farmers.

In partnership management pattern, on the other hand, poultry farmers (plasma) have limited decision in production system due to coordinative and consultative committed to nucleus such as integrated poultry farm companies, large-scale poultry farmers, and/or poultry shops. The collaboration between plasma and nucleus results in sharing the production risks. This partnership management pattern limits problems of smallholder poultry farmers particularly in terms of capital availability and production risk as well as poultry business competition.

In *maklun* management pattern, the status of poultry farmers was just as laborers of nucleus. Poultry farmers contributed (labor and shed) and obtained (labor wage per bird produced). It was noted that the average labor wage in *maklun* management pattern was about IDR 800-900 per bird. Those poultry farmers were unable to decide the production management entirely. All decisions were directly carried out by nucleus through operational field workers.

Apart from the aforementioned management systems, it was found semi-independent management pattern particularly in Tasikmalaya district/city. The pattern was defined in which poultry farmers, who had sheds and equipment, individually decided the labor wage and other operational poultry farm costs. Meanwhile, post-harvest and marketing aspects were carried out individually or through collaboration with other parties. Therefore, poultry farmers should have a strong bargaining position in relation to the authority and decision of poultry production. The characteristics of semi-independent poultry farm management pattern was usually based on capital collaboration with other parties in which poultry farmers just have a little capital contributions together with purchasing DOCs in cash, the first week of purchasing feeds, followed by purchasing feeds paid after harvesting period including drugs, medicines, and other. In this management pattern, poultry farmers were able: (1) to decide and select the partners; and (2) to conduct poultry disease control in line with drugs and medicines as well as vaccines provided by the partners. Even though poultry farmers under this management pattern perceived as independent poultry farmers, there were only a very few of poultry farmers existed in this pattern.

In this study, semi-independent management pattern was grouped in partnership management pattern. Consequently, poultry farm was classified into three management pattern, namely independent, partnership, and *maklun*. These management patterns were only found in broiler farms while layer farms were managed independently.

The result of estimation model analysis indicates that the independent poultry farmers tended to implement HPAI vaccination with a probability of about 0.506. However, the poultry management pattern had no significantly influence farmer's decision on the implementation of HPAI vaccination (with coefficient of 0.0244).

The understanding and experience on HPAI belong to large-scale commercial poultry farmers (act as nucleus enterprises in partnership management pattern) were delivered to and implemented by smallholder commercial poultry farmers (plasma), including to do not implement HPAI vaccination. In the case of the incidence of HPAI in broiler plasma farms that do not implement HPAI vaccination, the nucleus also consequently bear the risks. With regard to this, plasma farmers tend to follow the recommendation made by nucleus farmers. To anticipate the incidence of HPAI outbreaks, nucleus farmers recommend plasma farmers to improve biosecurity rather than vaccination. As a result, Table 6 reveals that the number of respondents who implemented HPAI vaccination was minor.

Role of Poultry Farm on Household Income

The greater the role of poultry farm on household economy, the more intensive should be farmer's attention on the poultry farm management. At least, this attention can be identified based on two aspects. The first aspect is related to production, namely how to prevent poultry deaths improve production efficiency. The second aspect is associated with market, namely how the obtained output price can cover production costs and provide a feasible farm profit margin.

Generally, about 80.1 percent of small-scale commercial poultry farms were the major household income of smallholder poultry farmers (Table 7). However, the result of estimation model analysis shows that the greater the role of poultry farms to household income, the lower the extent of farmer's decision on the implementation of HPAI vaccination (with coefficient of -2.1816) with a probability of about only 0.101. Statistically, the role of poultry farm to household income was significant. This result is not expected and there could be caused by other factors such as farm efficiency and market accessibility. In the perspective of broiler chicken farmers, marketing the poultry is more important than HPAI control measure (vaccination).

Poultry Farm Scale

The respondents include the small-scale commercial broiler and layer farmers. It was only one respondent had 12,000 broilers while the rest was predominantly had less than 3,000 broilers (2,731 broilers, on average). On the other hand, four respondents had 10,000 layers and the majority of respondents had 2,203 layers, on average (Table 8).

The variable of farm scale is always associated with efficiency. The higher the farm scale, the more efficient would be the treatment costs including vaccination cost per poultry per application. The larger the farm scale, the greater the tendency of farmer's decision to implement HPAI vaccination with a probability of about 0.500. This is implied by the result of the estimation model analysis with coefficient of 0.0003. However, the result had not statistically significant influence the farmer's decision on HPAI vaccination. This is because the distribution of respondents concentrated under the 3,000 poultry ownership, on average. It is in line with the point of view of Charisis (2008) that the implementation of biosecurity including vaccination is more simply conducted on large-scale poultry farms as compared to small-scale poultry farms.

Table 6. Number of respondents applied highly pathogenic avian influenza vaccine based on vaccination payment in Banten and West Java, 2010 (person)

Item	Paid	Unpaid	Total
Broiler:	1	5	6
Independent	1	2	3
Partnership	0	2	2
Maklun	0	1	1
Independent layer	21	26	47
Total	22 (41.5)	31 (58.5)	53 (100.0)

Note: ( ) = percent. Source: primary data, 2010.

Table 7. Role of poultry farm on household income in Banten and West Java, 2010

Item	Major	Additional	Minor	Total
Broiler:	123 (58.3)	25 (11.8)	7 (3.3)	155 (73.5)
Independent	64 (30.3)	20 (9.5)	7 (3.3)	91 (43.1)
Partnership	43 (20.4)	1 (0.5)	0 (0)	44 (20.9)
Maklun	16 (7.6)	4 (1.9)	0 (0)	20 (9.5)
Independent layer	46 (21.8)	8 (3.8)	2 (0.9)	56 (26.5)
Total	169 (80.1)	33 (15.6)	9 (4.3)	211 (100.0)

Note: ( ) = percent. Source: primary data, 2010.

Table 8. Proportion of respondents based on farm scale in Banten and West Java, 2010

Item	Average (bird)	Proportion (%)		
		≤ 3,000 bird	3,000-6,000 bird	6,000-12,000 bird
Broiler	2,731	72.3	17.4	10.3
Layer	2,203	85.7	7.1	7.1

Note: Source: primary data, 2010.

Poultry Mortality Rate

The poultry death is likely caused by certain factors including HPAI. To reduce the mortality rate of poultry can be attempted through various techniques such as increasing the feed quality and management, using better quality of DOC, keeping the sanitation and its environment using feed additive, vitamins, and antibiotics as well as implementing vaccination.

The result of estimation model shows that the poultry mortality rate had a positive influence on farmer's decision to HPAI vaccination. The higher the poultry mortality rate, farmers would more likely to implement HPAI vaccination (with estimated coefficient of 0.0562) with a probability of about 0.514. However, the statistical analysis reveals that there was no significant influence of farmer's decision on HPAI vaccination towards poultry mortality. This is because the poultry mortality rate per production cycle in this study was relatively low, namely 5-6 percent (Table 9).

The case of poultry death could be possibly caused by various diseases including HPAI. Based on the result of interview with respondents, it was found that they had relatively never experience with the case of HPAI outbreaks. To avoid the harmful of this disease, farmers carried out vaccination based on their own initiative or facilitated by government.

Poultry Health Cost

The cost of poultry health is part of poultry production costs. The component of poultry health cost includes costs of purchasing vaccines, vitamins, disinfectants, medicines, antibiotics, and health services. The contribution of poultry health costs to total production costs was quite low, namely 1.9 percent (broiler farms) and 0.9 percent (layer farms). Consequently, farmers should have not been influence to decide HPAI vaccination since the vaccine was able to prevent the mortality rate in relation to impede the decreasing farm profitability. Yet, it was found that there were many farmers did not implement HPAI vaccination in their farms.

Table 9. Mortality rate per production cycle based on farm type in Banten and West Java, 2010

Item	Mortality rate (%)
Broiler:	5.98
Independent	6.26
Partnership	5.42
Maklun	5.96
Layer	5.12

Note: Source: primary data, 2010.

Based on the extent of vaccine effectiveness and the existing condition of poultry farms, therefore, the decision of farmers to do not implement HPAI vaccination can be accepted rationally. Other factors influencing farmers to do not implement HPAI vaccination was because they tended to be a conservative towards new technology adoption since the poultry farm were considered as a sensitive biological industry. In line with the perspective of farmers, the effect of HPAI vaccination had not proven yet and it could affect on poultry stress lead to decreased production. The result of estimation model reveals the probability of about 0.500 with coeffcient of 2.42E-7 but it was unexpected sign. It is indicated that the poultry health cost did not affect on the decision of farmers to implement HPAI vaccination. According to Hinrichs *et al.* (2010), the decision of farmers on the implementation of vaccination depends upon its costs which also includes production impacts of vaccination such as decreased egg laying rate, the expected economic loss in the case of an outbreak, and the perceived probability of an outbreak.

HPAI Case on Poultry Farm

Western Java area was the worst affected area of HPAI outbreaks in 2003. However, the HPAI case did not equally occur in the study location. In the small administrative areas such as some sub-districts and poultry farm units, there were no poultry infected by HPAI. From the 211 respondents, about 25 respondents (12%) had experience with HPAI, 18 respondents (9%) did not know whether their poultry had infected by HPAI or not, and 168 respondents (79%) had never experience with HPAI (Table 10).

If farmer were a group of risk avoidance, farmers would implement HPAI vaccination based on their experience of this disease. In this study, 25 layer farms

Table 10. Number of respondent based on farm type and historical highly pathogenic avian influenza (HPAI) case on broiler and layer farms in Banten and West Java, 2010

Item	Historical HPAI case		
	Yes	No	Do not know
Broiler:	0	139	16
Independent	0	75	16
Partnership	0	44	0
Maklun	0	20	0
Independent layer	25	29	2
Total	25 (12)	168 (79)	18 (9)

Note: Source: primary data, 2010.

had ever infected by HPAI. Fifty-three farmers have implemented HPAI vaccination, included 47 layer farmers and six broiler farmers. This indicates that farmers really avoided the risk. The analysis using econometric model shows a different result in which the case of HPAI had negatively influence farmers' decision on HPAI vaccination (with coefficient of -14.0988) and it was statistically insignificant with low probability (0.001).

CONCLUSION AND POLICY IMPLICATION

Conclusion

1. Layer farmers more frequently implemented HPAI vaccination as compared to broiler farmers. Apart from that, layer farms require higher investment comparing to broiler farms. Consequently, layer farmers tend to implement HPAI vaccination with the aim of avoiding the risks.
2. The accumulated experience on practical poultry production knowledge provides farmers with a lesson learned that HPAI is a seasonal disease. Therefore, farmers tended to carry out sanitation, provide vitamins, medicines, and disinfectants rather than implementing HPAI vaccination in their farms.
3. The independent poultry farmers tended to implement HPAI vaccination.
4. The role of poultry farms to household income was not a considerable factor determining farmer's decision on HPAI vaccination. Smallholder farmers were relatively able to control HPAI than facing the large-scale farmers in terms of accessing the marketing dynamics.
5. The contribution of poultry health costs to total production costs was quite low. It is implied that cost was not an influencing factor of farmer's decision on HPAI vaccination. The main concern of farmers was the effectiveness and the benefit of vaccine in relation to HPAI control measure.

Policy Implication

1. The HPAI vaccination would be more effectively implemented in independent poultry farms since they did not accept the specific guidance from nucleus poultry enterprises of partnership and *maklun* systems.
2. The HPAI vaccination would also be more effectively implemented in the small-scale commercial poultry farms infected by HPAI, particularly layer farms. The sanitation and biosecurity improvements related to the often disease occurrences such as ND Gumboro are considered more effective and acceptable by farmers who belong the non-infected HPAI on their farms.

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