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ASESSING BIOSECURITY MANAGEMENT PRACTICE ALONG LAYER CHICKEN CHAIN IN BOGOR AND SUKABUMI

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Abstract: Biosecurity is one of the government's recommended risk management to limit the exposure of disease agents, but the implementation of biosecurity in supply chain is reportedly still not optimal. This study aims to identify supply chain of layers especially live chicken chain in Bogor and Sukabumi and to analyze the level of application of biosecurity in the chicken chain. Survey method with checklist questionnaire was used to obtain the required data. The results show that the chicken chain of layer involves the farmers and selllers of layers including collectors, poultry market sellers, and butchers, and end consumers. Culled layers are distributed in the form of live birds that can increase the risk of disease due to the accommodation time and market system which are mostly not first in first out (FIFO). The application of layer farmer biosecurity is at a moderate level (score 33.4 in Bogor and 40 in Sukabumi from a maximum score of 60). In the sellers of layers, the application of biosecurity is at a low level (score 21.9 in Bogor and 25 in Sukabumi from a maximum score of 69). Differences in biosecurity practices of farmers in Bogor and Sukabumi areas lie in the protection of wild birds. The differences in the biosecurity practices of layer bird sellers in the areas of Bogor and Sukabumi lie in the action against new poultry and action on transportation equipment. Biosecurity scores that have not been optimal indicate that the implementation of biosecurity still needs to be improved at each point of the chicken chain. Increasing biosecurity in each chicken chain point will help reduce the risk of exposure to AI viruses in layer birds through the chicken chain so that losses can be minimized.

Keywords: supply chain, biosecurity, disease, poultry, *unggas hidup*

Abstrak: *Biosekuriti adalah salah satu manajemen risiko yang disarankan pemerintah untuk membatasi paparan agen penyakit, namun pelaksanaan biosekuriti dalam rantai pasok banyak dilaporkan masih belum optimal. Penelitian ini bertujuan mengidentifikasi rantai pasok khususnya rantai ayam petelur hidup di Bogor dan Sukabumi serta menganalisis tingkat penerapan biosekuriti dalam rantai ayam petelur hidup tersebut. Metode survey dengan kuesioner checklist digunakan untuk memperoleh data yang dibutuhkan. Hasil penelitian menunjukkan bahwa rantai distribusi ayam petelur melibatkan peternakan ayam petelur, pedagang ayam petelur afkir (pengepul, pedagang pasar unggas, tukang potong), dan konsumen akhir. Ayam petelur didistribusikan dalam bentuk live bird yang dapat meningkatkan risiko penyakit karena adanya waktu tampung dan sistem penjualan yang sebagian besar tidak first in first out (FIFO). Penerapan biosekuriti peternakan ayam petelur berada pada tingkat sedang (skor 33.4 di Bogor dan 40 di Sukabumi dari nilai maksimum 60). Pada pedagang ayam petelur afkir, penerapan biosekuriti berada pada tingkat rendah (skor 21.9 di Bogor dan 25 di Sukabumi dari nilai maksimum 69). Perbedaan pelaksanaan biosekuriti peternak daerah Bogor dan Sukabumi terletak pada proteksi terhadap burung liar. Perbedaan pelaksanaan biosekuriti pedagang ayam petelur afkir daerah Bogor dan Sukabumi terletak pada tindakan terhadap unggas baru dan tindakan terhadap peralatan transportasi. Nilai biosekuriti yang belum optimal menunjukkan bahwa pelaksanaan biosekuriti masih perlu ditingkatkan pada tiap titik rantai ayam petelur hidup. Peningkatan biosekuriti akan membantu menurunkan resiko paparan virus AI pada ayam petelur yang masuk melalui rantai unggas hidup sehingga kerugian dapat diminimalkan.*

Kata kunci: *rantai pasok, biosekuriti, penyakit, ayam petelur, unggas hidup*

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INTRODUCTION

Bogor and Sukabumi are two regions that have the biggest population of layers in West Java. BPS (2016) stated that layer population in those areas reaches 8,060,199 layers or more than half of layer population in West Java. (15,143,460 layers). One of the biggest problem in layer industry is bird disease. Tabbu (2002) stated that bird disease could make significant loss with disease transmission and high layer bird mortality, decline in egg production, growth interference, and high cost of treatment for curing. Avian Influenza (AI) is a bird disease that causes big loss in industry. From 2003 to 2004, AI caused 6,4% mortality of total bird population in Java island, South Kalimantan, Central Kalimantan, and Lampung (Ministry of Agriculture, 2014). Losses experienced by farmers are very high related to chicken deaths and loss of potential egg production. West Java was documented as the province with the highest AI cases in 2015 and 2016 (Azhar, 2016). Tempo (2016) states that West Java is an area that is vulnerable to AI cases where throughout 2016 there were 56 cases of AI that killed more than 15 thousand birds.

Disease in layer industry can be directly and indirectly transmitted by layers supply chain, especially in live chicken chain. Azhar (2016) said that AI transmission risk is already in bird movement in Indonesia. Nofitri (2014) stated that Core Company is the most critical point for disease in supply chain. Sugiarti (2009) said that disease transmission risk in any live bird market is quite high.

Biosecurity is steps that are designed to prevent disease transmission in farms. Application of biosecurity management in layer farms is supervised in Broiler and Layer Farming Guidelines that is written in Regulation of Ministry of Agriculture, Republic Indonesia No. 31/ Permentan/ OT.140/2/2014. This Regulation confirms about the application of biosecurity to prevent the disease transmission in farms. The FAO (2008) mentioned that biosecurity could be a mitigation of AI in each poultry sector. Biosecurity in large scale commercial producer (sector 1 and 2) is a need and can be improved by the government support. Biosecurity for small-scale commercial producer (sector 3) should emphasize the creation of physical barriers against infection and control access. Biosecurity of scavenging poultry needs to pay attention to segregation by housing the chicken and by using disinfection. In live bird market, biosecurity measures including introducing rest days, limiting the species, which can be sold at a market, and using cleanable cages are the major biosecurity steps in reducing AI infection. Sharma (2010) and Ndem and Ogba (2017) said that there are three components in biosecurity that prevent the disease transmission: isolation, traffic control, and sanitation. Siahaan (2007) explained that a reasonably good biosecurity condition in sector 4 farms might decrease the AI transmission risk by 5.59 fold.

Many researches said that biosecurity is not applied properly in Indonesia yet. Siahaan (2007) evaluated the biosecurity rate in sector 4 farms in Bogor and Sukabumi as 'low' and 'sufficient'. Rusny et al. (2015) said that the rate adoption in biosecurity innovation for layers in Sidrap district is low. This fact makes the application of biosecurity in live chicken chain become questionable.

This research was conducted to identify the layer chicken chain in Bogor and Sukabumi and to analyze the rate application of biosecurity in layer chicken chain in Bogor and Sukabumi. This research focused on live layer chicken chain because these chicken are more vulnerable for disease transmission. The results are expected to give a representation on layer chicken chain that actually occur in layer industry and any related stakeholders and to become an evaluation material for biosecurity application.

METHODS

This research was conducted by a survey method using a checklist questionaire. The research more focused on the chain of live chickens from farms to sellers of culled layers that have a higher risk of disease. West Java was selected because it includes the top five provinces with the highest population of laying hens in Indonesia but has the highest AI cases. Bogor and Sukabumi were chosen for the research location as they are farm center districts for layers in West Java (BPS, 2016), and have high prevalence of AI (Setyawati, 2010). The prevalence of AI in Day Old Chick (DOC) in Bogor and Sukabumi was detected by 91.7% and 77.6% respectively. This study was conducted from October 2017 to February 2018 in Bogor and Sukabumi districts. There were 245 layer farms consisting of 171 farms located in Bogor and 74 farms located in Sukabumi (BPS, 2017).

With the use of the proportional calculation of Slovin method, the numbers layer chicken of samples collected from Bogor and Sukabumi was 50 farms and 21 farms respectively. The sampling method for culled layer sellers (collectors, Poultry Butchery-house, and consumption bird market) was based on Convenient Sampling Method in which the number of samples is adjusted based on the flow of the research in culled layers. The flow in layer chicken chain was descriptively analyzed based on observations and interviews with the people from layer industry. Biosecurity application was evaluated using scoring technique including isolation, traffic control, and sanitation variables (Table 1). Those three biosecurity variables were evaluated using checklist questionnaire based on Martindah et al. (2014) and veterinary control number. This checklist questionnaire method was also mentioned and used in FAO (2008), Tenzin et al. (2017), and Alhaji (2017). Scoring was used to measure the implementation of biosecurity to disease challenge. The scoring results from Bogor and Sukabumi were then compared using T-test. Biosecurity evaluation was conducted using scoring technique for biosecurity components (isolation, traffic control and sanitation), with Biosecurity Checklist Questionaire. Scoring number varied from 0, 1, 2, to 3. Zero number means that the biosecurity is not applied number 3 means good application of Biosecurity. In farms research point, the Biosecurity Checklist Questionaire consisted of 20 questions with the maximum score of 60, and in culled layer sellers, the Biosecurity Checklist Questionaire consisted 0f 23 questions with the maximum score of 69. The research framework in Figure 1.

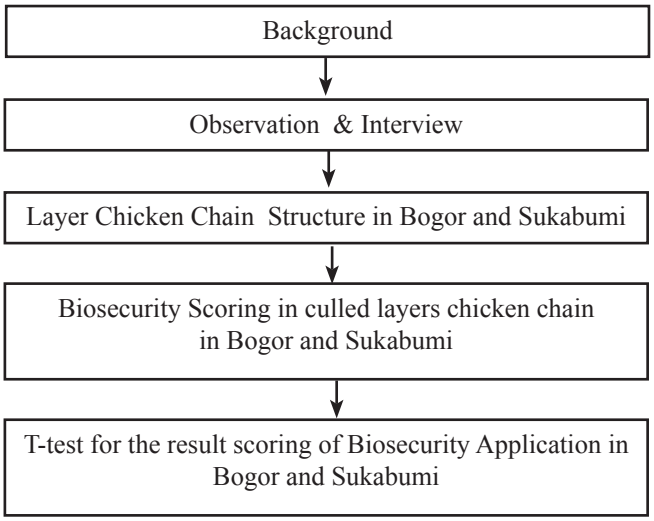

Figure 1. Research framework

RESULTS

Layers Supply Chain

Layer supply chain consisted of with live chicken chain, information, and cash flow between the farms and their final consumers. The components of the chicken chain included farms, culled layer sellers, and final consumers. Table 2 shows the farm's layer sources. Most of the farmers obtained the supply directly from DOC (Day Old Chick) and pullet breeders. In contrast to the broiler chicken, culled layers are not taken to the chicken slaughterhouse, (Tanjung et al. 2013) but they were taken to culled layer sellers instead. Culled layer sellers can be divided into three: collectors, poultry market sellers, and butchers.

Most respondents from culled layer sellers in Bogor and Sukabumi do not only sell culled layers but also other kind of birds (layers and ducks). Culled layer sellers may be divided into collectors, poultry market sellers, and butchers. Table 3 shows distribution system in active layer sellers.

Collectors have a role to buy culled layers from farms and then become the sellers for the next chain. The collectors themselves have a very important role in culled layer distribution, because most of them usually take the culled layers by themselves from the farms in big volume and then distribute the commodity to the next chains (other collectors, poultry market sellers, butchers, and final consumers). FAO (2008) mentions that collectors a larger coverage area than another actor in the supply chain. They can travel from one place to another to make a deal with poultry farmers and sell their culled layers to the next chain. Majority of the collectors actively sell culled layers the whole year and can play a role for bussiness to consumer (B to C) or Bussiness to Business (B to B). There are some collectors that have their shelter cages but some others have the shelter cages for temporary collection. In addition, some collectors have a role as butchers depending on consumer's order.

Poultry market sellers are culled layer sellers that sell the culled layers in market. The selling type used is live bird market where the hens would be butchered after being chosen by the buyers. Most bird market sellers would directly face the final consumers and give the butchering and cleaning service for them. Culled layers are usually supplied from farms or collectors. Bird

market sellers usually take the supply themselves if the sources are from farms. If the supplies are from collectors, the collectors usually deliver the supplies to poultry market sellers. The average poultry market sellers have shelter cages located at the selling location or at their house.

Butcher is a component in supply chain that has a role for butchering the culled layers but this component is not located at bird market.The selling type is live bird market where the layers would be butchered after being chosen by buyers. The amount of the commodity can be higher than that of the market bird sellers. Butchers usually obtain supplies from farms or collectors and take the commodities by themselves from farms or collectors. Butcher's consumer type is households and restaurants. Most of the commodity type is culled layers, but another bird type like local hens in small capacity as market's order is also availabl. Butchers usually have shelter cages for hen collection; thus, everytime they obtain an order for hens, they can directly butcher the hens in a certain working area.

The final consumers can be households or restaurants, and they can buy the culled layers from farms. Collectors also have a role as butchers or poultry market sellers. The average of the final consumers take the culled layers themselves from sellers, but for the routine-high amount buyers (usually restaurants), the sellers would give a delivery service. Therefore, the final consumer will obtain the culled layers as carcass, except if they directly buy the layers from farms.

Table 1. Operational definition of research variables

Reasearch Variables	Supply chain points	Indicator	Research Methods
Isolation	Farms	Wild bird attractiveness; Protection from wild birds; Placement of farm staffs; Distance to street/ road and local environment; Availability of farms' restraints; Number of bird types in farms; Treatment for sick bird; Feed Sources	Scoring with scales: 3 (Farms are not located at migrant birds path); 2 (Trees around farms but no pools); 1 (Pool near the farm with a 50-meter distance); 0 (Pool and trees with a 50-meter distance)
	Collectors Butchery-houses Bird Markets	Wild bird attractiveness; Placement of farm staffs; Distance to street/ road and local environment; Availability of farms' restraints; Number of bird types in farms; Treatment for sick bird; Layers output system; Cage building	
Traffic Control	Farms	Treatment for new arrivals of birds; Treatment for visitors; Treatments for vehicles; Treatment for equipment	Scoring with scale : 3 (Restriction and complete disinfections); 2 (Only disinfection); 1 (Minimal treatment); 0 (No treatment)
	Collectors Butchery-houses Bird Markets	Treatment for new arrival of birds; Treatment for visitors; Treatments for vehicles; Treatment for equipment; Treatment when hens are moved/ transported	
Sanitation	Farms	Treatment before entering bird cage; Capacity for disinfection- cleaning in farms; Capacity for equipment disinfection- cleaning; Waste treatment; Capacity for vehicle disinfection; Water sources; Treatment for bird carrion	Scoring with scale: 3 (Complete cleaning and disinfection); 2 (Partial cleaning and disinfection); 1 (Cleaning and disinfection only after outbreak); 0 (No cleaning and disinfection)
	Collectors Butchery-houses Bird Markets	Treatment before entering bird cage; Capacity for equipment disinfection- cleaning; Capacity for cage disinfection- cleaning; Waste treatment; Capacity for vehicle disinfection; Water sources; Treatment for bird carrion; Sanitation facility and equipment; Hygiene	

Table 2. Percentage of live layer sources for farms in Bogor and Sukabumi

Sources of Layer Supply	Bogor (%)	Sukabumi (%)
Pullet Breeder	24	0
DOC Breeder	48	95
Poultry shop	0	0
Other Farms	6	0
Self Hatchery	4	0
DOC & Pullet Breeder	12	5
Poultry shop & breeder DOC	4	0
DOC Breeder & Self Hatchery	2	0

Table 3. Percentage of distribution system in culled layer sellers in Bogor and Sukabumi

Characteristics		Bogor (%)	Sukabumi (%)
Kind of Hens	Layers	25	22.2
	Mixed Hens	75	77.8
Sources of Hens Supply	Collectors	62.5	11
	Farms	37.5	67
	Collectors and Farms	0	22
Supply System	Delivered by Supplier	56.25	11
	Self Taking	37.5	78
	Delivered by Supplier and Self Taking	6.25	11
Selling System	FIFO	18.75	22.2
	Depend on Order	81.25	77.8
Distribution System	Delivered by Supplier	6.25	22
	Self Taking	50	56
	Delivered by Supplier and Self Taking	43.75	22
Selling Time	Seasonal	6.25	33.3
	Year-around	93.75	66.7

Cash Flow from Final Consumer to Farms

The price of culled layers is relatively the same in Bogor and Sukabumi. In regular months (not holidays), the price of culled layers from farms ranges between Rp36.000 and Rp40.000/hen. Collectors, poultry market sellers, and butchers that get the supply from farms would sell the culled layers in the price of Rp40,000 or Rp45,000/hen. However, during the holidays, the price from farms would be Rp40,000-Rp45,000/hen. Thus, collectors, poultry market sellers and butchers would sell hens as much as Rp45,000 or Rp50,000/hen. Transaction among collectors or butchers will give a profit approximately Rp3,000/hen from the supplier price. The poultry market sellers that get the supplies from collectors will resell it with the profit of Rp5,000/hen or with the price of Rp50,000 or Rp55,000/hen in regular months and up to Rp60,000/hen on holidays.

The frequency of every path in chicken chain flow was calculated to see which path had the most frequent application at culled layers supply chain. The frequency data were then reviewed and calculated from the questionaire filled by the farms and culled layer sellers. Table 4 shows that the highest weight value is path number 3, followed by path number 2. Path number 1 is the longest path, and path number 5 has the 3rd highest weight value. Meanwhile, the most rarely applied path is path number 6 that directly distributes culled layers from farms to butchers. This is because butchers were not found in culled layer distribution path in Bogor. Thus, path number 4 and 6 in Bogor had a zero value. Longer supply chain path would increase the disease transmission and death risk in hens. Chicken chain flow for culled layers in Figure 2.

Hartawan and Dharmayanti (2012) detected AI transmission in traditional market in East Java, in which the local hens and butcher-houses had been AI positive when tested with Real Time Polymerase Chain Reaction (RT-PCR). This may be related with the accomodating time (1-7 days) and selling system of culled layers. Selling system that is not First in First Out (FIFO) and mixes the hens with some bird types in the location has a potency to change the accomodate place into a reservoir of diseases. Mixed birds in one location also could give impact in virus mutation. Disinfection and cage drying are needed to prevent disease accumulation in accomodate place. In addition, transportation for culled layers is usually the same as the transportation for any other bird. Inappropriate disinfection would make transportation become a disease transmission factor (ACIAR, 2014). Fournie et al. (2012) said that disease transmission among chains in chicken chain could be reduced using disinfection for transportation that connects chains in chicken chain system regularly. This would reduce the intermixing of diseases in market and bird accomodate place.

Table 4. Frequency value for paths in culled layer chicken chain

Path	Freq Value	
	Bogor	Sukabumi
Farms → Collectors 1 → Collectors 2 → Bird Market Sellers → Final Consumers	0.21	0.18
Farms → Collectors 1 → Collectors 2 → Final Consumers	0.21	0.19
Farms → Collectors → Bird Market Sellers → Final Consumers	0.26	0.21
Farms → Collectors → Butchers → Final Consumers	0.00	0.19
Farms → Collectors → Final Consumers	0.21	0.17
Farms → Butchers → Final Consumers	0.00	0.02
Farms → Bird Market Sellers → Final Consumers	0.05	0.02
Farms → Final Consumers	0.05	0.02

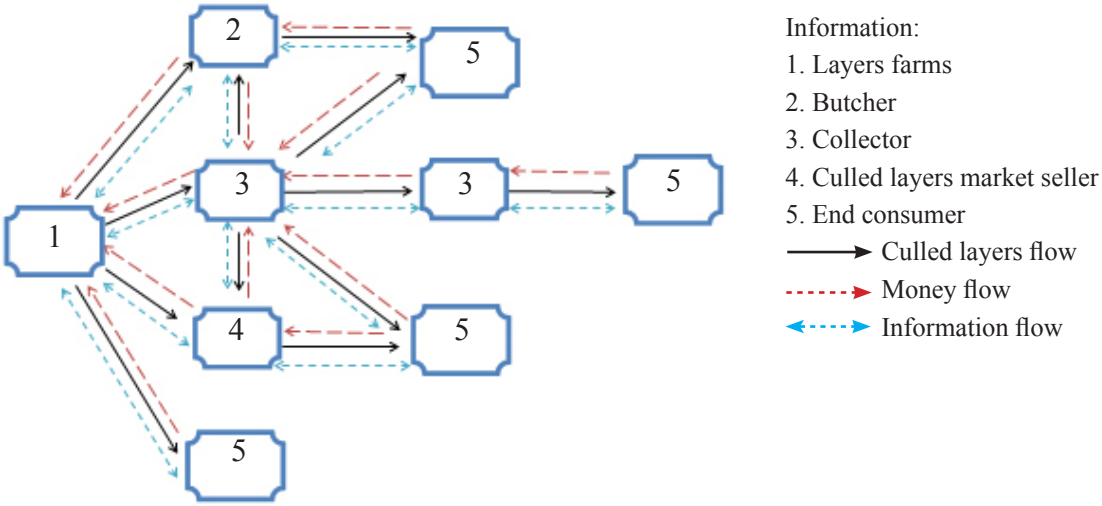

Figure 2.Chicken chain flow for culled layers

Biosecurity Application in Culled Layer Chicken Chain

Layer farms

Based on OIE (2009), biosecurity can be defined as implementation of steps to reduce risks of disease exposure and transmission. In this research, a questionnaire survey was conducted at 71 layer farms and other chicken chain points in terms of biosecurity. At the point of layer farms in Bogor and in Sukabumi, the values obtained are 33.4 and 40 from the maximum score of 60 respectively. These values show the biosecurity in layer farms in Bogor and Sukabumi areas are at a moderate level. Table 5 presents the score of each indicator. The survey results show that farmers in Bogor and Sukabumi have the lowest biosecurity value on protection against wild birds (0.89) and the appeal of wild birds (1.16). Knight-Jones et al. (2011), Huang et al. (2017), and Assam et al. (2016) mention that the Avian Influenza virus probability transmission will be reduced by reducing contact between wild bird and poultry. This low indicator value indicates the risks of disease transmission in the farm are still high. Large trees and pond that will attract wild bird still heavily surround the location of farms. Layer farms mostly use an open battery cage system, and there is no net or wall so that wild birds can easily enter the cages. The wild birds that enter the cage can be a disease vector from one farm to another. This disease may not show symptoms in wild birds but can spread and infect the layers.

Number of poultry in one location (2.97) and water source (2.9) indicate the highest biosecurity value in the layers farm. Almost all layer farms only breed one type of layers in one area. This is good considering that other poultry can serve as a dangerous disease carrier for layers. In addition, most breeders take water sources from drilled wells that are cleaner than surface water sources. The source of clean water will greatly prevent chickens from disease.

Table 5. Assessment of biosecurity scores on layer farms in Bogor and Sukabumi

Biosecurity	Indicator	Bogor		Sukabumi		p-value
		Mean	SD	Mean	SD	
Isolation	Attraction of wild birds	0.94	1.04	1.38	0.9	0.01
	Protection against wild birds	0.6	1.1	1.19	1.5	
	Placement of farm staff	1.78	1.17	1.95	1.2	
	Distance between farm and public road	1.28	1.23	1.95	1.2	
	Availability of farm barrier	2.08	0.72	2.33	0.5	
	Number of poultry types in the location	2.92	0.27	2.95	0.2	
	Treatment on sick poultry	1.86	0.89	1.81	0.7	
	Feed source	2.7	0.7	2.71	0.7	
Traffic control	Treatment to new poultry	1.5	1.3	1.6	1.5	0.001
	Treatment to visitors	0.8	1.18	2.0	1.4	
	Treatment to vehicle	1.2	1.2	1.9	1.2	
	Treatment to equipment	2.5	0.64	2.9	0.4	
Sanitation	Treatment to workers before entering the flock	0.7	1.11	1.5	1.3	0.124
	Farm cleaning and desinfection	1.8	0.99	1.8	1.1	
	Flock equipment cleaning and desinfection	1.7	1.03	2.0	0.8	
	Poultry waste treatment	1.7	1.0	1.6	0.9	
	Cleaning of transport vehicle	1.6	1.2	1.5	1.4	
	Water source	2.8	0.61	2.9	0.4	
	Treatment to poultry carcase	2.0	1.11	2.6	0.7	
	Sanitation biosecurity SOP	1.2	0.92	1.5	0.7	
	Total score	33.4		40		

The statistical tests on the implementation of sanitation, traffic control and isolation in Bogor and Sukabumi indicate that the isolation and traffic controls have p-value below 0.05 (0.01 and 0.001 respectively). This indicates that there are differences in isolation and traffic control in Sukabumi and Bogor. Differences in isolation scores appear in the attractiveness and protection of wild birds.

Many trees surround both Sukabumi and Bogor, but there are more farmers who also make fish ponds near the chicken cages in Bogor; as a result, the biosecurity score becomes lower. The protection against wild birds is still in low level in both areas since the openings in the flock are not managed properly. Artois et al (2018) mention that absence of openings in the farm is a protective factor to reduce HPAI. Moreover, Aengwanich et al. (2014) mention that cutting down trees surrounding the farm and poultry housing may decrease the attraction to wild bird.

The difference in traffic control in Bogor and Sukabumi is mainly seen in the control of visitors. The farm in Sukabumi has applied visitor spray system before entering the cage more than the farm in Bogor.

Culled Layers Seller

In layer sellers in Bogor and Sukabumi, biosecurity assessments were more directed to sellers who have chicken shelter. There were 6.25% respondents having no temporary shelters in Bogor, while there were 22.2% of them having no chicken shelters in Sukabumi. The biosecurity value in Bogor farms was 21.9 while that in Sukabumi was 25 from the maximum score of 69 (Table 6).

This value indicates that the values of the biosecurity in Bogor and Sukabumi areas are at a low level. This is because the respondents from Bogor are more dominated by poultry market sellers who have limited space to arrange for shelter pens.

The statistical test on the implementation of sanitation, traffic control, and isolation in culled layer sellers in Bogor and Sukabumi shows that the traffic control has p-value below 0.05 (0.01 each). This indicates that there is a difference of traffic control on layer sellers in Sukabumi and Bogor. This distinction is mainly on the action against new poultry and action on transportation equipment.

Table 6. Assessment of biosecurity scores on culled layer sellers

Biosecurity	Indicator	Bogor		Sukabumi		p-value
		Mean	SD	Mean	SD	
Isolation	Attraction of wild birds	1.7	1.4	0.9	6.0	
	Placement of staff	0.1	0.2	0.9	6.0	
	Distance between farm and public road	0.0	0.0	0.0	0.0	
	Availability of farm barrier	0.0	0.0	0.3	2.0	0.264
	Number of poultry types in the location	1.6	0.8	1.9	13	
	Treatment on sick poultry	1.3	1.2	1.7	12	
	Poultry expenditure system	0.9	1.1	1.1	8.0	
	Flock building	0.0	0.0	0.3	2.0	
Traffic control	Treatment to new poultry	0.5	0.8	1.7	12	
	Treatment to visitor	0.0	0.0	0.0	12	
	Treatment to vehicle	0.1	0.5	0.0	0.0	0.001
	Treatment to equipment	2.3	0.5	2.9	20	
	Transportation equipment	0.7	0.5	1.7	12	
Sanitation	Treatment to workers before entering the shelter	0.0	0.0	0.0	0.0	
	Cleaning and disinfection	1.9	1.1	1.9	13	
	Shelter equipment cleaning and disinfection	2.5	0.9	1.6	11	
	Poultry waste treatment	1.3	0.9	1.7	12	
	Cleaning of transport vehicle	1.8	1.1	1.9	13	0.82
	Water source	2.9	0.8	2.7	19	
	Treatment to poultry carcase	0.5	1.0	0.7	5.0	
	Sanitation and equipment facility	0.5	0.8	0.7	7.0	
	Cleanliness	1.1	1.2	0.4	6.0	
	Sanitation biosecurity of SOP	0.1	0.3	0.0	0.0	
	Total score	21.9		25		

Sellers in Sukabumi clean the transport cart more often and immediately after they deliver chicken. In Bogor area, this cleaning still splits between routine after delivery and cleaning when the poultry transport cage (basket) is dirty. The sellers in Sukabumi pay more attention at the poultry that they sell by doing a selection more stringently than the Bogor area. Sayeed et al. (2017) mention that housing chicken with another type of poultry and lack of hygienic in the shelter cage are the crucial factors for spreading Avian Influenza virus. Regular cleaning and giving disinfectant of poultry markets, proper washing facilities to the poultry transport cage and market rest days will reduce the spread of Avian Influenza virus (Offedu et al. 2016; Murhekar et al. 2013).

Managerial Implications

The managerial implications that can be recommended to layer chicken chain subjects related to the results of this research are as follows: The biosecurity scores in layer farmers and culled layer sellers are not optimal and need to be increased. Culled layer distribution system is in the form of live bird market that requires strict control in order to avoid exposure to the disease. In the farm, application of biosecurity points needs to be increased especially wild bird protection. Protection to wild bird may be increased by netting the gaps or opening in the flock building and by preventing wild birds to access the feed and water. The route, shelter time, and shelter disinfection process in the distribution of layers need to be considered to reduce the risk of disease.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Chicken chain of culled layers is a live bird system distribution, which involves layer farmers, collectors, poultry market sellers, butchers, and end consumers. Live bird distribution has the potential for disease spread especially if shelter hygiene is not considered.

The value of biosecurity scores of layers farm is at the medium level (33.4 and 40 from the maximum score of 60). In culled layer sellers, the scores are at the low level (21.9 and 25 from the maximum score of 69). Differences of biosecurity implementation at the farmer level between Bogor area and Sukabumi lie in the attractiveness and protection of wild birds. Differences of biosecurity implementation at the level of layer sellers in Bogor and Sukabumi lie in the action against new poultry and action on transportation equipment. At both points of this chicken chain. Sukabumi has a higher score than Bogor.

Recommendations

The live layer chicken chain has a potential spread of disease. The implementation of hygiene and sanitation, especially in the chicken chain point that has a poultry shelter should be considered. Making standard operating procedures in writing can be a way to improve the implementation of biosecurity.

REFERENCES

[ACIAR] Australian Centre for International Agricultural Research. 2014. Developing a clean market chain for poultry products in Indonesia. http://aciar.gov.au. [9 March 2017].

Aengwanich W, Boonsorn T, Srikot P. 2014. Intervention to improve biosecurity system of Poultry Production Clusters (PPCs) in Thailand. *Agriculture* 4:231–238. https://doi.org/10.3390/agriculture4030231.

Alhaji NB, Yatswako S. 2017. Awareness and mitigation measures on highly pathogenic avian influenza in pastoral poultry flocks of north central nigeria: any challenging gap?. *Veterinary Medicine and Science* 2017 (3): 156–168.

Artois j, Ippoliti C, Conte A, DHingra MS, Alfonso P, Tahawy AE, Elbestawy A, Ellakany HF, Gilbert M. 2018. Avian Influenza A (H5N1) outbreaks in different poultry farm types in egypt:the effect of vaccination, closing status, and farm size. *BMC Veterinary Research* 14: 187.

Assam A, Abdu PA, Ezealor A. 2016. Biosecurity risk of wild bird markets and wild bird trade to avian influenza in Kaduna State, Nigeria. *International Journal of Infectious Disease* 45 (1): 465. https://doi.org/10.1016/j.ijid.2016.02.985.

Azhar M. 2016. Situasi Penyakit AI Terkini dan Pelayanan Kesehatan Unggas Komersial. Dalam: *Seminar Peternak Unggas Nasional-Indolivestock 2016*. Jakarta: Departemen Pertanian.

[BPS] Badan Pusat Statistik. 2016. Jumlah unggas menurut kabupaten/ kota dan jenis unggas di Jawa Barat (Ekor). https://jabar.bps.go.id/statictable/2018/03/16/388/-jumlah-unggas-menurut-kabupaten-kota-dan-jenis-unggas-di-jawa-barat-ekor-2016.html [25 February 2017].

[BPS] Badan Pusat Statistik. 2017. Jumlah rumah tangga usaha peternakan menurut wilayah dan jenis ternak di Jawa Barat. https://st2013.bps.go.id/dev2/index.php/site/tabel?tid=50&wid=3200000000 [25 February 2017].

[FAO] Food and Agriculture Organization. 2008. Rural livelihood and biosecurity of smallholder poultry producers and poultry value chain. http://www.fao.org/docrep/013/al681e/al681e00.pdf [16 May 2018].

Fournie G, Guitian J, Desvaux S, Cuong VC, Dung DH, Pfeiffer DU, Mangtani P, Ghani AC. 2012. Interventions for Avian Influenza A (H5N1) risk management in live bird market network. *Journal PNAS* 110(22): 9177–9182. https://doi.org/10.1073/pnas.1220815110.

Hartawan R, Dharmayanti NLPI. 2012. Sirkulasi Virus Avian Influenza Subtipe H5N1 di pasar tradisional di Jawa Timur tahun 2012. *Berita Biologi* 13(1): 97–106.

Huang ZY, Loch A, Findlay C, Wang JM. 2017. Adoption of HPAI Biosecurity Measures: the chinese broiler industry. *Journal of Integrative Agriculture* 16(1): 181–189. https://doi.org/10.1016/S2095-3119(16)61511-3.

Knight-Jones TJ, Gibbens J, Wooldridge M, and Stark KD. 2011. Assesment of farm level biosecurity measures after an outbreak of avian influenza in the United Kingdom. *Transbound Emerge*

Disease 58 (1):69–75. https://doi.org/10.1111/j.1865-1682.2010.01183.x.

Martindah E, Ilham N, Basuno E. 2014. Biosecurity level of Poultry Production Cluster (PPC) in West Java, Indonesia. *International Journal of Poultry Science* 13(7): 408–415. https://doi.org/10.3923/ijps.2014.408.415.

Ministry of Agriculture. 2014. *Manual Penyakit Unggas*. Jakarta: Direktorat Jenderal Peternakan dan Kesehatan Hewan. Direktorat Kesehatan Hewan.

Murhekar M, Arima Y, Horby P, Vandemaele KAH, Vong S, Zijian F, Lee CK, Li A, and WHO. 2013. Avian Influenza A (H7N9) and the closure of live bird market. *Westerns Pacific Surveillance and Response Journal* 4(2): 4–7. https://doi.org/10.5365/wpsar.2013.4.2.008.

Ndem JU, Ogba EI. 2017. Biosecurity measures needed by rural poultry farmers for effective disease prevention. *International Journal of Advances in Agricultural Science and Technology* 4(4): 17–28.

Nofitri Z. 2014. Manajemen risiko rantai pasok unggas terkait kasus avian influenza di Kabupaten Bandung [skripsi]. Bogor: Institut Pertanian Bogor.

Offedu V, Cowling BJ, Peiris JSM. 2016.Intervention in live poultry markets for the control of avian influenza: a systematic review. *One Health* 2: 55–64. https://doi.org/10.1016/j.onehlt.2016.03.002.

[OIE] Office International des Epizootics. 2009. *Biosecurity for Highly Pathogenic Avian Influenza.* Rome: Food and Agriculture Organization of United Nation.

Rusny, Masri M, Baba S. 2015. Tingkat adopsi inovasi biosekuriti ayam ras petelur di kabupaten sidrap dan faktor-faktor yang mempengaruhi.Dalam: *Prosiding Seminar Nasional Mikrobiologi Kesehatan dan Lingkungan*. Makasar: UIN Alaudin. hlm 153–156.

Sayeed MA, Smallwood C, Imam T, Mahmud R, Hasan RB, Hasan M, Anwer MS, Rashid MH, Hoque MA. 2017. Assesment of hygienic conditions of live bird markets on avian influenza in Chittagong Metro, Bangladesh. *Preventive Veterinary Medicine* 142(1): 7–15. https://doi.org/10.1016/j.prevetmed.2017.04.009.

Setyawati S. 2010. Kajian epidemiologi virus Avian Influenza pada distribusi anak ayam umur satu hari [disertasi]. Bogor: Institut Pertanian Bogor.

Sharma B. 2010. Poultry production, management, and bio-security measures. *The Journal of Agriculture and Environment* 11: 120–125. https://doi.org/10.3126/aej.v11i0.3659.

Siahaan SJ. 2007. Pengaruh tingkat biosekuriti terhadap pemaparan avian influenza pada unggas air (studi kasus kontrol di Kabupaten Bogor dan Sukabumi) [tesis]. Bogor: Institut Pertanian Bogor.

Sugiarti D. 2009.Kondisi biosekuriti pada tempat penjualan unggas hidup di pasar tradisional di Kabupaten Tasikmalaya dan risikonya terhadap penyebaran avian influenza [skripsi]. Bogor: Institut Pertanian Bogor.

Tabbu CR. 2002. *Penyakit Ayam dan Penanggulangannya; Penyakit Bakterial, Mikal, dan Viral*. Yogyakarta: Kanisius.

Tanjung MH, Daryanto A, Muladno. 2013. Strategi bersaing pada rantai nilai ayam ras pedaging PT. Ciomas Adisatwa Region Jawa Barat Unit Bogor. *Jurnal Manajemen & Agribisnis* 10(1): 41–49.

Tempo. 2016. Kasus flu burung naik, jawa barat paling rawan.https://tekno.tempo.co/read/771344/kasus-flu-burung-naik-jawa-barat-paling-rawan. [24 July 2017].

Tenzin T, Wangdi C, Rai PB. 2017. Biosecurity survey in relation to the risk of HPAI outbreaks in backyard poultry holdings in thimpu city area, Bhutan. *BMC Veterinary Research* 13(113): 1–9.