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Biosecurity Level of Poultry Production Cluster (PPC) in West Java, Indonesia

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Abstract: A biosecurity assessment was conducted on poultry farms in Subang and Ciamis districts in West Java Province, Indonesia. The objective of the study was to assess biosecurity practices and the level of biosecurity across clustered and non-clustered poultry farms. A biosecurity scoring test which was developed in previous studies on avian influenza control practices, was used in this study. One out of every five farms was randomly chosen in poultry farms in Subang and Ciamis. The results of the study showed that individual farmers in both clustered and in non-clustered poultry farms did not apply biosecurity standard operational procedures (SOP) in optimal ways. In Subang, clustered poultry farms has an average score of 19 points, while non-clustered farms had an average score of 16.70. Two clustered poultry farms in Ciamis that are PPC I Ciamis and PPC II Ciamis had an average score of 7.40 and 9.97, respectively, from total score of 42 points. Therefore, all farmers in the study sites scored less than 50% in practicing biosecurity measures. Farmer did not properly apply biosecurity SOP partly because the company was already responsible for all disease preventions measures through vaccination program and provides all input for poultry production. It is recommended to reconsider of the involvement of farm workers in PPC and non-PPC as well as related stakeholders to follow some basic principles of biosecurity: (i) keep poultry in good condition, (ii) keep poultry in a protected environment and (iii) control the entries of outsiders to the farm.

Key words: Biosecurity, score, poultry production cluster, Indonesia

INTRODUCTION

After the Highly Pathogenic Avian Influenza (HPAI) outbreak in 2003, the governments in South-east Asian countries applied various control measures and posed higher biosecurity requirements for poultry producers. However, the small scale poultry farmers faced various institutional, political, technical and financial constraints to develop large scale poultry farms, as well as to upgrade and standardize its biosecurity. As one alternative, many Asian countries promoted the construction of poultry production clusters to drive small farms into intensive and standardized poultry production. In Indonesia, more than 160 Village Poultry Farming (VPF) had been established from 2006 to 2009 under a national pilot program (Direktorat Jenderal Peternakan, 2006). This program was initiated by the Directorate General of Livestock Services to develop centers of poultry production in rural areas, applying the Good Farming Practices as an effort to suppress outbreaks of poultry disease, particularly in the third and fourth sectors of poultry production. Based on production systems, Indonesian poultry industry is categorized into four sectors, namely sector one (large integrated industrial/breeding farm), sector two (population of 20,000-50,000), sector three (population of 1,000-20,000) and sector four (populations 1-100, mainly backyard chicken). Furthermore, the Ministry of Agriculture issued the regulation, Number 28/Permentan/OT.140/5/2008, on May 30, 2008 about "Compartment and Structuring Guidelines for Structuring the Poultry Business Zone" (Kementerian Pertanian, 2008). After the Avian Influenza (AI) crisis passed, some small-scale farmers bounced back to form a new poultry production cluster (PPC). Small-scale farmers recovered after the outbreak of AI due to partnerships with commercial breeders or farm company, as a nucleus. Langen (2002) defined a cluster as a "population of geographically concentrated and mutually related business units, associations and public (private) organizations centred on a distinctive economic specialization". He concluded that the performance of clusters depends on many factors, not only on the sum of the performance of the business units in the cluster.

In spite of the fast growth of production clusters, there is very limited empirical evidence of environmental consequences of production clusters, particularly the control of emerging animal diseases through biosecurity (McCrea and Bradley, 2008). Biosecurity is the product of all actions to reduce the risk of transmission of infectious diseases and to prevent introduction of

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disease agents into a specific area (Iqbal, 2009; Australian Biosecurity Co-operative Research Centre, 2009; Julien and Thomson, 2011; Fasina *et al*., 2011). Biosecurity is a way to avoid contact between animals and microbes and thus helps to protect a farm against many diseases, not only avian influenza. The three main principal components of biosecurity are isolation of farm location, traffic control (including human, animal and materials) and sanitation (McCrea and Bradley, 2008; Sharma, 2010). Isolation and traffic control are effective methods to prevent disease entering the flock, while sanitation is crucial in eliminating the presence of disease agents. Acording to Sharma (2010), the possible breakdowns in biosecurity norms and entering of new birds and traffic pose the greatest risk to bird's health.

In operating poultry farms, biosecurity practices are an important part of the health management plan of all operations. Even though small farms do not produce large numbers of poultry, it does not mean that biosecurity is not an important part. Biosecurity practices had been widely disseminated but the awareness of most poultry farmers to practice and implement biosecurity is still a challenge. Study in Thailand suggested that biosecurity levels of contract farm were better than cooperative and individual ones due to several factors (Wei and Aengwanich, 2012).

The objective of the study was to assess the practice of farmers in implementing biosecurity and to evaluate the level of biosecurity in the PPC in Indonesia. The knowledge gained will help in evaluating the outbreak control policies for poultry diseases and to promote the development of biosecurity practice of poultry farms.

MATERIALS AND METHODS

Study design: This case study was part of the research project entitle "Eco-Health Assessment on Poultry Production Clusters (PPCs) for the Livelihood Improvement of Small Producers". The design of this study is a survey to assess the practice of biosecurity in the small scale poultry farms of PPC in Indonesia, which was done in February to April 2012.

Study site: The study was conducted in two districts i.e. Subang and Ciamis of West Java Province, Indonesia. These locations were chosen to meet criteria for PPC, which consist of small scale poultry farmers with poultry population 1000-5000 birds per household. The type of poultry raised differ between those two locations. Farmers in Subang raised broiler and farmers in Ciamis raised male layer. In addition there are locations in Subang District where small scale poultry farmers live around the PPC and do not directly affected by the establishment of the PPC, i.e. non-PPC. This location representative of buffer location, poultry population per household are similar to those in PPC, that is less than 5000 birds. There is no control group in this study and there is no buffer location in Ciamis district.

Data collection and interpretation

Biosecurity assessment: Survey to assess of the biosecurity implementation by poultry farms in the PPCs (Subang, PPC I Ciamis, PPC II Ciamis) and non-PPC (Subang) was carried out by interview. Interview of total of 188 farmers or farm workers was conducted using questionnaires and wherever possible answers were verified by direct observation at the time of farm visits. In addition, to evaluate the level of biosecurity in the PPC, direct observation on the poultry farm was conducted. One out of every five farms (20% out of the total farms) were randomly chosen in poultry farms in Subang and Ciamis. Biosecurity measurement at the PPCs were conducted by using a simple biosecurity score check list. This list was developed by Dr. Les Sims, IDRC Project Consultants 2011, referring to the FAO information about the biosecurity system (FAO, 2008).

Guides to score biosecurity measures: Biosecurity is the product of all actions undertaken by an entity to reduce the risk of transmission of infectious diseases and to prevent introduction of disease agents into a specific area. Biosecurity score check list form (Table 1) was devised to allow some degree of standardization in approach towards farm biosecurity. Fourteen types of risk assessment parameters were used and the possible maximum score is 42. The higher the score the better the biosecurity level. Parameters 1 to 13 serve as potential pathways for the entry of diseases to farms and then into poultry sheds, while the last parameter (the 14th) provide general information on the overall approach to biosecurity. Scores were recorded as 0, 1, 2, 3, for each parameter. Zero (0) is the lowest score for each risk pathway (the interpretation of "0" is low biosecurity). Score of 1 and 2 showed "moderate" biosecurity while the scale of 3 was high biosecurity meaning biosecurity parameters were actually performed or applied.

RESULTS AND DISCUSSION

Clusters has been defined by Langen (2002) as a "geographically concentrated population shared by related business units, associations and public (private) organizations centred on a distinctive economic". In this study poultry production cluster (PPC) refers to areas of concentrated poultry farms (involving multiple households or owners) in rural areas, usually separated from residential area, which practice certain economy of scale and apply standard biosecurity. The existence of PPC is an important production mode for small scale poultry farmers to stay in poultry sector and how to control infectious diseases under the increased public concerns on biosecurity. Biosecurity measures become

Table 1: Indicator and definition of biosecurity scores

No	Indicators	Score	Definition
1	Attractiveness to wild birds	3	Farm is located in non-migrated bird area. No trees or water pools within 100 m
		2	Trees surrounding the farm but no pond
		1	Ponds nearby the farm within 50 m
		0	Both trees and ponds located within 50 m
2	Wild-bird protection	3	Chicken in cages, surrounded by nets as a protective enclosure
		2	The nets to protect the poultry sheds about 70%
		1	The nets can protect 50% of the poultry sheds
		0	The poultry shed is open and there is no net
3	Measures related to staff in the farm	3	Farm worker lives in the farm at least for one production cycle
		2	Farm worker lives outside the farms and use disinfectant, equipments (change of shoes, clothes etc) when entering the poultry sheds
		1	There is some action upon entering the poultry shed, but very little impact on biosecurity. (eg just changing shoes)
		0	Farm workers work without any control when entering and out of the farm and does not implement biosecurity standards
4	Measures for incoming poultry (all in, all out?)	3	The farm keeps the same cycle and all the poultry comes from the same company
		2	Measures are taken for the control of the incoming poultry
		1	New entering poultry is separated only by using a partition
		0	No measure is taken for new entering poultry
5	Measures for visitors	3	Visitor cannot enter the farms or there is a fully developed disinfection system (taking a shower; changing clothes).
		2	Taking some measures for the visitors, fencing around the farm. Footwear and disinfection are required at the entrance
		1	Measures taken but not so effective or under poor arrangement
		0	Visitor can enter the poultry sheds directly
6	Measures for traders	3	Traders are not allowed to enter the farm
		2	Traders enter the farm without entering the poultry sheds
		1	Traders are allowed to enter the poultry sheds after getting disinfection
		0	No measures for the traders at all
7	Measures for equipments and vehicles, (transport for feed, DOC etc)	3	No vehicle entering the farm
		2	Disinfect the vehicles upon entry into the farm
		1	Measures are taken but not so effective or under poor arrangement
		0	No control to the vehicles/ vehicles are free entering the farms
8	Source of water	3	Clean water from dug wells (underground)/artesian well
		2	Clean water from rain water and uncontaminated
		1	Sources: surface water (river, pond) to be treated, e.g., chlorine
		0	Sources: surface water without treatment
9	Source of feed	3	Feed provided by the company (commercial feed)
		2	Formulation of feed mixed at the farm using machinery (mini feed mill)
		1	Mixed feed formulation by the farmers
		0	Mixed feed without special formulation
10	Local environment: distance from road to the farm	3	The farm is far from a public road and other farms more than 300 m
		2	Either other farm or public road are located within 100-<300 m
		1	Either other farm or public road located within 50-100 m
		0	Both other farm and public road located within 50 m
11	Different types of poultry in farm	3	Only one type of poultry in the farm
		2	A few types of poultry in the farm, kept in separated housings
		1	A few types of poultry in the farm, free range
		0	Various types of poultry around the poultry sheds
12	Capacity to clean and disinfect the farm	3	Cleans and disinfects the whole area regularly (more than once a week)
		2	Cleans and disinfects only several parts of the farm regularly
		1	Cleans and disinfects, usually during outbreaks
		0	No disinfection or cleaning at all
13	Measures taken at the entrance to poultry sheds	3	Fully developed system of disinfection (usually under the guidance of a company). e.g. taking a shower and changing clothes
		2	Some measures of disinfection, including-pass a disinfectant tank before entering the shed, change boots or other footwear special for the sheds
		1	Measures taken but not so effective, for example only change the shoes
		0	No disinfection or cleaning at all
14	Biosecurity plans	3	Design a coherently suitable plan under sustainable biosecurity development
		2	Farmers have separate plans e.g. updating equipments for a better biosecurity level, learn about biosecurity
		1	Just obey any guidance or regulation of the local area. No individual plan
		0	No plan or guidance to follow

crucial for better performance and quality of poultry production in a competitive world (Sharma, 2010).

Poultry production cluster and non-ppc in subang: Poultry Production Cluster (PPC) in Subang district (PPC Subang) is located in rice field areas with flat topography, which covering two villages i.e. Situsari and Sukasari villages. There are no clear geographic boundaries between two villages. Non-PPC Subang consists some small poultry farmers who raise broiler chickens but are not included in the PPC. The pens of the poultry are spread out and are not located in one area. They located in three villages: Batusari, Cisampih and Dawuan Kidul.

The farmers in PPC and non-PPC in Subang raise broiler chickens, in their own land which used to be rice fields. The distance between pens and residential area in the PPC Subang is about 1.1 km, while the average distance between the farmers' house and the poultry pen in non-PPC is about 0.5 km. The number of farmers in PPC are 52 people, with the broiler population in average were 5138 per household. The number of farmers in non-PPC Subang is 31 people and mean chicken population per household is 4,577 birds. Since the year 2006/2007 farmers in PPC Subang partnered with the company (contract farm) as a nucleus under the '*maklun'* system, that is a partnership with no risk sharing. The company/nucleus has the authority over operational and diseases control management through its technical service person and also responsible for marketing of the live chicken.

Poultry production cluster in ciamis: Poultry Production Cluster (PPC) in Ciamis district are located in Baregbeg sub district (PPC I Ciamis) and in Sukadana Sub district (PPC II Ciamis). Those small-scale poultry farmers contract with the Poultry-shop, as nucleus, also under the '*maklun*' system. PPCs in Ciamis, are located on undulating topography, where the poultry pens are in residential area with trees around them. In these two locations, the average distance between farmers' houses and poultry pens is much less than 100 m, or even some of them are only 3 meters from the house to the poultry pen. Climate of the natural environment on both PPC did not differ. Although the distance between two PPCs in Ciamis is about 30 km, however their poultry management are relatively similar since those PPCs are partnered with the same poultry shop. The number of farmers in PPC I and in PPC II in Ciamis were 54 and 51 people, respectively. The type of poultry that are kept in both PPCs in Ciamis is male layer and it was started since 1990. The poultry population in the PPCs per farmers on average is 2.206 to 2.854 chickens, respectively.

Implementation of biosecurity in study sites: Shane (1998) divided biosecurity components in three levels of hierarchy, i.e. conceptual biosecurity, structural biosecurity and operational biosecurity:

1: A conceptual biosecurity (level one), is the basic of the whole program of disease prevention. This includes site selection for the farm in the area. The placement of a poultry sheds in a location that is close to public road, residential and poultry slaughterhouse will affect the effectiveness in maintaining optimal production standard
2: Structural biosecurity (level two) relating to the farm layout such as fences installations, drainage, tools of decontamination, feed storage, equipment, etc
3: Operational biosecurity (level three) consists of management procedure and routine activity to prevent diseases transmission and spread in the farm area

With regard to the conceptual biosecurity, the area of both PPC and non-PPC in Subang are effective in term of distance from residential area, where more than 94% out of 52 poultry pens in PPC Subang and 64% out of 31 poultry farms in non-PPC are far away from the residential areas. Meanwhile, the farm sites in Ciamis (PPC I and PPC II) are less effective, as most of the poultry pens are located in residential area (Fig. 1). Ideally, conceptual and structural biosecurity should first be considered before operational biosecurity (Poultry Indonesia, 2013). However, in most situations it is impossible to change the location of the premises. It is usually feasible to optimize performance and to improve the technical equipments.

Results of survey towards farm workers on implementation of biosecurity measures can be seen in Table 2 and Table 3. Direct interview was conducted during the survey. Table 2 shows that only few farmers practiced biosecurity principles with low consistency. The use of special clothing to enter poultry sheds for example was only applied by 7-20% of farmers. Feet dipping in non-PPC Subang and PPC II Ciamis practice by 58 to 78%, respectively (Table 2). However, "dipping" according to farmers' perception means washing the feet, even without disinfectant. This finding indicated that most farmers lack knowledge on biosecurity messages, such as that the function of disinfection is as one of supporting strategy to reduce pathogen enter to the premise. This was consistent with the finding of Nerkar *et al.* (2010) in India and Lestari *et al.* (2011) in Indonesia, that very few smallholders poultry farm have a foot bath as sanitary before entering the poultry area.

With regard to the biosecurity practice at farm gate (Table 3), few farmers in non-PPC Subang had "YES" answer (12.8%) which make the total of "YES" answer is the highest compare to the other three PPCs. It could be understood as farmers in non-PPC are independent in providing farm inputs, those make some of them aware

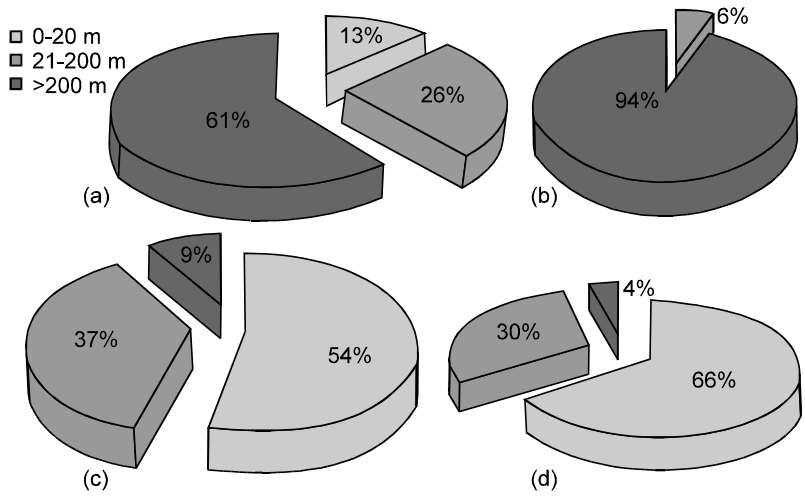

Fig. 1(a-d): Percentage of residential areas from the poultry pens, based on its distance. (a) Non-PPC Subang, (b) PPC Subang, (c) PPC I Ciamis and (d) PPC II Ciamis

Table 2: Sanitation as part of biosecurity implementation by farm workers in Study Areas

	Subang		Ciamis	
Indicator	Non PPC (n = 31)	PPC (n = 52)	PPC I (n = 54)	PPC II (n = 51)
Usage of special clothing (%)				
Yes	16.13	20.75	7.41	22.22
No	83.87	79.25	92.59	77.78
Usage of special footwear (%)				
Yes	48.39	47.17	12.96	33.33
No	51.61	52.83	87.40	66.67
Usage of special masker (%)				
Yes	12.90	41.51	18.2	31.75
No	87.10	58.49	81.48	68.25
Usage of special hat (%)				
Yes	16.13	49.06	3.70	23.81
No	83.87	50.94	96.30	76.19
Feet dipping (%)				
Yes	58.06	33.96	16.67	77.78
No	41.94	66.04	83.33	22.22
Total average of yes answer	30.32	24.91	11.85	37.78

to apply biosecurity for the farms. However, vehicle spraying and providing special clothing and footwear (shoes) to the visitor, is unlikely practiced by farmers in all PPCs and in non PPC. The finding suggested, that structural and operational biosecurity is still weak, due to lack of resources and farmers' initiative to apply biosecurity properly in their farms. Lestari *et al*. (2011) found that the low level of biosecurity adoption might caused by socio-economic and technical factors. Acording to Sharma (2010), the possible breakdowns in biosecurity norms and entering of new chickens and traffic pose the greatest risk to poultry health. He suggests these two factors should be managed properly as a top priority in a farm. Some experts on poultry farm who are interviewed by Poultry Indonesia (2013) suggested that the cycles of diseases which is occurred every years was caused by multi-factors such as management, biosecurity and control function such as vaccination program.

Survey finding had been confirmed by field observation to measure the biosecurity level (score) based on the 14 indicators. The maximum scores of all 14 indicators 42 points. The biosecurity score in PPCs and non-PPC (Table 4) was obtained from direct observation in PPC I and PPC II in Ciamis, PPC Subang and non-PPC Subang. The highest score is achieved by PPC Subang with total score of 19, followed by non-PPC Subang 16.7, PPC II Ciamis and PPC I Ciamis, 9.97 and 7.4 points respectively. In general, the biosecurity score in the three PPCs were low, which is confirmed with survey finding and it indicated that farmers are not aware and lack knowledge on biosecurity messages. The score of biosecurity in PPC Subang was 19 out of 42, only 45.24% from 14 indicators applied. Meanwhile, the figure of non-PPC Subang was 39.76%, PPC II Ciamis 23.73% and PPC I Ciamis was only 17.62%. Therefore, score of all farms in practicing biosecurity measures both contract farm/PPCs and independent farm/non-PPC

Table 3: Biosecurity practice at farm gate in study areas, 2012

	Subang		Ciamis	
Indicator	Non PPC n = 31	PPC n = 52	PPC I n = 54	PPC II n = 51
Visitor spraying (%)				
Yes	26	2	0	2
No	74	98	100	98
Vehicle spraying (%)				
Yes	6	0	0	0
No	94	100	100	100
Provision of special clothing for visitor (%)				
Yes	0	0	0	0
No	100	100	100	100
Provision of special footwear for visitor (%)				
Yes	3	0	0	0
No	97	100	100	100
Vehicle entry prohibition (%)				
Yes	29	2	0	21
No	71	98	100	79
Total average of yes answer	12.8	0.8	0	4.6

Table 4: Biosecurity Score in PPC I Ciamis, PPC II Ciamis, PPC Subang and non-PPC Subang

	Observation			
Indicator	PPC I Ciamis	PPC II Ciamis	PPC Subang	Non-PPC Subang
Wild bird existence	0	0	0	0
Wild bird protection	1	1.16	1	1
Associated farm worker	0	0	1	1.25
Poultry entry (all in-all out)	1.08	1.25	3	1.05
Visitors	1	1	1	1
Seller	1	1	3	1.5
Used tool and vehicle	0	0	0	0
Water source	1.08	2.08	2	2.1
Animal feeds	2	2.08	3	3
Local environment (distance with road)	0	0.16	1	1.3
Existence of another bird around the poultry sheds	0.16	0.06	2	1
Hygiene and cage disinfection	1.08	1.08	0	1
Measurement of Bio-security Implementation at entrance of farm area	0	0	1	1.5
Bio-security SOP	0.08	0.08	1	1
Total	7.4	9.97	19	16.7

in the study area was less than 50%. However, findings suggested that biosecurity practices in broilers farmers (PPC Subang and non-PPC Subang) were better than male layer farmers in PPC I and PPC II Ciamis, even though was not good enough for biosecurity measures. These findings were different with study results from Thailand (Wei and Aengwanich, 2012) that biosecurity levels of contract farm were better than cooperative and individual ones. Based on these results, company should have a right and power to encourage farmers to practice the biosecurity measures. Fraser *et al.* (2010) suggested that financial inducements or penalties for farmers could be necessary to facilitate adoption of biosecurity measures. Meanwhile, Susilowati *et al.* (2013) found that biosecurity control scores (BCS) in Bali broiler smallholders have a significantly higher biosecurity scores than layer smallholders, while in West Java, layer farms have significantly higher BCS scores than broilers.

Interview result among PPC showed that PPC II Ciamis has the highest total of 'YES' answer to the question related to the sanitation as part of biosecurity implementation (Table 2). These result was not consistent compare to the observation result (Table 4), in which the score of biosecurity is low. This finding indicated that farmers actually know what have to be done, so that they are able to answer questions correctly. However, minimal biosecurity practices as list in the questionnaire were not implemented by the farmers.

Implementation of appropriate biosecurity is one important part in disease prevention, which is included in the control management. In a *maklun* scheme (partnership without risk), all production inputs are provided by the company. Under this scheme marketing for all products is handled by the company. These cause farmers do not have any goal to increase their poultry production, likewise in their effort to reduce mortality rate.

Prevention and disease control are part of companies' responsibilities, so farmers possibly will conduct disease prevention efforts with minimum capacity. It could be understood as under *maklun* scheme farmers will not face any risk. Case in Subang District, payment from the company has already done in advance when DOC enter the farm and this cause farmers have less responsibility in term of farm management and disease control, less aware to the important of biosecurity. All of these, resulting less concern to the risk factor of their poultry health. In fact, operational biosecurity much more depends on its implementation, especially the commitment of farm workers. In other words, farms workers who work directly or indirectly in the poultry farm is responsible for biosecurity measures. Biosecurity activities are management changes, which may be low cost but require commitment from owners and farm workers to implement (Susilowati *et al*., 2013). Bleich *et al*. (2009) stated that developing and achieving adoption of biosecurity measures required a multidisciplinary and participatory approach of all related stakeholders among poultry farms, such as producers, intermediaries, traders and communities. In Nepal, biosecurity policy can be formulated with the participation of stakeholders, which would give new dimensions towards poultry farming (Sharma, 2010). In order to support effective operation of biosecurity, reconsider the involvement of farm workers, health monitoring in each cage and regular evaluation standard biosecurity implementation are needed. It is recommended that farmers must be encouraged to follow some basic principles of biosecurity: (i) keeping chickens in a healthy condition, (ii) keeping chickens in a conducive environment and (iii) prevent people from entering the enclosure.

Conclusion: In general, most farmers in PPC did not properly apply biosecurity SOPs partly because all input for poultry production including disease preventions measures through vaccination program is under the responsibility of partner or company. Level of biosecurity in the PPCs are still lack behind a good biosecurity standard. Company should have a right and power to encourage farmers to practice the biosecurity measures. These following recommendation for farmers are important: (I) keeping chickens in a healthy condition, (ii) keeping chickens in a conducive environment and (iii) prevent people from entering the enclosure.

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