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Biosecurity Level Practices in Pig and Poultry Production in Vietnam

Ngo Thi Kim Cuc*, Nguyen Cong Dinh, Ngo Thi Le Quyen, Ha Minh Tuan

National Institute of Animal Science, Vietnam

Abstract | The objective of this study was to score the biosecurity status of pig and poultry production systems in Vietnam. The project surveyed 35 pig and 35 poultry farms, in Hanoi and Dong Nai provinces respectively, using the Biocheck.Ugent™ tool. The Biocheck.UGent tool comprises 109 pig and 79 poultry questions subdivided within breeds into the external biosecurity and the internal biosecurity question sets. External and internal biosecurity scores for pig farms were similar (53,56% and 55,05%, p>0.05). By contrast, for poultry farms, the external score was lower than the internal score (59,55% and 65,18%, , p<0.05). For the external biosecurity of pig farms, purchasing animals and semen scored highest, whereas entrance of personnel and visitors scored lowest. For the internal biosecurity of pig farms, disease management scored highest. For the external biosecurity of poultry farms, purchase of day-old chicks scored highest. For the internal biosecurity of poultry farms, supply of material and disease management scored highest whilst removal of manure and dead animals scored lowest. In conclusion, whilst there was some variation in scores between and within external or internal factors for the pig and poultry farms surveyed, relatively low scores throughout the study indicate opportunities for improvement in all factors considered.

Keywords | Internal biosecurity, External biosecurity, Pig farm, Poultry farm, Biocheck tool

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***Correspondence** | Ngo Thi Kim Cuc, National Institute of Animal Science, Vietnam; **Email:** cucngokim@yahoo.com
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INTRODUCTION

In Vietnam, the pig and poultry sectors play a leading role in the production of meat. In 2018, there were 28.151 million pigs and 408.97 million poultrys slaughtered to produce 3.8 million tons of pork and 1.1 million tons of poultry meat, accounting for 92 percent of the country's meat output. Ha Noi and Dong Nai provinces contributed the highest pig and poultry population (GSO. 2019). However, the productivity of both sectors is currently threatened by major biosecurity issues such as African swine fever (ASF) and Avian Influenza (AI). The ASF virus was first detected in Vietnam in February 2019 and has since spread to all 63 provinces leading to the death and culling of approximately 6.0 million pigs. The AI virus has spread to 24 provinces with 0.13 million poultrys dead and culled (Luu, 2019). The Vietnamese Government had identified improved biosecurity as a key strategy to prevent such outbreaks in the future.

The Food and Agriculture Organisation of the United Nations (FAO, 2020) strongly recommends the strict application of biosecurity measures as the most effective way to prevent and control the spread of AI viruses and to prevent transmission to humans. Since the development of a vaccine for ASF is yet to be achieved, the improvement of farm biosecurity remains the best option for prevention. Biosecurity, defined as all measures taken to prevent both the introduction and the spread of infectious agents on-farm (Barcelo and Marco, 1998) is a major factor affecting disease occurrence and antimicrobial use (Amass and Clark. 1999). The successful application of on-farm biosecurity strategies can prevent pathogenic agents from entering (external biosecurity) or spreading once inside the farm (internal biosecurity); to improve animal productivity and health and to a low reduce the use of antimicrobials (Laanen et al., 2013, Gelaude et al., 2014, Rojo-Gimeno et al., 2016, Postma et al., 2016; 2017).

The widespread misuse of antimicrobials, particularly antibiotics for the prevention of bacterial disease in livestock and poor husbandry management represent major risk factors for the development antimicrobial resistance in Vietnam. For example, Hoa et al. (2019) found that 100% of pig household-owners used antibiotics primarilyas growth promoters and many used them at a higher does rate than prescribed. However, whilst specific studies such as these provide insights, there is currently no systematic review of how well biosecurity is implemented on Vietnam's pig and poultry farms. Different studies have shown positive associations between biosecurity and some pig production parameters such as piglet mortality, finisher mortality, and average daily gain (Laanen et al., 2013, Postma et al., 2016) and between biosecurity and farm profitability (Corrégé et al., 2012, Rojo-Gimeno et al., 2016). A higher biosecurity level also has a positive impact on reducing the amount of antimicrobials used on-farm (O'Neill, 2014, Laanen et al., 2013, Postma et al., 2016, Rojo-Gimeno et al., 2016).

Concerns with antimicrobial resistance in pig and poultry production and the risk of transmission of their diseases to humans has increased awareness in Vietnam of the need to improve farm biosecurity. In order to achieve that a systematic assessment of biosecurity is needed, so as to define the biosecurity factors with greatest potential for improvement. The Biocheck.UGent™ scoring system offers such an assessment tool. It was developed by Gent University (www.biocheck.ugent.be) to assess biosecurity using a risk management approach and has been successfully applied in many countries (Laanen et al., 2013, Gelaude et al., 2014, Backhand et al., 2015, Postma et al., 2016). The need to improve pig and poultry farm biosecurity needs also to be considered in the context that larger scale farms in Vietnam are considered to have relatively better biosecurity than small-scale (household) farms and that the government is actively promoting a move toward larger scale more intensive meat production systems (Vietnamese Government Decision 124/QD-TTg (2012) "Master plan of production development of Agriculture to 2020 and a vision toward 2030"; Ministry of Agriculture and Rural Development Decision 984/QD-BNN-CN (2014). Therefore, the objectives of this study were to describe the biosecurity status in the pig and poultry production systems in Vietnam using Biocheck technology based on interviews with the farmers.

MATERIALS AND METHODS

Selection of Participating Herds and Herd Visits

This study was carried out in the Vietnamese provinces of Ha Noi and Dong Nai from September 2018 to December 2019. The secondary data on information on the pig and poultry farms were collect from the Ha Noi and Dong Nai Department of Agriculture and Rural Development. Following this information, a total of 35 pig and poultry 35 farm managers were randomly selected for a single visit and interview. A description of the selected farms is provided in the Table 1. The data was collected using the Biocheck questionnaire tool (www.biocheck.ugent.be; Laanen et al., 2013) which is a web-based scoring system using limesurvey. A strict protocol was used to interview the participating farmers, guaranteeing a similar collection and entry of data across farms. Interviewers received training in how to standardize the method for data collection from a collaborating Belgium veterinarian/researcher familiar with the Biocheck questionaire.

Data Collection

A tour of each farm was conducted to collect the data using the BioCheck tool. It comprised 109 questions for pig farms and 79 for poultry farms, with mainly di- or trichotomous questions subdivided into subcategories for external and internal biosecurity. Every subcategory comprised 2 to 13 questions. This risk-based scoring tool is designed to assess the level of both external and internal biosecurity and has been used in more than 50 countries. For pig farms, there were 6 subcategories for external biosecurity and 6 subcategories for internal biosecurity (Table 2). For poultry farms there were 8 subcategories for external biosecurity and 3 subcategories for internal biosecurity (Table 3).

Briefly, points were allotted for questions within the subcategories, with each given a weighting factor depending on its estimated importance for the introduction and spread of infectious diseases, as defined by Laanen et al. (2013) and Gelaude et al. (2014). The weighted scores of the questions were subsequently combined into scores for each subcategory which were further weighted and combined into scores between 0 and 100 for internal and external biosecurity respectively, where 0 corresponded to "total absence of biosecurity" and 100 to "perfect biosecurity". Finally, the mean of the scores for external and internal biosecurity was calculated as a whole-herd score.

All questions in the tool were translated from English into Vietnamese and questions about production parameters, preventive measures such as vaccination routines, and the educational level, gender and years of experience of the staff member responsible for pig and poultry management were also included. All questions from Biocheck tool were answered.

Statistical Analysis

After each visit, the data collected was converted to scores by the Biocheck tool. A detailed description of how the scores are calculated is explained by Backhans et al. (2015),

Table 1: Characteristics of the pig and poultry farms

Farm type	Parameters	X	SD	MAX	MIN
Pig	Number of pig	328.8	230.2	750	110
	Years of experience	14.33	5.21	25	5
	Number of workers per farm	2.90	1.18	6	1
	Age of oldest building (years)	11.62	4.09	20	6
	Age the youngest building (years)	6.48	4.11	15	1
Poultry	Number of poultry	7387.5	2942.3	12000	3000
	Years of experience	10.15	5.43	20	2
	Number of workers per farm	3.75	2.97	15	1
	Age of oldest building (years)	9.45	4.24	15	2
	Age the youngest building (years)	4.15	3.30	15	1

Table 2: Biosecurity scores of pig farms (%, n=35)

Category	Subcategory	X	SD	MAX	MIN
External	Purchase of animal and semen	83.12	15.06	100	50
	Transport of animals and removal of manure and dead animals	53.93	14.49	78	24
	Feed, water and equipment supplies	41.12	14.54	58	12
	Entrance of personnel and visitors	28.79	24.17	82	0
	Vermin and bird control	40.59	12.05	76	20
	The environment and region	45.85	26.73	100	20
	Mean	53.56	7.88	70	40
Internal	Disease management	56.66	27.93	100	18
	farrowing and suckling period	62.90	14.46	88	38
	Nursery units	67.21	14.22	86	34
	Fattening units	63.29	17.94	100	36
	Measures between compartments and the use of equipment	36.94	12.92	75	12
	Cleaning and disinfection	65.62	19.80	98	20
	Mean	55.05	11.97	82	32
Total		54.53			

Table 3: Biosecurity scores of poultry farms (%, n=35)

Category	Subcategory	X	SD	MAX	MIN
External	Purchase of day old chicks	84.45	17.60	100	36
	Depopulation of broiler	74.64	19.56	100	35
	Feed, water supplies	30.27	21.60	88	4
	Removal of manure and dead animals	19.09	17.82	68	6
	Entrance of visitor and personal	57.73	19.50	92	35
	Supply of material	88.00	22.74	100	56
	Infrastructure and biological vectors	60.91	20.90	92	11
	Location of farm	56.64	23.94	100	30
	Mean	59.55	11.80	88	41

Internal	Disease management	82.91	15.93	100	52
	Measures between compartments and the use of equipment	50.82	15.37	100	15
	Cleaning and disinfection	61.91	28.84	100	29
	Mean	65.18	10.70	83	45
Total		62.36			

Laanen et al. (2013) and Galaude el al. (2014). The scores for each biosecurity factor are then compared with benchmark international averages derived from previous studies on real farms that have used the Biocheck tool in many countries around the world, analyzed anonymously.

RESULTS

Pig Biosecurity

Characteristics of pig farm was indicated in the Table 1. The number of pigs per farm ranged from 110 to 750. The external biosecurity subcategory that received the highest score was the purchase of animal and semen (83.12 ± 15.06%), while other factors had relatively low scores such as entrance of personnel and visitors (28.79 ± 24.17%); vermin and bird control (40.59 ± 12.05%); feed, water and equipment supplies (41.12 ± 14.54%); and environment and location (45.85 ±26.73%) (Table 2). For internal biosecurity, the highest score was nursery units (67.21 ± 14.22%) while the lowest was measures between compartments and the use of equipment (36.94 ± 12.92%). Some subcategories showed relatively high variation across farms, such as entrance of personnel and visitors or disease management and cleaning and disinfection. The external and internal biosecurity scores in pig farms averaged 53.56% and 55.05% , respectively. There were no farm showing all subcategories met biosecurity requirement when test by Bio-check.

Compared to average global biosecurity scores, the results in the Figure 1 indicate that three subcategories of the internal biosecurity in the pig farms - cleaning and disinfection, nursery and farrowing units – were satisfactory. However, the scores of the other three internal biosecurity subcategories and all of the external biosecurity subcategories in the external biosecurity were lower than the global benchmarks.

Poultry Biosecurity

The number of poultrys per farm ranged from 3000 to 12000 (Table 1). For external biosecurity, the subcategory with the highest score was supply of material (88.00 ± 22.74%), followed by purchase of day old chicks (84.45 ± 17.60%), depopulation of broiler (74.64 ± 19.56%) and infrastructure and biological vectors (60.91 ±20.90%) (Table 3). The subcategory with the lowest score was removal of manure and dead animals (19.09 ±17.82%), followed by feed and water supplies (30.27 ±21.60%). For internal biosecurity, the disease management subcategory scored highest (82.91 ± 15.93%) , while measures between compartments and the use of equipment scored lowest (50.82 ± 15.37%). The subcategories including supply of materials, and the managements of materials and measures between compartments have a large variation across in scores across farms. There were no farm showing all subcategories met biosecurity requirement when test by Bio-check.

Compared to average global biosecurity scores, four subcategories were higher: purchase of day old chicks, supply of material, and depopulation of broiler and disease management. However, the average external and internal biosecurity scores of surveyed poultry farms were lower than the global average scores (Figure 2).

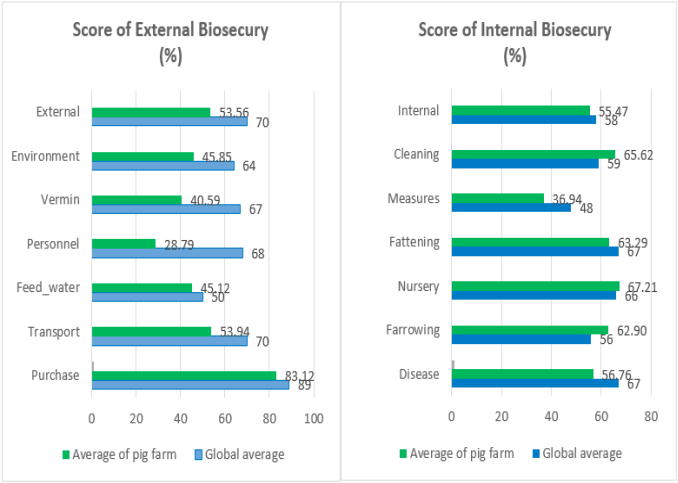

Figure 1: The average biosecurity scores of surveyed pig farms compared to the global average scores

Keynote: *Purchase: purchase of animals and semen; Transport: transport of animals and removal of manure and dead animals; Feed_ water: feed, water and equipment supplies; Personal: entrance of personal and visitor; Vermin: vermin and bird control; Environment: the environment and region. Disease: disease management; Farrowing: the farrowing and suckling period; Nursery: nursery unit; Fattening: fattening unit; Measure: measures between compartments and the use of equipment; and Cleaning: cleaning and disinfection.*

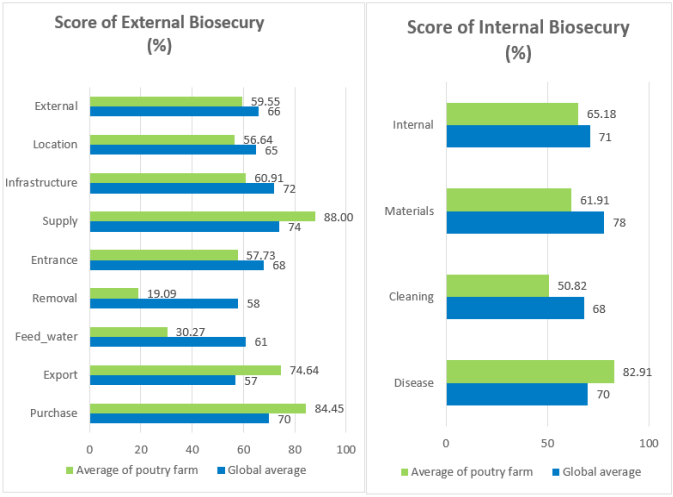

Figure 2: The average biosecurity scores of surveyed poultry farms compared to the global average scores

***Keynote**: Purchase: purchase of one day old chicks; Export: depopulation of broiler; Feed_ water: feed, water supplies; Removal : removal of manure and dead animals; Entrance: entrance of visitor and personal"; Supply: supply of material; Infrastructure: iInfrastructure and biological vectors and Location : location of the farm. Disease: disease management; "measures between compartments and the use of equipment"; and "Cleaning and disinfection".*

DISCUSSION

For external biosecurity factors on the pig farms the highest score was for the purchase of animal and semen. This could be explained as follows: (i) almost all of breeding pigs, piglets and semen were purchased from the same supplier, (ii) The farmers paid more attention to the health status of the farm where the animal or semen originated, and (iii) the time of year that breeding pigs are delivered is limited. Lack of some controlling activities, such as checking visitors before entrance to the stables, hygiene lock, changing farm-specific clothing and shoes, washing hands and control of vermin, resulted in low scores for these factors. For internal biosecurity, the high scores in relation to the nursery units is likely due to habit of Vietnamese people to pay most attention to younger animals. However, the farmer paid less attention to the use of farm-specific clothing and shoes, and washing hands when they moved between compartments. This could explain the lowest score for measures between compartments and the use of equipment.

For pigs, the average score for external biosecurity was slightly higher than indicated by the benchmark for Belgian herds (52%) described by Laanen et al. (2013) but lower when compared with Swedish pig herds (68%) (Backhand et al., 2015), using the same scoring system. However, the average scores for internal biosecurity in the current study (55.05%) were lower than those in the studies of Laanen et al. (2013). Laanen et al. (2013) and Backhand et al. (2015) reported that the average score for internal biosecurity of pig farms was 66% and 59%, respectively.

Postma et al. (2016) researched the biodiversity of pig farming in four European countries and found that the average external biosecurity level and the internal biosecurity level them was 65.5% and 55.7%, respectively. The external biosecurity was highest in Germany (70.2%) and lowest in France (59.4%), while the internal biosecurity level was highest in Sweden (58.8%) and lowest in Belgium (50.3%). However, compared to these average global biosecurity scores, and those indicated in the Biocheck tool, the average external and internal biosecurity scores of the pig and poultry farms surveyed in the current study were lower. All subcategories in the external biosecurity and some subcategories of internal biosecurity showed also lower than the global average scores. This indicated that improvement of all subcategories in the external biosecurity and some subcategories of internal biosecurity, including measures between compartments and the use of equipment, the fattening unit, and disease management, in the surveyed pig farms require more attention.

For external biosecurity on the poultry farms, limitation of using equipment between farms and good disinfection could explain the high score for supply of material. The low score for removal of manure and dead animals could be a consequence of a lack of specific carcass storage areas on-farm, or carcass storage areas not closed to prevent vermin or not cleaned/disinfected. For internal poultry biosecurity, the subcategory disease management scored highest probably due to the prioritization of young animal care by farmers. However, the farmers did not change into the farm-specific clothing and shoes or wash hand when moving between compartments, resulting in a low score for measures between compartments and the use of equipment. This was similar to that observed for pig internal biosecurity.

For poultry farms, the subcategories including supply of materials, the management of materials and measures between compartments showed a large variation in scores. Despite the poultry production sector in Vietnam often being considered to be one of the most advanced sectors of animal production in relation to biosecurity, there is still the potential for considerable improvement.

Subcategorie scores for internal biosecurity in the current study are similar to those found by Gelaude et al. (2014), ranging from 67% to 81%. In contrast, for the external biosecurity, Gelaude et al. (2014) showed that the supply of material had the lowest score (42%) while the infrastructure and biological vectors indicated the highest score

(79%). This difference could be due to better vermin control, disinfection and more movement of equipment in the study of the Gelaude et al. (2014) than the current study.

The internal biosecurity scores in the poultrys poultry farms in the current study were higher than the external biosecurity score. Similar results were found in studies in Belgium (Van Steenwinkel et al. 2011; Gelaude et al., 2014). Gelaude et al. (2014) found internal and external biosecurity of 72% and 65%, respectively. The difference between the external and internal biosecurity scores in poultry farms could be partly explained by there being fewer preventive measures for external biosecurity in comparison with the internal biosecurity. Therefore, high scores reaching the maximum score of 100% can be more easily obtained for internal biosecurity.

Costa et al. (2019) researched the effect of biosecurity scores and farm characteristics on productive performance. They found that there was an increase in mortality with age of the youngest building in which pigs were kept, and a tendency for it to decrease in farms with better scores in the biosecurity category referring to feed, water, and equipment supply. Mortality of finisher pigs increased with the average herd size and decreased with good disease management scores. Low scores in the categories environment and region and in nursery unit management tended to be related to higher mortalities. Good measures between compartments and use of equipment seemed also to decrease finisher mortality. Average daily gain (ADG) increased in large farms and with the experience of the farm manager. Good practices in disease management improved ADG. These findings show the important role of biosecurity and its relation to productive performance.

Implementing biosecurity practices on pig and poultry farms in Vietnam is difficult for many reason such as management, geographic conditions, typical farms systems being small-household rather than larger scale intensive systems, and poor farmers' knowledge. This study is of great importance as it demonstrates in an objective and quantitative manner the importance of biosecurity measures in preserving the health and productivity of animals in Vietnam. If the Biocheck scoring system could be used throughout the country, the biosecurity level could be mapped to identify areas at high risk for the spread of disease. This would be valuable in case of epidemic disease outbreaks and makes targeted surveillance strategies more achievable.

CONCLUSION

For external biosecurity on pig farms, the highest score was the purchase of animal and semen and (83.12%), the lowest scores was for entrance of personnel and visitors. For internal biosecurity on pig farms, the highest score was for nursery units (67.21%) while the lowest score was for measures between compartments and the use of equipment. (36.94%).

For the external biosecurity on poultry farms, the subcategory with the highest score was supply of material (88.00%). The subcategory with the lowest score was removal of manure and dead animals (19.09%). For internal biosecurity, the subcategory with the highest score was disease management (82.91%), while measures between compartments and the use of equipment scored the lowest (50.82%).

This survey of pig and farms in the Vietnamese provinces of Ha Noi and Dong Nai showed that all require improvement in most subcategories for both internal and external biosecurity.

RECOMMENDATION

Policymakers, herd advisors and farmers can use the results of this study to target biosecurity improvements on Vietnamese pig and poultry farms. More pig and poultry farmers should be included in future projects and the relationship between biosecurity and antimicrobial use be determined to investigate whether or not biosecurity improvements can reduce the use of antimicrobials. Future research should also target the identification of the minimum biosecurity levels required to prevent ASF and AI outbreaks.

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CONFLICT OF INTEREST

There is no conflict of interest.

AUTHORS CONTRIBUTION

Ngo Thi Kim Cuc, Nguyen Cong Dinh andHa Minh Tuan

colected data. Ngo Thi Le Quyen, Ha Minh Tuan and Ngo Thi Kim Cuc wrote and prepare the manusript.

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