

Correlation Strength Assessment of Animal Husbandry Components to the Implementation of ASEAN Good Animal Husbandry Practices: A case study in layer farming

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ABSTRACT: ASEAN Good Animal Health Practice (GAHP) is a joint product of ASEAN member countries to be applied in laying farms. The Research aimed to explore management practices of laying farms in accordance with the guidelines from ASEAN GAHP. South Lampung District and East Lampung District were the chosen locations in this Research. The ASEAN GAHP-based questionnaires were arranged and used for this Research. A variety of data analysis were conducted namely normality analysis, validity analysis, reliability analysis, descriptive analysis, and correlation analysis technique. The Result showed there were no significant difference were found between South Lampung District and East Lampung District farmers in the implementation of GAHP components in layer farms. Application of Veterinary Control Number (*Nomor Kontrol Veteriner*, NKV) issued by Government becomes a strong driver for farmers to implement the ASEAN GAHP. The Research concluded the components which have a strong relationship in the implementation of ASEAN-GAHP were waste management, personnel hygiene, transportation, water quality and treatment, and surveillance and diseases control.

Keywords: ASEAN-GAHP; Layer farming; Veterinary control number; Correlation analysis

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INTRODUCTION

The ASEAN Sectoral Working Group for Livestock (ASWGL) has identified antimicrobial resistance in livestock as a priority area for action. Antibiotics have an important role in the livestock industry. About 40% of the world's antibiotics are used as feed additives to stimulate growth (antibiotic growth promoter, AGP). Apart from being used as a growth promoter, antibiotics are also used by farmers as a preventive measure against bacterial infections and not for treatment (Cervantes, 2015; Costa *et al.*, 2017).

Feedmills, especially chicken feed manufacturers, use antibiotics because they can increase the rate of absorption of feed nutrition and daily body weight gain (Mokhtari *et al.*, 2015; Costa *et al.*, 2017; Gadde *et al.*, 2018). Antibiotics should be used to treat infections. The problem is that some antibiotics used in the poultry industry are also associated with human health (WHO, 2017). Antibiotics using may be triggered to medication failure, economic losses and becomes a pool of genes encoding resistance of microorganisms to antibiotics. Antibiotic residues were also detected in eggs, meat and other products (Cornejo *et al.*, 2020; Widiasih *et al.*, 2019; Witoko *et al.*, 2019; Mund *et al.*, 2017; Sajid *et al.*, 2016; Muaz *et al.*, 2018).

However, from all the benefits of antibiotic administration, they also have negative impact (WHO, 2016). A number of bacteria such as *Salmonella* spp., *Escherichia coli*, *Shigella* spp., *Citrobacter* spp., *Klebsiella* spp., *Proteus* spp., *Yersinia* spp., *Enterobacter* spp., *Serratia* spp., and *Edwardsiella* spp. showed their resistance to ampicillin, trimethopim/sulfamethoxazole, chloramphenicol, ciprofloxacin, gentamycin, tetracycline, nalidixic acid, sulfamethoxazole, chloramphenicol, cefoxitin, and gentamycin (Hadi *et al.*, 2013; Yulistiani *et al.*, 2017). Center for Tropical Animal Studies (CENTRAS) research showed the results of surveillance research in West Java Province that the similar bacteria and *Staphylococcus aureus* have

resistant to erythromycin (100%), ampicillin (94.83%), oxytetracycline (93.10%), tetracycline (89.66%), nalidixic acid (89.66%), enrofloxacin (86.21%), ciprofloxacin (81.03%), gentamycin (55.17%), chloramphenicol (29.31%).

On the 6th October 2016, in recognition of the need for a concerted regional effort to combat antimicrobial resistance (AMR) in the agriculture sector, the ASEAN Ministers for Agriculture and Forestry (AMAF) agreed on cooperation to combat AMR at the 38th AMAF meeting, including the promotion of the prudent use of antimicrobials in livestock. Aligning its efforts with the "ASEAN guidelines for the prudent use of antimicrobials in livestock" adopted at the 39th AMAF Meeting in September 2017, FAO Regional Office for Asia and the Pacific (RAP) is looking to determine areas of needs in the adopting prudent antimicrobial use in the agriculture sector among ASEAN Member States (FAO, 2018; Gómez-Gómez *et al.*, 2019).

The Indonesian Government has issued a Decree of the Minister of Agriculture Number 11 of 2020 concerning Certification of Veterinary Control Numbers for Animal Products Business Units. The Regulation is mainly applied to layer farms in implementing good layer farming practices. South Lampung District and East Lampung District are part of the Government's efforts to make pilot projects for its implementation. The Research aimed to explore management practices of laying hens conducted by farmers in accordance with the guidelines from ASEAN GAHP and assessing the influence strength of each parameter

MATERIALS AND METHODS

Survey

Eighty laying farmers of South Lampung District and East Lampung District were used as respondents in this Research. Both of Districts were area of layer farming using a partnership system, and as a pilot project for the application of Veterinary Control Numbers or (*Nomor*

Kontrol Veteriner, NKV) with Biosecurity Zone 3 parameters. Each team then conducted an interview with the farm according to the GAHP Questionnaires. The Questionnaires' results were uploaded to Google Form.

Questionnaires

The two GAHP Questionnaires have been used to search and observe information on (i) evidence-based interventions, innovations and methods in poultry industries; and (ii) current state of adherence of poultry farms to good animal husbandry practices.

Data Collection

Data collected in this activity consisted of primary, secondary data, focus group discussion, and seminar. Primary data were collected by conducting interviews with farmers and local agency staffs, and conducted cross-sectional studies. The questionnaires were created following the ASEAN Good Animal Husbandry Practice (ASEAN, 2020). Data collection was carried out based on the result of interviews with type of data, data sources, and data collection methods that were

adapted to the objectives of the study. Secondary data were collected from references, government offices, and other research/activity reports. Focus group discussions (FGD) were held at the observation areas visited and after the number of target respondents were achieved. Layer farmers, layer farmer organizations, local government officials, and several other stakeholders were invited to FGD. Then, seminar have been carried out at the Central Government level to raise an issues discussed at the FGD level.

Data Analysis

Several data analysis techniques were used in this study, such as analysis of normality, validity, reliability, descriptive analysis, and correlation analysis. Correlation analysis is a statistical method used to evaluate a strengthness of relationship between two quantitative variables. A high correlation means two or more variables have a strong relationship with each other, while a weak correlation means the variables are hardly related. In this Research, Pearson correlation formula was used in below.

$$r_{xy} = \frac{n \sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

Where:

- r_{xy} = Pearson r correlation coefficient between x and y
- n = number of observations
- x_i = value of x (for i^{th} observation)
- y_i = value of y (for i^{th} observation)

RESULTS AND DISCUSSION

South Lampung District and East Lampung District had an area of 2,109.74 km² and 5,325.05 km², respectively. Poultry populations in South Lampung District were 2,395,938 birds in 2017 and consisted of non-breed (kampong) chickens, layers, broilers, and ducks (BPS Lamsel, 2017 and 2018, DiskominfoLS, 2020). Poultry populations in East Lampung District were 1,238,795; 1,255,930; and 1,258,930 consecutively in the year of 2017, 2018, and 2019; and consisted of non-breed chickens, broilers, layers, ducks, Muscovy

ducks, and quails (BPS Lamtim, 2018 and 2019; BPS Lamtim, 2020; DiskominfoLT, 2017). There are seven main components contained in the Requirements of the ASEAN GAHP for Layer which contains 105 questions/points observed in this study (Table 1).

The data obtained from the results of interviewing layer farmers were tested using both normality and validity analysis. After the data were considered valid, then an analysis of the strength of each component was carried out against the existing components in the ASEAN GAHP.

Components of layer farming practices at two Districts were also being analyzed using Correlation Analysis and Important Performance Analysis Technique. The five major components that have a strong relationship were waste management, personal hygiene, transportation, water quality and water treatment, and

surveillance and diseases control. The study also compares the components of layer farms in the two Districts that have been observed.

The components that have a strong correlation in the implementation of layer farming practices in the two Districts are presented in Table 2.

Table 1. The number of questions in the requirements of the GAHP for layer asked to layer farmers

No.	Components	Sub-Components	No. of Questions
1.	Farm components	3.1 Farm location	6
		3.2 Farm layout	5
		3.3 Housing	2
2.	Feed and water	2.1 Feed supply	4
		2.2 List of veterinary products and banned chemicals	3
		2.3 Water quality and treatment of water	8
3.	Farm management	3.1 Farm management	3
		3.2 Personnel	5
		3.3 Competency	3
		3.4 Hygiene and sanitation	18
4.	Chicken health management	4.1 Introduction of new stock	3
		4.2 Surveillance and control of diseases	15
5.	Transportation and storage	5.1 Transportation	7
		5.2 Storage	4
6.	Record keeping	Record keeping	15
7.	Egg management	Egg management	4
Total of questions			105

Table 2. The five major livestock component that has a strong influence on the suitability of GAHP implementation in layer farming

No.	Components	Score
1.	Waste Management	0.966
2.	Personnel hygiene	0.963
3.	Transportation	0.954
4.	Water Quality and Water Treatment	0.939
5.	Surveillance and Diseases Control	0.911

Table 3. The major livestock component that has a strong influence on the suitability of GAHP implementation in layer farming in South Lampung District, and East Lampung District

GAHP components that are a priority in					
South Lampung District			East Lampung District		
No.	Variables	Score	No.	Variables	Score
1.	Transportation	0.970	1.	Waste management	0.973
2.	Personnel hygiene	0.970	2.	Personnel	0.960
3.	Waste management	0.963	3.	Surveillance and diseases control	0.958
4.	Competency	0.960	4.	Personnel hygiene	0.940
5.	Water quality and water treatment	0.947	5.	Water quality and water treatment	0.919
6.	Personnel	0.923	6.	Transportation	0.911
7.	Farm manual	0.917	7.	Egg Management	0.903

The major components that have strong relations with ASEAN GAHP are almost similar between the two Districts which are waste management, personal hygiene, water quality and water treatment, transportation, surveillance and diseases control, and farm manual and egg management.

ASEAN GAHP for Layers and Broilers is a standard of good animal husbandry practices for broiler and layer production in the ASEAN region (ASEAN, 2021). Since 2001, The Indonesian Government has also issued the Minister of Agriculture Decree No. 425/Kpts/OT.210/7/2001 regarding The Good Layer Farming Practice. The both of Guidances are mainly aimed at preventing, or minimizing occurring food safety incidents. It also covers elements of biosecurity, workers' health and safety, animal welfare and measures to reduce environmental impact.

Waste management is a livestock component that has a very strong influence on the implementation of GAHP for layer farm. Several factors cause the strong influence of the waste management components including effluent pond/s in the farm: effluent ponds are located away from farming operations and does not overflow; compost stations: compost stations must be positioned away from the activities of the farm, waterways and also protected from the

rain to avoid leaching; and managing wastewater from the farm: waste water from the farm is treated before discharging into public water resources. Improper waste management will affect not only chickens in the farm but also a human and environment in and outside the farm. Ammonia accumulation will be a problem if manure waste was managed improperly. Ammonia may cause irritation of an upper respiratory tract and this condition causes pathogenic agents' entry and growth in an upper respiratory tract (Abdullah, 2019). Water in effluent pond and waste water contain a lot of chemical and biological components which may be dangerous to environment, human, and other species if consumed. These dangerous components, if not properly managed, will enter public water source and cause various environment and health problems. Manure management from the cage can provide additional income for farmers.

Personal hygiene is a livestock component that has a strong influence on the implementation of GAHP for layer farming. Several factors cause the strong influence of the personal hygiene components including (i) movement control: workers' movement in the farm is controlled, avoiding cross contamination between different age groups of chicken, workers enter clean areas first then move to dirty areas, workers do not move from dirty areas to clean areas; (ii)

accessories: workers ensure that no unnecessary accessories and personal effects that may pose hazards are brought in the production area; (iii) worker quarantine: downtime/quarantine must be observed before entering the production area for workers coming from outside the farm; and (iv) appropriate clothing: workers wear appropriate protective clothing and foot wear at all times that can be sanitised and if necessary with masks. Pathogenic microbes can be transferred by individual equipment (Tobin *et al.* 2015).

Transportation is a livestock component that has a strong influence on the implementation of GAHP for layer farm. Several factors cause the strong influence of the transportation components including (i) packing of animals: day old chicks (and chickens) are packed in appropriate packaging or restraining containers as required by the country regulations; and (ii) vehicle use: vehicles used to transport chickens is exclusively used for only chicken transport. Any health problem, such as stress, injury, or disease can affect chickens' production. Attention should be paid so that the transportation of live birds, especially trade of rejected layer hens, can spread several infectious diseases so that the implementation of transporting live chickens must follow the biosecurity aspect (Wu & Perrings, 2018]. Moreover, layer transportation should not allow bringing DOC from breeder to the farm. These DOC are more susceptible to diseases and their little bodies are prone to injury, or worse, death if not properly packaged (Goldsmith *et al.* 2013).

Base on GAHP Water, requirements in poultry farms include potable water, or treated unpotable water are used for drinking water, cooling systems, and shed wash downs. Water quality and treatment of water are a livestock component that has a strong influence on the implementation of GAHP for layer farm. Several factors influence water quality and treatment of water components including (i) maintenance: the farm checks the water sanitizing system

regularly (at least once for every batch of chickens), checking and recording; (ii) appropriate parameters are recorded, record sheet is retained with batch records at end of batch; and (iii) water testing: the farm checks water pathogen levels regularly (*E. coli* and faecal coliforms as sanitation indicators) (Nowicki *et al.* 2021).

Surveillance and disease control are a livestock component that has a strong influence on the implementation of GAHP for layer farm. Several factors cause strong influence to surveillance and disease control components including (i) separating and culling: infected chickens are separated from healthy chickens to avoid infection transmission, and where necessary, cull infected chickens humanely; and (ii) isolation area: identified isolation area/pen for "suspected infected birds" was provided, antibiotics using or medicated feeds for disease control were in accordance with the instructions of a veterinarian following country regulations. Dead chickens were re-collected used as fish food. The chicken carcass will be boiled before giving it to their fish. It's the similar with the use of chicken feathers as fish feed (Ekawati *et al.* 2016).

The components that are considered to have a strong relationship with the ASEAN GAHP component similar between the laying farms in South and East Lampung Districts. The study also compares the components of layer farms in the two Districts that have been observed. The components that are considered to have a strong relationship with the ASEAN GAHP component similar between the laying farms in South and East Lampung Districts. This situation is influenced by the role of the Government and the private sector in supporting the implementation of layer farms operated by farmers. The Government applies the NKV Program to layer farmers and assists them to implement it.

The Indonesian Government issued Decree of the Minister of Agriculture Number 11 of 2020 concerning Certification of Veterinary Control Numbers for Animal

Products Business Units. The Veterinary Control Number Certificate is a certificate as valid written evidence that hygiene and sanitation requirements are fulfilled as a guarantee for the safety of animal products in the animal product business unit. The NKV must be owned by layer farmers so that the NKV Program was a brief guidance for farmers to implement and fulfilled requirements related to hygiene and sanitation by applying good practices to an animal product supply chain. Good practices in animal product supply chain related to layer farming include (i) good practices at the place of farming; (ii) place of animal origin food production; (iii) collection and sales points; and (iv) transportation. Then, technical requirements that must be fulfilled include (i) infrastructure and facilities that meet a requirement for hygiene and sanitation, biosecurity and animal welfare; (ii) veterinarian who is hired as a technical person in charge; and (iii) technical workers with proper competence in the field of hygiene and sanitation, or animal welfare for those who are required.

There are other parties also involved in providing technical assistance to farmers. Commercial feed producers, veterinary medicine and vaccine producers, and breeder companies are **all** the parties that often provide technical guidance and training to farmers according to their business fields and business interests.

CONCLUSION

There is no significant difference between South Lampung District and East Lampung District farmers in the implementation of several variables that influence the implementation of ASEAN GAHP in layer farms. These variables are including waste management, personnel, personnel hygiene, water quality and water treatment, transportation and egg management, and surveillance and diseases control. The NKV Program and parties whose business is related to layer farming encourages layer farmers to carry out

farming activities in accordance with GAHP.

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REFERENCES

- Gündüz, S., Aslanova, F., & Abdullah, K. S. (2019). Poultry Waste Management Techniques in Urban Agriculture and its Implications: A Case Study of Tripoli, Libya. *Ekoloji*, 28(107), 4077-4084.
- [AMAF] AMAF Meeting. (2017). ASEAN Guidelines for the Prudent Use of Antimicrobials In Livestock.
- [ASEAN] Association of Southeast Asian Nations. (2020). ASEAN Good Animal Husbandry Practices for Layers and Broilers: Food Safety Module.
- [ASEAN] Association of Southeast Asian Nations. 2021. ASEAN Biosecurity Management Manual for Commercial Poultry Farming.
- [BPS Lamsel] Badan Pusat Statistika Kabupaten Lampung Selatan. (2017). *Lampung Selatan Regency in Figures 2017*. South Lampung: Statistics of Lampung Selatan Regency.
- [BPS Lamsel] Badan Pusat Statistika Kabupaten Lampung Selatan. (2018). *Lampung Selatan Regency in Figures 2018*. South Lampung: Statistics of Lampung Selatan Regency.
- [BPS Lamtim] Statistics of Lampung Timur Regency. (2018). *Lampung Timur Regency in Figures 2018*. East Lampung: Statistics of Lampung Timur Regency.

- [BPS Lamtim] Statistics of Lampung Timur Regency. 2019. *Lampung Timur Regency in Figures 2019*. East Lampung: Statistics of Lampung Timur Regency.
- [BPS Lamtim] Statistics of Lampung Timur Regency. (2020). *Lampung Timur Regency in Figures 2020*. East Lampung: Statistics of Lampung Timur Regency.
- Cervantes, H. M. (2015). Antibiotic-free poultry production: is it sustainable?. *Journal of Applied Poultry Research*, 24(1), 91-97. <http://dx.doi.org/10.3382/japr/pfv006>
- Cornejo, J., Pokrant, E., Figueroa, F., Riquelme, R., Galdames, P., Di Pillo, F., & Hamilton-West, C. (2020). Assessing antibiotic residues in poultry eggs from backyard production systems in Chile, first approach to a non-addressed issue in farm animals. *Animals*, 10(6), 1056. [sdoi:10.3390/ani10061056](https://doi.org/10.3390/ani10061056)
- Costa, M. C., Bessegatto, J. A., Alfieri, A. A., Weese, J. S., Filho, J. A., & Oba, A. (2017). Different antibiotic growth promoters induce specific changes in the cecal microbiota membership of broiler chicken. *PLoS One*, 12(2), e0171642. <https://doi.org/10.1371/journal.pone.0171642>
- [DiskominfoLS] Dinas Komunikasi dan Informasi Kabupaten Lampung Selatan. (2020). Selayang Pandang.
- [DiskominfoLT] Dinas Komunikasi dan Informasi Kabupaten Lampung Timur. (2017). Geografi Singkat Lampung Timur.
- Ekawati, A. W., Yuniarti, A., & Marsoedi, M. (2016). Chicken Feather Silage Meal As A Fish Meal Protein Source Replacement In Feed Formula Of Pomfret (*Colossoma macropomum*). *Research Journal of Life Science*, 3(2), 98-108.
- Goldsmith, T., Buswell, M., Halvorson, D., Snider, T., Voss, S., Weaver, T., & Malladi, S. (2013). An Assessment of the Risk Associated with the Movement of Broiler Day-Old Chicks Into, Within, and Out of a Control Area During a Highly Pathogenic Avian Influenza Outbreak. Collaborative agreement between USDA:APHIS:VS:CEAH and University of Minnesota Center for Animal Health and Food Safety, Fort Collins, CO.
- Gómez-Gómez, C., Blanco-Picazo, P., Brown-Jaque, M., Quirós, P., Rodríguez-Rubio, L., Cerdà-Cuellar, M., & Muniesa, M. (2019). Infectious phage particles packaging antibiotic resistance genes found in meat products and chicken feces. *Scientific Reports*, 9(1), 1-11. <https://doi.org/10.1038/s41598-019-49898-0>
- Hadi, U., Kuntaman, K., Qiptiyah, M., & Paraton, H. (2013). Problem of antibiotic use and antimicrobial resistance in Indonesia: are we really making progress. *Indones J Trop Infect Dis*, 4(4), 5-8. <http://dx.doi.org/10.20473/ijtid.v4i4.222>
- Mokhtari, R., Yazdani, A. R., Rezaei, M., & Ghorbani, B. (2010). The effects of different growth promoters on performance and carcass characteristics of broiler chickens. *Journal of Animal and Veterinary Advances*, 9(20), 2633-2639. <https://doi.org/10.5897/JVMAH2015.0394>
- Muaz, K., Riaz, M., Akhtar, S., Park, S., & Ismail, A. (2018). Antibiotic residues in chicken meat: global prevalence, threats, and decontamination strategies: a review. *Journal of food protection*, 81(4), 619-627. <https://doi.org/10.4315/0362-028X.JFP-17-086>
- Mund, M. D., Khan, U. H., Tahir, U., Mustafa, B. E., & Fayyaz, A. (2017). Antimicrobial drug residues in poultry products and implications on public health: A review. *International Journal of Food Properties*, 20(7),

- 1433-1446. <https://doi.org/10.1080/10942912.2016.1212874>
- Nowicki, S., deLaurent, Z. R., de Villiers, E. P., Githinji, G., & Charles, K. J. (2021). The utility of *Escherichia coli* as a contamination indicator for rural drinking water: Evidence from whole genome sequencing. *PLoS One*, *16*(1), e0245910. <https://doi.org/10.1371/journal.pone.0245910>
- Sajid, A., Kashif, N., Kifayat, N., & Ahmad, S. (2016). Detection of antibiotic residues in poultry meat. *Pak. J. Pharm. Sci*, *29*(5), 1691-1694. PMID: 27731830.
- Tobin, M. R., Goldshear, J. L., Price, L. B., Graham, J. P., & Leibler, J. H. (2015). A framework to reduce infectious disease risk from urban poultry in the United States. *Public Health Reports*, *130*(4), 380-391. <https://doi.org/10.1177/003335491513000417>.
- [WHO] World Health Organization. (2016). *Critically Important Antimicrobials for Human Medicine – 5th Rev.* Switzerland: WHO
- Widiasih, D. A., Drastini, Y., Yudhabuntara, D., Maya, F. L. R. D., Sivalingham, P. L., Susetya, H., ... & Sumiarto, B. (2019). Detection of antibiotic residues in chicken meat and eggs from traditional markets at Yogyakarta City using bioassay method. *Acta VETERINARIA Indonesiana*, 1-6. <https://doi.org/10.29244/avi.0.0.1-6>
- Witoko, M. C., Suardana, I. W., & Rudyanto, M. D. (2019). Detection Of Antibiotic Residues In Chicken Eggs At The Chicken Egg Farmers And Egg Distributors On Trading Business In Denpasar Municipality. *Journal of Veterinary and Animal Sciences*, *2*(2), 72-78. <https://doi.org/10.24843/JVAS.2019.v02.i02.p05>
- Wu, T., & Perrings, C. (2018). The live poultry trade and the spread of highly pathogenic avian influenza: Regional differences between Europe, West Africa, and Southeast Asia. *Plos one*, *13*(12), e0208197. <https://doi.org/10.1371/journal.pone.0208197>
- Yulistiani, R., Praseptiangga, D., Raharjo, D., & Shirakawa, T. (2017, April). Prevalence of antibiotic-resistance enterobacteriaceae strains isolated from chicken meat at traditional markets in Surabaya, Indonesia. In *IOP Conference Series: Materials Science and Engineering* (Vol. 193, No. 1, p. 012007). IOP Publishing. <https://doi.org/10.1088/1757-899X/193/1/012007>.