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## Determining system boundaries on commercial broiler chicken production system using ISO 14040/14044 guideline: A case Study

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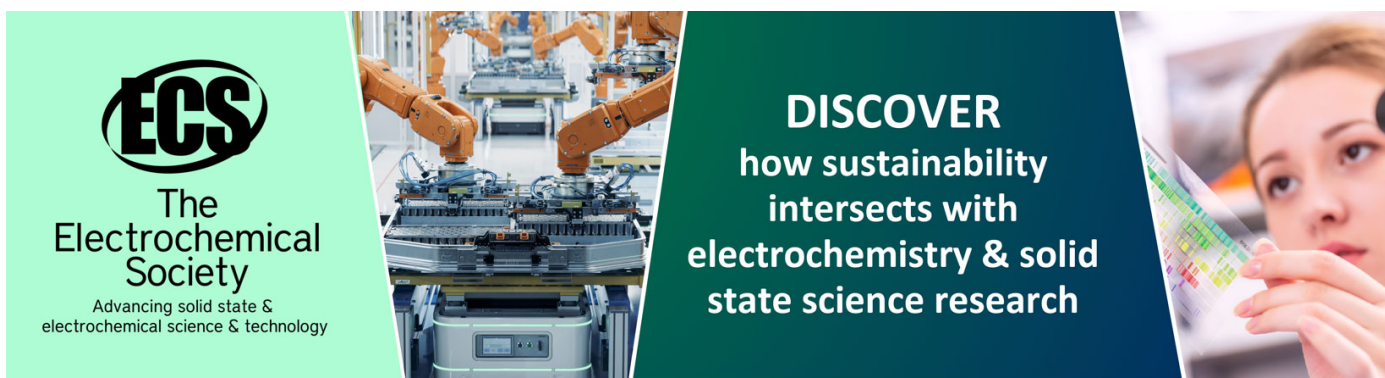
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# **Determining system boundaries on commercial broiler chicken production system using ISO 14040/14044 guideline: A case Study**

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**Abstract.** The demand of poultry product in Malaysia market shows an escalation throughout the year and expected to increase in the future. The expansion of poultry production has led to environmental concern in relation to their operational impact to environment. At present, assessment of waste management of poultry production in Malaysia is lacking. A case study research was conducted in a commercial broiler farm to identify and assess the system boundaries in the lifecycle supply chain of broiler chicken production using ISO 14040/44 guidelines. ISO 14040/44 standard includes Life Cycle Assessment (LCA) framework guidelines to evaluate environmental influence associated with a product/process throughout its life span. All attributes associated with broiler operation is defined and the system boundaries is determined to identify possible inputs and outputs in the case study. This paper discuss the initial stage in the LCA process, which set the context of the research and prepare for the stage of Life Cycle Inventory.

## **1. Introduction**

Chicken meat has become one of the most extensively consumed food products in the world [1]. Apart from its low price, chicken is popular as it is an important source of proteins, vitamin B and minerals and is low in saturated fats [2],[3]. Broiler chicken is the type of chicken that are reared for their meat. Commercial broiler chickens are bred to be very fast growing in order to gain weight quickly. The life of chickens destined for meat production consists of two distinct phases. They are born in a hatchery and moved to a growing farm at 1 day old. They remain here until their weight is optimum; normally up to 3kg and sent to the slaughterhouse or chicken supplier.





**Figure 1.** Broiler chicken in the case study.

ISO 14040 provide guidelines of Life Cycle Assessment (LCA) to analyse and evaluate the environmental performance of a product/process/activity at a various points in its life cycle span [4],[5]. In order to address the environmental aspects of the operation, the system boundaries of the broiler production are determined. The performance characteristics of the systems is specified where it will provide as a reference which the input output data are normalized [6]. This research will be analyzing the system boundaries of broiler farm from cradle to gate where it analyzed the process from the day one old broiler chick until to when they are matured and ready to be transported to slaughterhouse/supplier.

This research intended to define the goal and scope definition of broiler chicken production system by identify their system boundary. In order to achieve the objective of study, process flow of the chicken production must be identified.

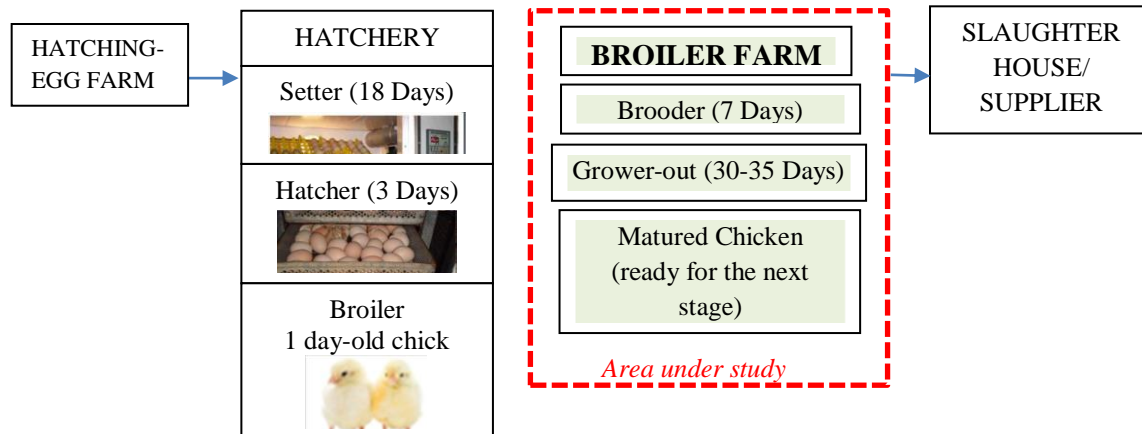
## **2. Research Methodology**

Case study used in the research is a commercial broiler chicken farm in Kalumpang, Selangor. The farm used a closed house system where all broilers placed in two large double-storey chicken coops. Capacity of all the chicken coops is about 106,000 chicks. This commercial broiler farm was established in 2016 and has been rearing the broilers for the fifth batch. Their records on mortality rate is rather impressive which is below than 10% and the lowest is 3% of the total broilers. The broiler farm use semi-automated technology in handling the feed, water and temperature of the broilers.

Operation lifecycle in a commercial broiler farm is identified and quantitative data for insertion in the inventory are collected for each unit process specified within the system boundary. Functional unit in the system boundary is defined to be 3kg of broiler chicken meat at the point of sale. The unit is chosen as it is the amount of raw chicken that contains recommended daily protein supply for an average family (four people). In addition, it is the average weight of a broiler chicken (excluding packaging) available for consumption in Malaysian markets.

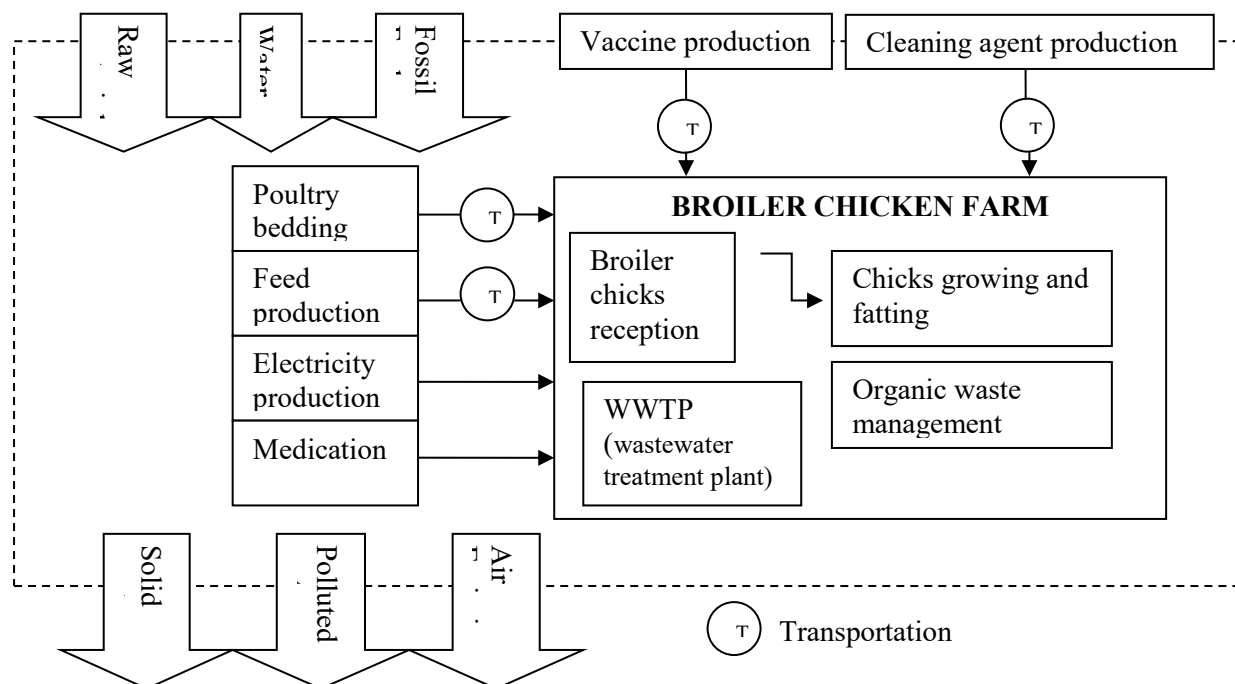
### 3. Results and Discussion

Main function of the system under study is to identify the system boundaries and to study the chicken production flow throughout the life cycle of broiler chicken production system through a cradle-to-gate perspective.



**Figure 2.** Process flow of chicken production system in Malaysia.

According to figure 2, process flow of the chicken production system in Malaysia has been identified. Starting from hatching-egg farm, the chicken will transported to the hatchery and then to the broiler farm for fattening period. Area under study which starts from cradle-to-gate will cover from the day the chicks enter broiler farm until they are matured enough to leave the broiler farm.



**Figure 3.** System boundaries of the broiler chicken production system.

Production system under study encompassed all activities related to the chicken farm according to cradle-to-gate analysis (Figure 3). In this way, the product (broiler chicken) could be monitored until it was ready for distribution to wholesales. Activities carried out directly in this subsystem starts with the reception of chicks at the farm gate. Chicks are transferred to a production pen for a fattening period of 35 days.

Broilers are housed in poultry beds, which are commonly composed of a mixture of materials such as sawdust, bark, wood shavings or chips. Feed is mainly composed of maize, wheat, soybean cake, soybean oil, monocalcium phosphate, protein concentrate and fats. Throughout the growth period, vaccine and medication are given to the broilers. Activities of cleaning the chicken farm not only involve water but also the cleaning agents (detergents and disinfectants).

Wastewater generated from cleaning activities and farm-related uses is treated in a small wastewater treatment plant (WWTP) which is located in the broiler chicken farm. Manure and wasted poultry beds produced in the chicken farm will cause emission towards environment. Manure is an important source of nutrient which can be processed to be organic fertilizer for agriculture product. Possible air emission that involved in the broiler chicken farm are  $\text{NH}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CH}_4$ ,  $\text{NO}_3^-$  and  $\text{PO}_4^{3-}$ .

#### 4. Conclusion

In summary, it can be concluded that a complete system boundary of broiler chicken production system especially in the case study was developed. Throughout the system boundary that is from cradle-to-gate, several inputs parameter were defined such as water supply, poultry bedding, feed production, electricity production, vaccine and medication and also cleaning agent for cleaning process. Output parameters of the system include solid waste (manure, dead chicken, bedding waste), polluted water and air emission ( $\text{NH}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CH}_4$ ,  $\text{NO}_3^-$  and  $\text{PO}_4^{3-}$ ). System boundaries was conducted to identify possible input and output used in the production system.

#### Acknowledgement

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