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# Environmental Aspect Assessment in a Poultry Meat Processing Facility Compliant with ISO 14001 Standards: A Case Study in Colombo District

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***Abstract*—This study aimed to identify the key environmental indicators responsible for making poultry meat production one of the most polluting food processing industries in Sri Lanka. For that, the environmental aspects of a large-scale meat processing plant were assessed using the guidelines of ISO 14001:2015 Environmental Management System (EMS) and conducting a risk assessment through an impact aspect register in terms of the severity of consequences and the likelihood of occurrence. The poultry meat production site demands a significant amount of energy and water, both valuable natural resources. As part of the production process, it generates livestock waste and wastewater. The impact of these environmental aspects is particularly pronounced in the processing unit, where pollution levels are at their highest significant environmental impact. To mitigate this impact, a vertical integration (Key stages in materials, suppliers, manufacturing, and distribution of supply chain ownership management business strategy) system was implemented to reduce waste generation and enhance resource utilization efficiency. This study aims to introduce new or refine existing indicators to propose solutions for mitigating the environmental impacts associated with poultry meat production plants.**

***Keywords—Environmental impact, environmental aspect, environmental risk, environmental management system***

## I. INTRODUCTION

Chicken meat production is anticipated to reach 103.4 million metric tons in 2023, with Brazil and the US taking the lead. In 2021, global poultry production reached 70.7 billion, with China being the largest contributor. The US anticipates 1% growth, while Brazil is poised to achieve a 3% increase [1]. The poultry industry in Sri Lanka plays a vital role in ensuring food security. Despite a slight market contraction of -1.7% in 2022, despite increasing consumption, the sector faced challenges between 2020 and 2022 due to a decline in exports and an increase in imports from Thailand, Brazil, and the US [4]. Poultry production has a detrimental impact on the environment in several ways. This includes inadequate management of manure and litter, improper disposal of waste from processing plants (such as blood, bones, feathers, etc.), as well as issues related to bird carcasses, dust, insects, and unpleasant odors. Additionally, intensive poultry production is accountable for greenhouse gas emissions, acidification, and eutrophication. In a poultry processing industrial setting, environmental aspect assessment serves as a systematic method for identifying potential environmental impacts [2]. Environmental Aspect Assessments for livestock industrial sites are now managed using drone technology to enable real-time monitoring and life cycle assessments for measuring carbon footprints [3]. To evaluate these impacts, the use of the ISO 14001:2015 Environmental Management System Impact Aspect Register is vital to identify the environmental aspects associated with each practice [5]. This research emphasizes the need for a systematic framework customized for the poultry sector, sheds light on the insufficiency of existing environmental tools, and advocates for global sustainability and the reduction of environmental impacts [6]. This research aimed to provide an analysis of a large-scale poultry meat processing plant in the Colombo district Sri Lanka by leveraging the ISO 14001:2015 Environmental Management System (EMS) and conducting a risk assessment through an impact aspect register. Moreover, this study underscores the significance of assessing environmental risks in meat production facilities by utilizing a risk rating matrix [7] as a means to enhance existing operational conditions.

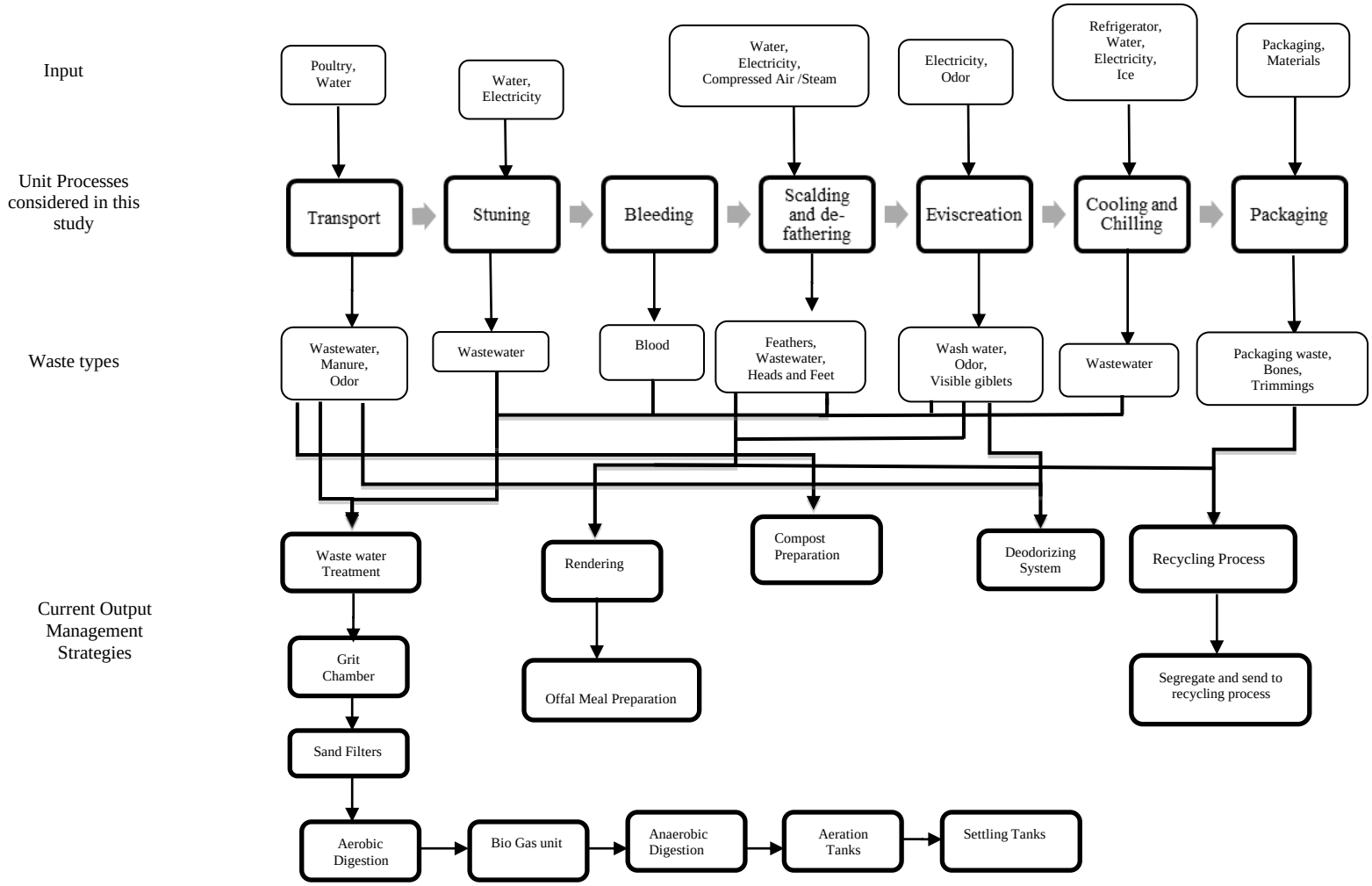


Fig. 1. Process flow diagram of the processing plant for the poultry meat processing facility of this study

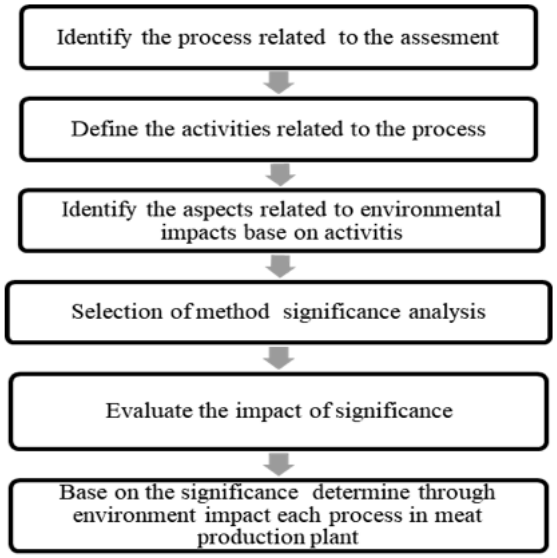


Fig. 2. Environment aspect assessment process [8]

### A. *Environment Significant Rating Matrix*

Equation 1 [10] which was developed to assess the environmental aspects was used to determine the environmental significance rating [9]. The rating matrix, used for this study, is presented in Table 1. The degree of impact was established by analyzing the primary activities influencing the process, and this impact level was assessed using the scale outlined below [10]. The identification of critical aspects and the prioritization of these aspects were carried out through a systematic assessment.

*Rs (Risk Significance) = Severity of consequences + Probability of occurrences + Scale and boundaries* (1)

1. Low or slight damage to the environment
2. Medium damage is limited or has a medium impact on the environment
3. Significant damage to the environment

## II. Materials And Methods

### A. *Study Site*

This study was carried out at a large-scale poultry meat processing plant with a daily processing capacity of approximately 20,000 to 30,000 live birds. The selected site is situated in the Colombo District, Western Province of Sri Lanka. Figure 1 illustrates the process flow diagram of the processing plant. This diagram encompasses each specific unit process that was considered in this analysis.

### B. *Environment Aspect Assessment*

The indicator ranking method was employed as part of the environmental aspect identification process from the poultry meat processing plant following the guidelines of the ISO 14001:2015 Environmental Management System. This approach is illustrated in Fig. 2 [8]. This study was conducted over a six-month period, from January 2023 to June 2023. It involved on-site visits to poultry meat processing plants and the collection of information through interviews with plant managers and supervisors. The gathered data was used to determine various aspects of meat processing operations.

Table 1: Significant Rating Matrix

| Score | Severity of consequences | Probability of occurrence | Scale/ Boundaries |
|---|---|---|---|
| 1 | Unhealthy workplace and conditions on a short basis: minor controlled spills or very low | Rarely | Working areas (workshops or offices) |
| 2 | Slight health and safety impact on toxicity is that harmful materials leak into an enclosed environment /low | Annually | The departmental level is composed of many working areas. |
| 3 | Slight health and safety impact on human health or medium | Monthly | Inside the plant facility |
| 4 | Acute health and safety effects cause permanent disabilities. A hazardous substance spill or leak requires internal intervention and is high-risk. | Weekly | Inside the plant facilities (Adjacent areas) |
| 5 | Fatality of extreme environmental effects is very high. | Daily | Outside the organization's site or city area |

The significance of an environmental aspect was determined by the sum of scores (K) for all levels of the aspect, according to equation 1 [10]. The overall significance score of the environmental aspect was derived based on the guidelines provided in Tab. 2 [10]. Consequently, this allowed for the determination of the impact levels associated with each unit operation within the processing plant.

Table 2: Overall Significance Score of Environment Aspect

| Index | Name | K (sig) value | Additional condition |
|---|---|---|---|
| I | Insignificant | 3 - 7 | No significant |
| S | Significant | 8 -15 | Significant level |

## II. Results and Discussion

The management team at the processing plant is actively striving to enhance resource efficiency and environmental management. These efforts contribute to the development of a resource-circular economy. According to the current analysis of the significance and insignificance of each production and processing plant (Tab. 3), the following processes had the most significant environmental impact. The processing plant, along with the cool room and blast freezers, exerts the most significant environmental impact. According to the data presented in Figure 01, the processes in question result in the generation of various types of waste, including wastewater, feathers, manure, blood, heads and feet, visible giblets, packaging materials, and bones. Currently, conventional practices, as depicted in Figure 01 involve treating wastewater/washed water through biological treatment methods, aerobic and anaerobic digestion methods, and physical treatment methods, grit chamber/sand filters/aeration tanks, and settling tanks are part of wastewater management. Additionally, an odor reduction system is employed to mitigate the generation of unpleasant odors. The management of manure involves composting it within a designated composting plant process. Fixed dome biogas plant is linked with anaerobic digestion process in wastewater treatment plant as shown in Figure 1. Eviscerated materials, gut waste, and feathers are utilized in the rendering process to create offal meals. Furthermore, packaging materials are separated and forwarded to the recycling process. Solid waste was a streamlined stage of slaughter that involved removing the offal and solid waste (gut waste) and other disposal by-products or raw materials. Wastewater generation was identified as another point with specific mandatory cleaning and disinfection practices. Wastewater processing, inventory, and storage are needed for purification or treatment, and wastewater release is shown on the inland water surface as purified before discharged into agricultural lands are all examples of necessary cleaning. Manure traps and grease traps are used to clean and disinfect infected drains. Energy management system used to assess and implement energy-saving options. The environmental risk corrective action plan and standard operating procedures are implemented based on ISO 14001. Boiler units, steam generators, cool rooms, and blast freezers are other processes that have an impact on the environment due to intensive electricity usage and thermal energy waste generation. Enhancements were made to the wastewater treatment process by introducing a bio-chemical treatment method to regulate biochemical oxygen demand and chemical oxygen demand levels. The reduction of wastewater and waste generation was achieved through the implementation of standard operating procedures, as well as the enhancement of worker effectiveness through training programs as part of a comprehensive strategy. Additionally, biological waste generation was minimized by utilizing feed-rendering. An integrated approach involved the utilization of wastewater for agricultural purposes. Furthermore, an EMS was employed, which included the development of an operation control action plan to enhance system management.

TABLE 3: STATUS OF SIGNIFICANT RATING

| Process | Significant Rate | Insignificant Rate |
|---|---|---|
| Garage/Maintenance point | 4 | 4 |
| Fuel Pumping Point | 0 | 4 |
| Transport | 5 | 2 |
| Tube well | 1 | 4 |
| Processing | 7 | 2 |
| Cool Room and Blast freezer | 7 | 3 |
| Generator | 2 | 5 |
| Broiler and steam generator | 6 | 3 |
| Microbiology Lab | 3 | 4 |
| Packing Material Printing Room | 1 | 3 |
| Loading Point | 0 | 6 |
| General Stores | 1 | 5 |
| Solid waste Collecting Plant | 2 | 2 |
| Offal Room | 3 | 3 |
| Rendering Plant | 4 | 6 |
| Wastewater Treatment Plant | 6 | 3 |
| Sludge Collection Room | 1 | 5 |
| Compost Preparation Plant | 2 | 2 |

## III. Conclusion

The established research examined the direct and indirect effects of a poultry meat processing facility, providing a systematic evaluation and presenting a roadmap for risk reduction and the implementation of sustainable practices. The optimal solution involves fostering sustainability within the poultry industry by embracing resource-efficient practices, strengthening environmental regulations, and educating consumers to mitigate the industry's negative environmental impacts. This research not only underscores the significance of a structured approach in evaluating environmental aspects but also serves as a foundational guide for making sustainable decisions and formulating effective mitigation strategies in industrial operations.

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