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Analysis of Beef Halal Critical Points with Halal Logistics Approach and Risk Management

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Abstract. *The increase in the number of certified halal products shows the Indonesian people's increasing level of awareness of the halalness of a product. In addition, people are also increasingly curious about all the activities involved along the supply chain to ensure whether the products they buy are genuinely halal. One of the consumer products that need to be traced to the halal supply chain is beef products because there is a risk of contamination throughout the supply chain from raw materials, production processes, distribution, storage and handling. Calculation of risk in this study will use the House of Risk (HOR) method. This research focuses on the process of inbound and outbound logistics and the beef slaughtering process at the Purwokerto Slaughterhouse. The results of this study obtained 26 risk events and 28 risk agents. Based on risk mapping using phase 1 and Pareto HOR diagrams, 11 risks are prioritized based on the highest ARP values, namely A15, A25, A19, A7, A5, A28, A6, A2, A16, A17, and A21. Moreover, it made 14 recommendations for mitigation actions that the company can apply to control these risks.*

Keywords: *beef, halal, logistic, House of Risk, slaughterhouse.*

I. INTRODUCTION

Halal products are a basic need for residents in Muslim-majority countries such as Indonesia. Based on 2021 data compiled from data from the Directorate General of Population and Civil Registration of the Ministry of Home Affairs, the percentage of the Muslim population in Indonesia reaches 86.88% of the total population or equivalent to 236.53 million people. Therefore, the government stipulates Law no. 33 of 2014 concerning the guarantee of halal products, which guarantees that all products that enter, circulate and trade in the territory of Indonesia must be certified halal. The primary purpose of halal certification is to determine whether a product to be consumed by Muslims is halal or not (Neio Demirci, Soon, and Wallace 2016).

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Based on data from LPPOM MUI in 2019, only 10% or 688,615 products from all products circulating in Indonesia have been certified halal (Patriella 2019). However, in 2021 there will be a significant increase in the number of products that have been certified halal, namely 1,292,392 products (MUI 2021). This number shows the increasing level of awareness of the Indonesian people toward the halalness of a product. Consumers today are increasingly aware and concerned with the integrity of the halal status. They are also increasingly curious about all the activities involved along the supply chain to ensure whether the products they buy are genuinely halal (Zulfakar, Anuar, and Talib 2014). The requirement of a supply chain based on Islamic law is that all processes along the supply chain must be halal (permissible) and tayyib (Omar et al. 2011). Halal assurance is required for the final product and at every stage of the supply chain (D. Wahyuni et al. 2020). Halal supply chain management regulates not only food production or manufacturing but also includes the source or origin of raw materials (halalness), movement, transportation and distribution processes from upstream (origin) and downstream to the market (end-user) involving transporters, containers, modes by road, air or sea, owners and operators of warehouses and distribution centers and their operations; wholesalers and retailers and their

businesses up to hypermarket services, supermarkets and small retail outlets must meet halal compliance (Ahmad and Shariff 2016).

One of the consumer products that need to be traced to the halal supply chain is beef products because there is a risk of contamination throughout the supply chain from raw materials, production processes, distribution, storage, and handling (Supian 2018). This risk comes from anywhere, for example, the use of enzymes (Ermis 2017) and ethanol (Alzeer and Abou Hadeed 2016) in farms, distributors, slaughterhouses, and retailers (Wahyuni, Vanany, and Ciptomulyono 2018). Identifying and mitigating halal risks in the industry provides many benefits, for example, prevention, mitigation, and risk recovery (Marco Tieman 2017).

Figure 1. Total Indonesian Beef Production (tons)

According to data obtained from BPS (BPS, 2019), the number of beef production from 2017 to 2020 shows a graph that continues to increase. This data is also in line with the number of cattle slaughtered in Banyumas Regency, Central Java, in 2019, which reached 10,780 heads and became the livestock whose meat was cut the most in Banyumas Regency compared to goat, buffalo, or lamb (Banyumas 2019).

The research focuses on transportation, handling, storage and distribution from farms (inbound logistics) to slaughterhouses and outbound logistics processes from slaughterhouses to distributors in the Banyumas Regency area. A halal logistics approach must be taken to avoid contamination of perishable materials, raw materials and food products during transportation or distribution activities (Tarmizi et al. 2014). Therefore, in this study, we will map and mitigate risks in the beef supply chain's logistics process in Purwokerto Slaughterhouse to obtain a handling strategy to reduce or eliminate the identified risks. According to (Tieman and Ghazali 2014), in the logistics process, packaging, storage and transportation must be physically separated from other non-halal foods or things designated as najis (ritually unclean) by Islamic law.

The risk management identification in this study uses the House of Risk (HOR) method. The calculation of HOR in this study consists of phase 1, which is the risk identification phase that must be given priority for preventive action, and phase 2 is the phase where several treatment strategies are selected that are considered adequate to reduce the probability of the impact caused by risk agents (Pertiwi and Susanty 2017). Several researchers have used this method to determine halal risk in the beef supply chain, including (Dini Wahyuni et al. 2020) dan (Wahyuni et al. 2018). The difference between this study from previous studies is the focus on the inbound and outbound logistics processes of the beef production process. The results of this study can be used by stakeholders involved in the beef supply chain, namely livestock, slaughterhouses, and beef distributors, to know the risks that can threaten the halalness of beef.

II. RESEARCH METHOD

This study combines several approaches to identify the critical points of the halal beef process. This study begins by identifying the logistics process in the production of halal beef at the Purwokerto Slaughterhouse, which consists of three main activities: inbound logistics, slaughter process, and outbound logistics. After that, identify risks to discover risk events and agents and calculate risks to determine the level of impact, frequency of occurrence, and correlation between getting the Aggregate Risk Priority (ARP) value. This calculation is in the House of Risk (HOR) 1 phase. After that, it evaluates the highest Aggregate Risk Priority (ARP) value and creates a risk mitigation action plan that will be calculated

in the House of Risk (HOR) 2 phase. Complete research steps can be seen in Figure 2.

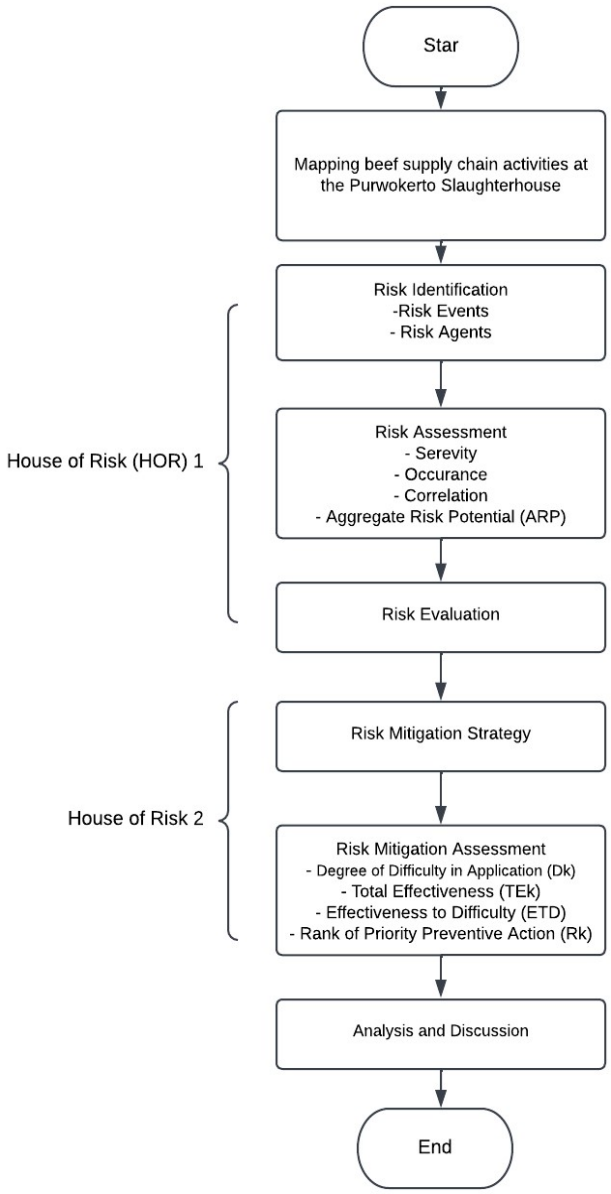

Figure 2. Research Steps

Risk Management

Risk is a function of the level of uncertainty and the impact of an event (Sinha, Whitman, and Malzahn 2004). Meanwhile, , risk management is making decisions regarding risks and their subsequent implementation and flows from risk estimation and evaluation. Risk management consists of several stages, including risk identification, analysis, evaluation, risk management, and monitoring (Qazi et al. 2017).

House of Risk (HOR)

HOR is the development of the FMEA (Failure Modes and Effects of Analysis) method and the house of the quality model (HOQ) to choose which risk source is the first to take action to reduce the potential risk from the risk source. HOR focuses on preventive actions to determine which risk causes are the priority and will be given mitigation actions (Pujawan and Geraldin 2009).

The stages of risk assessment using the House of Risk consist of two stages, namely:

1. House of Risk Phase 1. In this phase, the Aggregate Risk Priority (ARP) is calculated with the following formula:

   $ARP_j = O_j \sum S_i R_{ij}$ (1)

   ARP : Aggregate of risk agents
   Oi : Probability of Occurrence
   Si : Severity of Impact
   Rij : Correlation between Risk agents and Risk

   After calculating the ARP value, it is found that risk agents have the largest ARP value based on the 80/20 Pareto diagram. Moreover, provide recommendations for mitigation actions against risk agents with the largest ARP value.
2. House of Risk Phase 2. In this phase, calculations are made on the recommendations for mitigation actions proposed to the company and choose which mitigation actions are most likely to be implemented within the company. The first step is to calculate the Total Effectiveness (TEk) for each risk agent with the following formula:

   $TE_k = \sum ARP_i . E_{jk}$ (2)
3. The next step is to calculate the total value of the difficulty level ratio with the following formula:

   $ETD_k = TE_k / D_k$ (3)

   The last step is to rank priority for each preventive action (Rk).

   Dk : Degree of difficulty
   TEk : Total effectiveness
   ETDk : Effectiveness to Difficulty

Food Halal Supply Chain

Supply Chain Management (SCM) coordinates production, inventory, location, and transportation in the supply chain to achieve responsive and efficient cooperation best to serve the market (Hugos, M. 2006). SCM is also defined as a relationship between suppliers, factories, distribution, and customers where raw materials are taken from suppliers to manufacturers who carry out production into finished products and arrange shipments to reach consumers.

Halal food supply chains apply the same principles as conventional supply chains with special exceptions to the types of products handled. The halal food supply chain involves the process of planning, implementing, and controlling the efficient flow and storage of halal-certified products from source to the point of demand or can be called a management process related to the procurement, movement, storage, and handling of food products through companies and supply chains that comply with the principles of sharia law (Tieman and Ghazali 2014)

The basis for the success of the halal industry, regardless of what type of product is halal, is halal integrity. Without halal integrity, there is no market or halal industry.

Logistic Halal

Halal logistics is part of the halal supply chain which plays an important role in the halal industry in line with higher global standardization to obtain halal certification and is the key to halal integrity (Amir and Tjibtosubroto 2019; Mohamed, Abdul Rahim, and Ma'aram 2020). The trend of halal logistics is increasing from year to year because halal logistics can provide better guarantees to consumers (Fathi et al. 2016). Halal logistics is not only a trend but also a necessity (Saidah and Lestari 2021), especially in Muslim-majority countries.

III. RESULT AND DISCUSSION

Supply Chain Activity Mapping

The research focuses on three major processes: Inbound Logistics, Slaughtering, and Outbound Logistics. Data processing starts from mapping the supply chain activities in the Purwokerto Slaughterhouse. In Table 1, it can be seen the process of the beef supply chain at the Purwokerto Slaughterhouse, which consists of players, major processes, and subprocesses. Inbound logistics consists of the process of transportation, distribution, storage, and handling from the feedlot to the Slaughterhouse.

Meanwhile, outbound logistics consists of the transportation, distribution, storage, and handling processes from the Slaughterhouse to the final customer, such as meatball grinding and traditional markets.

Table 1. Supply Chain Activity Mapping at Purwokerto Slaughterhouse

Player	Mayor Process	Sub Process
Transporter	Inbound Logistic	Transportation, Distribution, Storage and Handling
Butcher, Veterinarian	Slaughtering	Antemortem Check, Before Slaughtering, Slaughtering, Postmortem Check
Transporter	Outbound Logistic	Transportation, Distribution, Storage and Handling

Risk Identification

Risk identification is a stage to know the risk events that disrupt supply chain activities in the company and to find out the risk agents that cause these events. Identification was made through interviews at the Purwokerto Slaughterhouse. Based on the results of interviews with Slaughterhouse managers and Halal Auditors of the Halal Product Assurance Organizing Agency, it was found that 28 risk agents caused 26 risk events in the beef supply chain. It could affect beef's halalness, as seen in Table 2 and Table 3. The severity value in this research starts from 1-5, which states that the higher the severity value, the more impact it has on the halalness of beef. While the probability value shows the level of frequency of the risk occurring. The higher the probability value, the more often the risk occurs.

Table 2. Measurement Results of Risk Events

Code	Risk Events	Severity
E1	Cattle stress during the transportation process	4
E2	Depreciation of live weight of cattle during the transportation process	3
E3	Cows loose during transportation	1
E4	There was an accident during the process of sending the cow	3
E5	Transport trucks do not have a guarantee to transport only halal cattle	5
E6	Cows that come are not equipped with a Certificate of Animal Health	4
E7	Beef cattle are injured in the process of moving to the barn	3
E8	Infectious disease found in cattle	4
E9	Cows are productive females	1
E10	Cow rest less than 12 hours as required	5
E11	The herding of cows to the barn is done roughly	4
E12	Slaughtered cows under stress	3
E13	The carotid artery and/or jugular vein are not completely cut	5
E14	Butchers don't have halal certification yet	2
E15	A work accident occurred during the process of skinning and cutting meat	2
E16	The meat that has been cut is placed on the floor	5
E17	The cow is still not completely dead during the skinning process	5
E18	The process of cutting meat does not pay attention to cleanliness	4
E19	Meat, offal and carcass stinks	5
E20	Meat is not wrapped during the shipping process	5
E21	Meat delivery delay	2
E22	Meat fell to the floor during the loading process to the haul truck	3
E23	Trucks used to transport meat are not kept clean	4
E24	The material handling equipment used in transporting beef to the transport car is not kept clean	4
E25	Contamination with najis during the shipping process	5
E26	Transport trucks have no guarantee to transport halal meat	5

Table 3. Measurement Results of Risk Agents

Code	Risk Agents	Probability (Si)
A1	Unloading facility is too high	4
A2	Cows lack food and drink during the transportation process	3
A3	The cattle truck is too open	2
A4	Cattle truck capacity does not consider animal welfare	1
A5	Poor road conditions during the transportation process	3
A6	Lack of supervision from the Slaughterhouse manager	4
A7	Butcher doesn't keep clean	4
A8	Disease transmission from sick cows to healthy cows	2
A9	The knife for slaughtering is not sharp	1
A10	The knife size is too small	2
A11	The process of laying the cow down is done roughly	2
A12	Equipment used for slaughtering and transporting meat is not sterilized first	3
A13	Have not included the butcher to get halal slaughter interpreter certification	2
A14	The slaughtering technique is not in accordance with the Shari'a	1
A15	Not following the SOP	5
A16	Cows come late	3
A17	Cows are not rested during the shipping process	3
A18	Truck driver negligence in driving	3
A19	Lack of understanding regarding the concept of halal and tayyib	4
A20	Negligence of transport workers	4
A21	Cows that come are not equipped with a Certificate of Animal Health	4
A22	Butchers pay little attention to animal welfare	2
A23	Occupational health and safety has not been properly socialized	3
A24	No antemortem examination	3
A25	There is no container to put the meat that has been cut	5
A26	The slaughtered cow is sick	1
A27	The slaughtering process takes a long time	1
A28	Transport trucks are not kept clean	3

House of Risk (HOR) I

Mapping in this model is done by entering the results of measuring the severity of risk events (table 3) and the occurrence of risk agents (table 4) and their correlation. More clearly, the mapping of the HOR model phase 1 is listed in

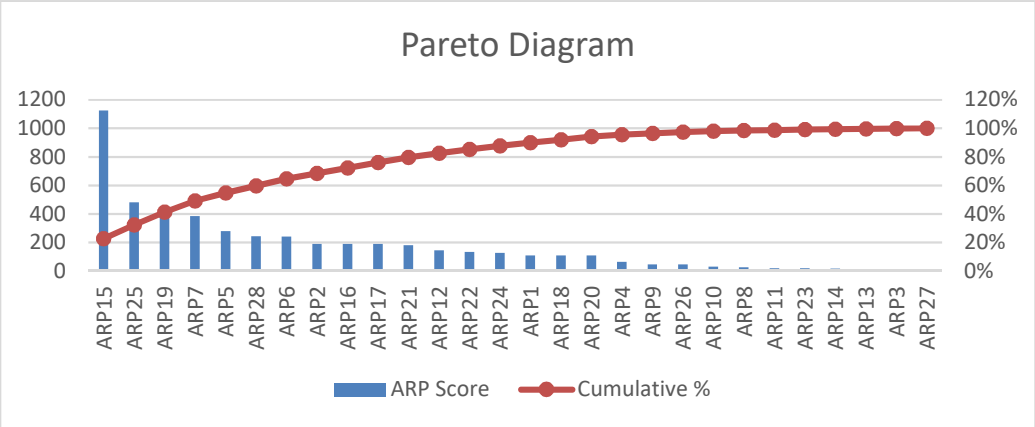

Figure 3. ARP Diagram

Appendix 1. This mapping aims to find the ARP (aggregate risk priority) value. ARP Diagram in Figure 2.

Based on the ARP diagram in Figure 2 and using the 80/20 principle from Pareto, risk agents will be chosen as a basis for considering risk mitigation actions. Figure 3 shows that the risk agents A15, A25, A19, A7, A5, A28, A6, A2, A16, A17 and A21 are the highest, with each ARP value shown in Table 4. These risk agents will be included in the HOR 2 model to determine mitigation actions. Mitigation actions are taken to reduce the impact of risk agents. Recommended mitigation actions are shown in Table 4.

Table 4. Recommendations for mitigation actions

Code	Risk Agents	Code	Mitigation Action	Degree of Difficulty in Application
A15	Not following the SOP	P1	Routinely socialize the SOP that applies at the Slaughterhouse.	2
		P2	Give sanctions to those who do not comply with the SOP.	3
		P3	Evaluate the applicable SOPs	2
A25	There is no container to put the meat that has been cut	P4	Slaughterhouse management provides clean containers for meat.	4
		P5	Butcher brought his own container to put the meat.	2
A19	Lack of understanding regarding the concept of halal and tayyib	P6	Routinely conduct socialization related to the concept of halal and tayyib.	2
A7	Butcher doesn't keep clean	P7	Giving sanctions to butchers who do not maintain cleanliness	3
		P8	Socialization regarding the importance of hygiene to prevent bacterial contamination of meat	2
A5	Poor road conditions during the transportation process	P9	Looking for alternative roads that are closer and in better road conditions	2
A28	Transport trucks are not kept clean	P10	Routine supervision during the distribution and transportation process	2
		P8	Routinely socialize the SOP that applies at the Slaughterhouse.	2
A6	Lack of supervision from the Slaughterhouse manager	P11	Evaluating worker shift schedule	3
		P14	Slaughterhouse management routinely checks the arrival of cows	2
A2	Cows lack food and drink during the transportation process	P12	Planning the delivery of cattle according to animal welfare	2
A16	Cows come late	P13	Planning a cattle delivery schedule	2
A17	Cows are not rested during the shipping process	P12	Planning the delivery of cattle according to animal welfare	2
A21	Cows that come are not equipped with a Certificate of Animal Health	P1	Routinely socialize the SOP that applies at the Slaughterhouse.	2
		P14	Slaughterhouse management routinely checks the arrival of cows	2

Tabel 5. Calculation House of Risk Phase 2

Aj	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	ARPj
A15	9	9	3												1125
A25				3	9										480
A19						9									444
A7							9	9							384
A5									9						279
A28								9		9					243
A6											9			9	240
A2												9			189
A16													9		189
A17												9			189
A21	3													9	180
Tek	10665	10125	3375	1440	4320	3996	3456	5643	2511	2187	2160	3402	1701	3780	
Dk	2	3	2	4	2	2	3	2	2	2	2	3	2	2	
ETDk	5332,5	3375	1687,5	360	2160	1998	1152	2821,5	1255,5	1093,5	1080	1134	850,5	1890	
Rk	1	2	7	14	4	5	9	3	8	11	12	10	13	6	

House of Risk (HOR) II

In this phase of HOR 2 calculation, it will choose a treatment strategy considered adequate to reduce the probability of the impact caused by the risk agent. This step in HOR phase 2 begins with designing a treatment strategy, looking for the relationship between the treatment strategy and existing risk agents, calculating the Total Effectiveness (TEk) and Degree of Difficulty (Dk) values, and finally calculating the Effectiveness To Difficulty (ETDk) ratio for find out the priority ranking of the existing strategies. For clarity, the calculation of HOR 2 can be seen in Table 5.

IV. CONCLUSION

Based on the data processing and data analysis results, there were 26 risk agents caused by 28 that could threaten the halalness of beef produced by the Purwokerto Slaughterhouse. From risk mapping using HOR phase 1 and Pareto diagrams, 11 risks are prioritized for handling based on the highest ARP values, namely A15, A25, A19, A7, A5, A28, A6, A2, A16, A17 and A21. From the 11 risks, a mapping of the handling was carried out, and 14 recommendations for mitigation actions that the company could apply were made to control the risks.

Based on the calculation of the HOR phase 2, the priority order of 14 mitigation actions was obtained, namely P1, P2, P8, P5, P6, P14, P3, P9, P12, P10, P11, P13 and P4. Based on the results of discussions with the Slaughterhouse Manager, it was decided that five priority mitigation actions were selected in this study that can mitigate the risk of halal meat, namely P1 (Routinely socialize the SOP that applies at the Slaughterhouse), P2 (Give sanctions to those who do not comply with the SOP) and P8 (Socialization regarding the importance of hygiene to prevent bacterial contamination of meat), P5 (Butcher brought his container to put the meat) and P6 (Routinely conduct socialization related to the concept of halal and tayyib). From the five mitigation action recommendations obtained from the results of the HOR 2 calculation, it can be concluded that the biggest problem is the leading cause of the risk that threatens the halal beef produced at the Purwokerto Slaughterhouse is the butcher who does not comply with the SOP.

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