Production Risk of Ground Fish in UD. XY Bengkulu City: Failure Mode and Effects Analysis (FMEA)

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ABSTRACT: One of the fish processing units in Bengkulu City is UD.XY, which is located in Sumber Jaya Urban Village, Kampung Melayu Sub-district, Bengkulu City. The seafood processing product is ground fish made of fresh mackerel. Analysis of production risk is an important aspect in ensuring the survival of a business. The production risk was 15% in one production, so the selling price lowered and reprocessing was impossible. The risk comes from the material, production process, and final product. The present study was aimed to analyze the production risk of ground fish. The analysis method was FMEA. The research result showed that the highest risk was poor fish supply, poor ground fish product and competing ground fish products.

Keywords: Failure, Production Risk, Ground Fish

INTRODUCTION

Bengkulu City is located on the west coast of Sumatera, facing Indonesian Ocean. Geographically, it is located at 3°45′ – 3°59′ SL and 102°14′ – 102°22′ EL. Bengkulu City has massive marine resources potential with over 17.6 km² of coast line and 387.6 km² of waters. Based on the Data of the Department of Marine and Fisheries of Bengkulu Province, fishery production in Bengkulu City in 2016 was 29,676.8 tons/year or equal to 47% of total fishery production of Bengkulu Province, which was 62,407.7 tons/year. The availability of marine resources is followed by annual increase of the number of fishermen. The number of fishermen in Bengkulu City rose from 5.867 in 2014 to 8.480 in 2017 (BPS, 2018).

Existing fish material encourages business people in Bengkulu City to process the fish products. There were 426 fish processing units in Bengkulu Province include 147 units (34.51%) are in Bengkulu City and 270 units (65.49%) are in others. One of the fish processing units is UD.XY, which is located in Sumber Jaya; Kampung Melayu Sub-district, Bengkulu City was established in 2007. Their product ground fish has Quality, Safe and Feasibility Certificates issued by the Government Authority of Fish Quarantine, Quality Control and Fishery Product Safety Agency (BKIPM) of Bengkulu Province.

The marketing of ground fish covers Bengkulu City, as well as Palembang, Jambi, Bangka, Riau, Jakarta, and Lampung and will soon be distributed abroad in Singapore and Malaysia. The production system is *making to order*, which means producing and product after customer makes an order. The material of ground fish is fresh mackerel. The availability of material affects the production. The production process of UD.XY faces some risks. Risk is chance of undesirable outcome, so risk is only related with situation which allows negative outcome and is related with prediction of the negative outcome. Risk always refers to negative situation (Hidayat, 2015). The average production of UD.XY in 2017 was 3,000 kg/month with total monthly

sales of Rp 300,000,000/month (Anggita *et al.*, 2017).

The material is mackerel. In processing, there is risk of causing product defect. According to the chairman of UD.XY, the production risk in 2018 was 15% in one production, so the selling price lowered and reprocessing was impossible. The risk comes from the material, production process, and final product such as soy bean (Tahir, 2011), corn (Kurniwati, 2012), Paddy (Muzdhalifah, *et al.*, 2012), Cassava Crackers (Pariyanti, 2017), and Crude Palm Oil (Kuncoro, *et al.*, 2018). The risks are material scarcity, poor quality of material, unhygienic and quickly rotting product, and product marketing risk. Risk can be connected with possibility of unexpected loss. The possibilities show uncertainty which damage the company. It could affect the achievement of company objective. To improve efficiency and reduce, business risk analysis should be performed to identify and assess the risk to prevent or minimize loss.

MATERIALS AND METHODS

The research location was determined purposively in UD. XY at Bengkulu City. The study was performed on August - September 2019. The respondents were six people of the owner and five employees.

Data Analysis

Two factors were measured i.e. risk factors and risk indicators. The risk assessment covered material, production process and product risks (Darmawi, 2002). Data Processing use FMEA. It is a structured procedure to identify and prevent failure mode as much as possible using priority scale (Stamatis, 1995; McDermot *et al.,* 2008; Iswanto *et al.,* 2013; Hasbullah *et al.,* 2017; Kuncoro, 2018). The outcome of FMEA is Risk Priority Number (RPN). The components of RPN as formula bellow :

$$RPN = Severity\ (S)\ x\ Occurence\ (O)\ x\ Detection\ (D).$$

Severity reflects the severity of impact of a potential failure or loss of every risk indicator. Occurrence probability is chance of failure or loss of every risk indicator. Detection is availability level of the detection system of the impact of a potential failure or loss of every risk indicator to determine a failure or loss of every risk indicator earlier. Risk assessment based on risk factor and production risk indicator are presented in Table 1.

Table 1. Ground fish production risk study and assessment

No	Risk Factor	Risk Indicator
A	Material Risk	1. Fluctuating price of fish material 2. Poor availability of fish supply 3. Poor fish quality 4. Late material delivery
B	Production Process Risk	1. Poor ground fish product 2. Unhygienic and uncomfortable work environment 3. Machine and equipment damage 4. Mistake in cutting and filleting fish 5. Operator error in packaging 6. Uncontrolled cooling temperature and period 7. Insufficient clean water availability
C	Product Risk	1. Fluctuating demand for ground fish 2. Competing ground fish product 3. Ground fish order cancellation 4. Late ground fish delivery 5. Mistake in packaging process 6. Damage during storage 7. Poor quality awareness of the society

Sources : Compilation (2019)

RESULTS AND DISCUSSION

Risk Priority Number (RPN) was obtained by using FMEA (Failure mode and effect analysis). RPN is affected by Severity, Occurrence and Detection values. The highest value is the priority in determining strategy to minimize risk. The result of RPN calculation of each risk indicator is shown in Table 2.

Table 2. Result of assessment of ground fish production using FMEA

No	Risk Factor	Risk Indicator	S	O	D	RPN	Rank
A	Material Risk	1. Poor availability of fish supply	7.7	5.3	6.0	245.3	1
		2. Fluctuating price of fish material	5.2	6.0	6.3	196.3	2
		3. Poor fish quality	4.5	4.8	3.7	79.8	3
		4. Late material delivery	3.3	1.8	1.5	9.2	4
B	Production Process Risk	1. Poor ground fish product	6.2	4.3	2.3	62.4	1
		2. Machine and equipment damage	5.0	2.2	3.8	41.5	2
		3. Insufficient clean water availability	3.7	2.5	2.7	24.4	3
		4. Mistake in cutting and filleting fish	5.5	1.8	2.3	23.5	4
		5. Operator error in packaging	4.5	2.2	2.3	22.8	5
		6. Uncontrolled cooling temperature and period	4.8	2.3	1.7	18.8	6
		7. Unhygienic and uncomfortable work environment	4.8	3.2	1.2	17.9	7
C	Product Risk	1. Competing ground fish product	7.0	6.8	6.7	318.9	1
		2. Fluctuating demand for ground fish	5.3	5.5	4.3	127.1	2
		3. Poor quality awareness of the society	4.7	5.0	4.0	93.3	3
		4. Ground fish order cancellation	5.2	2.2	3.3	37.3	4
		5. Late ground fish delivery	4.3	1.3	1.5	8.7	5
		6. Damage during storage	3.7	2.0	1.2	8.6	6
		7. Mistake in packaging process	2.8	1.8	1.3	6.9	7

Source: Processed primary data (2019)

Material Risk Factor

Based on Table 2, the highest RPN in material risk factor was in poor availability of fish supply (RPN of 245.3). This risk factor directly affects ground fish production. The availability of fresh mackerel, which was the main material of ground fish, depended on the weather. In bad weather, the availability would lower. The material was obtained from own catch and fishermen at Bengkulu City and South Bengkulu Regency. Sufficient material availability will increase production and poor fish supply will lower production. On June and July 2019, very poor fish supply affected production, which only produced 300 Kg on June and 800 Kg on August. The study by Irawan (2017) showed that the material risk factor with the highest RPN is material price, while availability of material has the second highest RPN. Study by Prasetiyo *et al,.* (2017) shows that the risk factor with the highest RPN is quality of material.

The second highest risk was fluctuating price of fish material with RPN of 196.3. Material availability depended on price of material. In good weather, material was easy to obtain and vice versa. The price of fresh mackerel was Rp 50,000/Kg – Rp 65,000 / Kg. If

the price of fresh mackerel rose, the price of ground fish sold to the customer would also rise. It couldn't be avoided the firms, material supplier and the government. Fluctuating prices of agricultural and fishery commodities are affected by climate.

The third highest risk was poor fish quality with RPN of 79.8. Good material quality would produce good ground fish. In UD.XY, material quality was ensured. There are three types of material quality, i.e. a quality (fresh and big), B quality (frozen fish), and C quality (not fresh/soft meat and small). The material bought from fishermen in Bengkulu City and South Bengkulu Regency. Distance and delivery time should be considered in buying material. The material from fishermen should be immediately processed without freezing. The material obtained from South Bengkulu Regency about 173 km. Delivery time could reduce material quality. It was the fourth highest material risk factor with RPN of 9.2. Timely material delivery allows fast ground fish production. Conversely, slow and untimely material delivery disturbs production.

Production Process Risk

The highest production process risk was poor ground fish product with RPN of 62.4. Poor ground fish product was indicated as off-white color, rough texture and non-fresh smell. This was affected by material quality and mistake in the production process. Fresh and A quality material processed by proper grinding would produce quality product. Similarly, proper packaging and freezing would produce the same. In the study by Irawan (2017), the highest production process risk factor is poor product quality due to improper production.

Meanwhile, Septifani, *et al.* (2018) found that the highest indicator is plastic bottle, followed by machine and equipment damage. Another study by Prasetiyo *et al.*, (2017) shows that the highest production process risk factor is reduced quality/dead starter bacteria which results in poor yoghurt product.

The second highest risk was machine and equipment damage with RPN of 41.5. Machine and equipment damage was one of the important problems in producing ground fish. UD.XY had 4 grinding machines in the production process that use electricity. The machines and knives of the machines should be checked regularly. Packaging machine also affected product quality. Another equally important machine was freezer to store newly produced ground fish. Other equipment such as knives in cutting and filleting should be maintained, sharp and not rusted. Other important equipment was spoon and fork in meat scrapping. Machine and equipment damaged could be countered by proper and regular maintenance.

Insufficient clean water availability was the third highest risk indicator with RPN of 24.4. Washing fresh mackerel was the first step in production. Washing was performed twice using clean fresh water. Water availability was also an important factor in production. The location, which is near the sea, means there's limited clean water from well. Currently, UD.XY has installed fresh water of Government Water Treatment called PDAM to provide water. The fourth highest risk indicator was operator error in packaging with RPN of 23.5. Packaging process should follow the procedure. The packaging machine should be used appropriately and skillfully. Error in

packaging could affect product quality. The amount of ground fish in a packaging should be right and the packaged should be taped correctly because packaged ground fish was very sensitive to temperature.

Uncontrolled cooling temperature and period was the fifth highest production process risk factor with RPN of 18.8. Ground fish was frozen in the freezer at 18°C to 25°C for about less than 6 hours. The freezer depended on electricity. Temperature should be noted because when the electricity was out, it should be replaced by generator set. The recommended freezing time was 6-8 hours. Unhygienic and uncomfortable work environment was the sixth highest production process risk factor with RPN of 17.9. The worker need clean and comfortable to work to be able to focus in their jobs and produce good product. Clean work environment could reduce work accident or injury and lead to healthy workers and increased productivity.

Product Risk

The highest risk in production was competing ground fish product with RPN of 318.9. This was a serious product risk. Quality ground fish was an important factor to make customer buy the product beside price and service. Ground fish competitors in Bengkulu City were Ikan Giling Evi, Ikan Giling Anton, Ikan Giling Asep, Ikan Giling Mul Mandi 88 and other homemade ground fish. Customer satisfaction would create positive assessment, so that they keep buying the product. Loyal customer could be a marketing strategy for the product. In the study by Prasetiyo *et al.,* (2017), the product risk factor with the highest RPN is also competing similar product, i.e. a famous yoghurt

product as the main competitor is the main risk. Another study by Irawan (2017) shows that the product risk factor with the highest RPN is fluctuating tempe cracker demand, while compete product is the second highest risk.

The second highest risk was fluctuating ground fish demand with RPN of 127.1. Demand was unpredictable. Fluctuating ground fish demand could affect the revenue of UD. XY and continuation of production. UD. XY could only predict increased demand during holidays, e.g. Eid, Christmas, and Lunar New Year, as well as school holidays, New Year, and national events. The third highest product risk was poor quality awareness of the society. People's poor awareness on product quality could affect their decision to use the product. UD. XY has worked with fish quality awareness and quarantine society forum (Formikan) of Bengkulu to enhance product quality and socialize the importance of quality in using a product.

The fourth and fifth highest product risk factors were order cancelation and late delivery with RPN of 37.3 and 8.7, respectively. Order cancelation usually happened because customer demanded product quality where the stock was empty. Meanwhile, late delivery was caused by public transport, i.e. damaged or replaced expedition car. Product damage during storage was the sixth highest product risk factor with RPN of 8.6. Product not being stored at certain temperature could lead to damaged product. Product was frozen at 18°C for 6-8 hours, and then the product shouldn't be stored in the freezer below 25°C after freezing. Negligence during freezing and storing could damage the product. The seventh highest risk was mistake in packaging with RPN of 6.9. Product delivery had

good packaging procedure. Product which was ready to deliver was put in cardboard with the correct density and padded with Styrofoam/fiber to protect the product during delivery. The cardboard should also be lined by outer plastic cover to protect the product from water.

CONCLUSION

The highest material risks in UD.XY ground Mackerel Company is poor availability of fish supply, the highest production process risk is poor ground fish product, and the highest product risk is competing ground fish product. Every company should perform risk analysis to improve efficiency and reduce loss because a company which doesn't realize its risk and makes no effort to control it will experience loss or even be bankrupt. UD.XY should continue to identify production risk factor in terms of material, production process, and product to create strategy to mitigate risk for the survival of the business.

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