RISK MANAGEMENT ON COCOA SUPPLY CHAIN IN MSME KAMPUNG COKLAT SENARA, LOMBOK, INDONESIA

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ABSTRACT

Kampung Cokelat Senara (KCS) is a Micro Small and Medium Enterprise (*MSME*) *that processes cocoa beans to produce chocolate products. The imbalance of supply and demand increases risks in the primary actors of the supply chain. This study aims to identify, assess, and determine risk factors through FMEA, and determine risk mitigation strategies for the cocoa supply chain in KCS through* an *Analytical Hierarchy Process* (*AHP) analysis. Ten risk factors were identified for cocoa farmers, nine risk factors for cocoa product manufacturers, and seven risk factors for distributors/retailers. The priority risk factor at the cocoa farmer level is pests and disease damage. The priority risk factor at the producer level is the uncertain supply of raw materials. The priority risk factor at the distributor/retailer level is fluctuating buying interest. Cocoa farmers are prioritized actors in the supply chain. The priority strategy for supply chain risk management at the farm level is the crop intensification program. The priority strategy for supply chain risk management at the producer level is an expanded partnership with farmers. The priority strategy for supply chain risk management at the distributor/retailer level is product specialization.*

Keywords : *Analytical Hierachy Process; Cocoa; Risk; MSME; Supply Chain*

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INTRODUCTION

West Nusa Tenggara (Nusa Tenggara Barat or NTB) is one of the best quality cocoa producing provinces in Indonesia. The NTB Provincial Government has made cocoa a regional flagship commodity in addition to coconut, coffee and vanilla (Supeno et al., 2018). In 2017, the government inaugurated Genggelang Village as a cocoa center in NTB. Kampung Coklat Senara is an MSME (Micro, Small and Medium Enterprises) that processes cocoa beans into semi-finished materials to produce ready-to-eat chocolate products. Products sold include cocoa butter, cocoa powder, chocolate drinks, chocolate bars, and chocolate candies with various flavors. MSME Kampung Coklat Senara procures fermented cocoa beans from Genggelang village farmers (especially from the Bunga Mekar Farmer Group) and employs the locals in its business activities, thus playing important role as a backbone in the local cocoa trade.

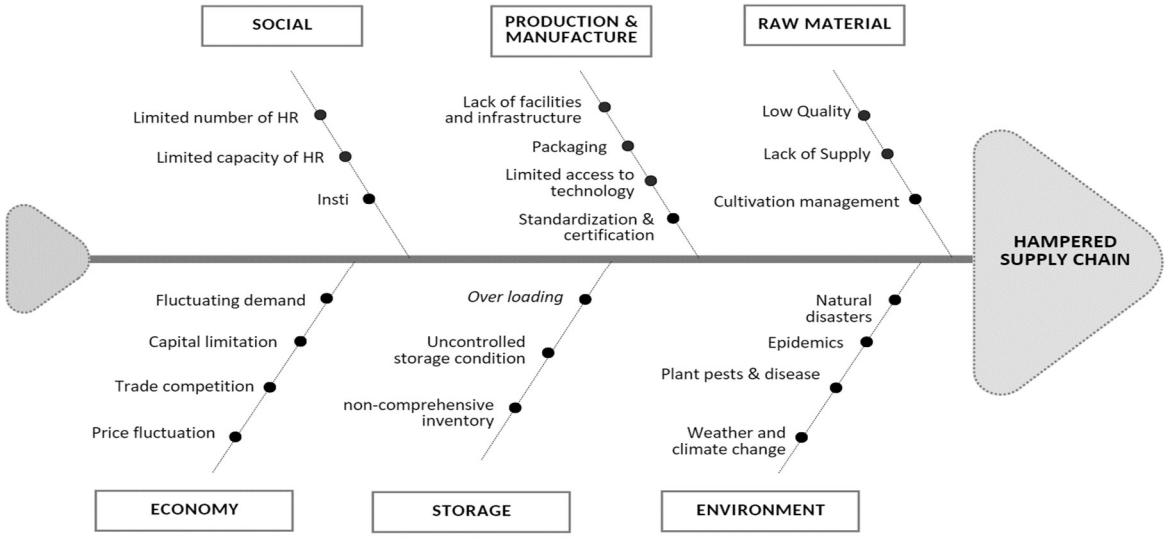
The supply and demand imbalance of cocoa beans increases the risk in primary actors in the local chocolate industry, including MSME Kampung Coklat Senara (Aprizal et al., 2018). Based on Diskominfo of North Lombok Regency (2021), Gangga Sub-district has a total cocoa plantation area of 1,719.05 ha; where the land area with Producing Plants (TM) is only 1,196.2 ha, the land area with Non-Producing Plants (TBM) is 281.8 ha, and the area with Old/Damaged Plants (TT/TR) is 241.73 ha. The land area of productive and healthy plantations is only 56% which caused non-optimal production.

The causes of low productivity include a non-optimal cultivation process, lack of access to information and application of technology, and limited capital owned by farmers (Aprizal et al., 2018). Moreover, cocoa bean production tends to decline every year. According to the North Lombok Regency Government (2021), cocoa productivity in Genggelang Village has decreased from 650.79 kg/ha in 2020 to 636.41 kg/ha in 2021.

The Bunga Mekar Farmer Group has initiated fermentation of cocoa beans to improve quality, flavor, aroma, and shelf life. However, the productivity of fermented cocoa beans has not been consistent in quantity or quality, as climatic and environmental conditions highly influence the yield and fermentation results. In addition, most farmers only sell in the form of dry cocoa and only a small number of farmers can perform fermentation techniques. This leads to the scarcity of fermented cocoa beans and hampers the flow of the supply chain.

Unpredictable natural conditions are another obstacle to cocoa agro-industry activities in MSME Kampung Coklat Senara. Infrastructure damage caused by the 7.0 magnitude earthquake in 2018 halted cocoa cultivation and chocolate manufacturing (Saloko et al., 2018). In addition, the sustainability of the cocoa supply chain was also hampered by the large-scale social restriction regulation during the COVID-19 pandemic, making it difficult for the community to recover the local economy (Indah, 2021). These phenomena show that every actor in the supply chain has a high risk and potentially threatens the sustainability of MSME Kampung Coklat Senara as the flagship business of North Lombok Regency.

The problems in the cocoa supply chain in MSME Kampung Coklat Senara are described in Figure 1. Risk mitigation needs to be considered to optimize the supply chain flow. Risk management in the supply chain helps analyze risks on an ongoing basis to prepare businesses to provide preventive action, cope with existing risks through corrective action, and safeguard the company from unwanted losses (Schlegel & Trent, 2014). Therefore, an analysis is needed to identify risk factors in the cocoa supply chain, weigh the priority risk factors, and make decisions to prevent or minimize the impact of existing risk factors. The analysis must be conducted thoroughly from farmers as suppliers, manufacturers, distributors, to retailers.



Source: Raharto, 2016

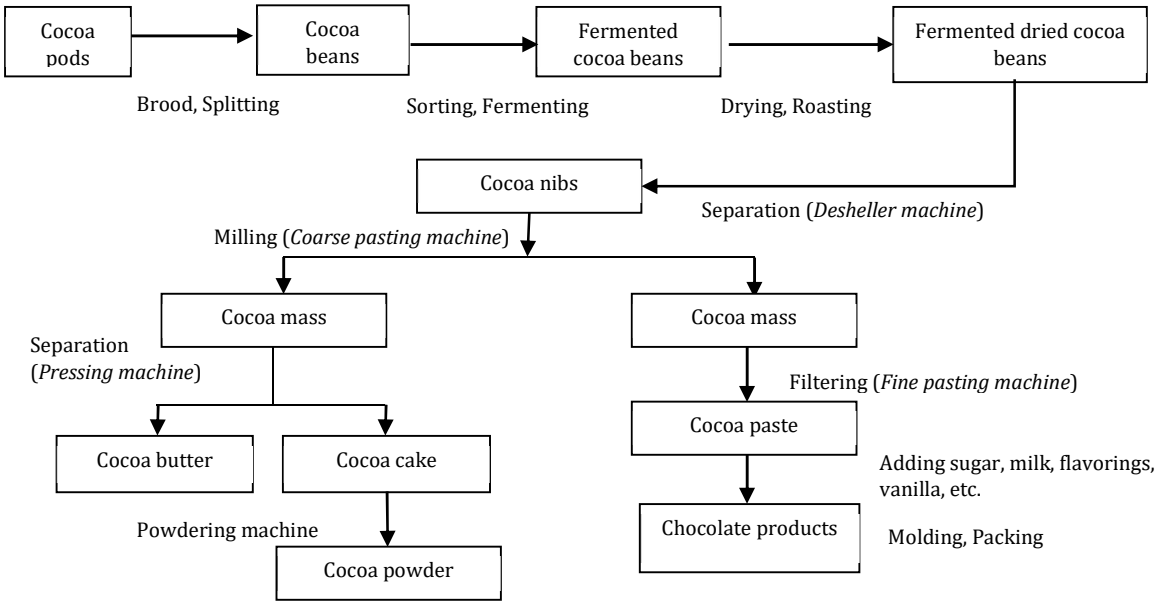
Figure 1
The Cocoa Agro-industry Supply Chain's Problems in Fishbone Diagram

Figure 1 indicates that a more in-depth study is needed to manage risk in the cocoa agro-industry supply chain to determine the right strategy as a risk mitigation/prevention step to ensure the sustainability of MSME Kampung Coklat Senara. Therefore, this study aims to identify risk factors, assess and determine priority risk factors, and determine strategies as risk mitigation efforts in the cocoa supply chain in the MSME Kampung Coklat Senara.

LITERATURE REVIEW

Chocolate Industry Process

Cocoa (*Theobroma cacao*) as an agro-industrial commodity is cultivated to obtain quality beans. Cocoa cultivation activities include nursery, planting, pruning, pest and disease control, maintenance, and harvesting. Cocoa processing activities include post-harvest handling and cocoa product processing. Post-harvest processing of cocoa is done through curing, fermentation, drying, and sorting of beans (Afoakwa, 2014). Cocoa beans are fermented to improve cocoa quality, flavor, and aroma (Schwan & Wheals, 2004). Processing and manufacturing of cocoa paste includes roasting, grinding, filtering, heating, and packaging (Goya et al., 2022). A flowchart of the chocolate processing and manufacturing process can be seen in Figure 2.



Source: Goya et al., 2022

Figure 2
Chocolate Processing and Manufacturing Flowchart

Supply Chain Management

A supply chain is a series of networks between every actor in a system from upstream to downstream that is connected to deliver products to consumers (Blanchard, 2021). According to Tompodung et al. (2016), conceptually the supply chain is defined as the entire process of converting processed raw materials into end-of-life products. The supply chain aims to ensure that materials in the system continue to move to prevent accumulation or scarcity in a particular link (Danis, 2015). Supply chain management is an effort to meet customer needs by paying attention to product quality, time, cost, and labor used in running the distribution system (Blanchard, 2021). Supply chain management depends on products, services, financial resources, and information (Sjah & Zainuri, 2020). The purpose of supply chain management is to manage the relationship between actors in the system so that it becomes competitive and adaptive in responding to market developments (Fizzanty & Kusnandar, 2012). The Supply Chain Council (SCC) and the American Production and Inventory Control Society (APICS) issued a supply chain reference model called the Supply Chain Operation Reference (SCOR). The SCOR model was formed with the aim to help evaluate a business so that it can perform reliable, consistent, and efficient supply chain management (Ahoa et al., 2018). The level 1 process of the SCOR model focuses on 5 main processes: plan, source, make, deliver, and return (APICS, 2017).

Risk Management

Risk is anything that has the potential to cause adverse impacts that can affect the achievement of the goals of a party or organization (Kountur, 2004). Risk is the possibility of loss that can occur from an event, while uncertainty is a disturbance that comes from outside (Hopkin, 2018). Thus, risk is defined as the impact of uncertainty on achievement goals (ISO 31000). Risk management is a series of processes to identify, measure, analyze, control, and evaluate risks in all business activities (Power, 2004). According to Darmawi (2006), risk management is an overall risk control effort that aims to increase the effectiveness and efficiency of the company. Supply-chain risk management is a combined

concept that bridges each component in the supply chain to apply the risk management process (Giannakis & Papadopoulos, 2016). According to Schlegel and Trent (2014), the supply chain risk management process is practically carried out through the process of identifying, building a framework, evaluating, and monitoring risks.

METHOD

Location and Time

This research was conducted from September 2022 to August 2023. Data collection was conducted at MSME Kampung Coklat Senara, located in Genggelang Village, Gangga District, North Lombok Regency, West Nusa Tenggara (-8.349592508058933, 116.2366334357663).

Purposive sampling was used as a method to select actors in the supply chain as samples in the study (Indah, 2021). The census method is a sampling technique from one population group, which is suitable for quantitative research with a small population and capable of capturing comprehensive and representative data (Alfazah et al., 2020). Based on this description, the respondents were determined as follows.

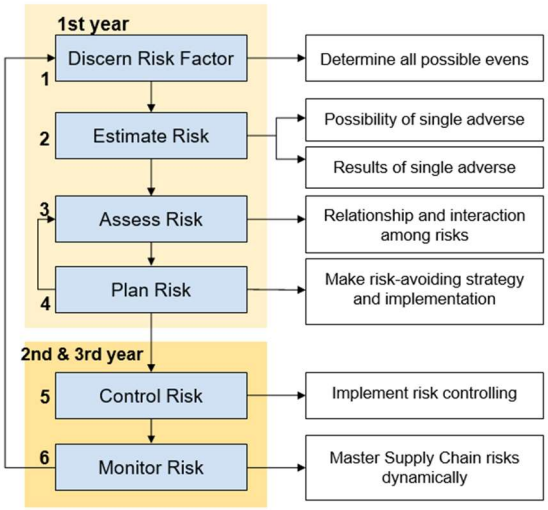
1. Farmer respondents were determined using a purposive sampling method with the provisions of being farmers who live in Genggelang Village, own cocoa land, and/or become farm workers in cocoa plantations and supply cocoa beans to MSME Kampung Cokelat Senara. There were 49 respondents.
2. Labor in processing and manufacturing respondents were censused, consisting of 8 respondents.
3. Respondents of outlet distributors were conducted by census, consisting of 3 respondents.
4. Key informants or experts are representatives of the North Lombok Regency Plantation Office, North Lombok Regency Industry Office, North Lombok Regency Trade Office, owners of MSME Kampung Coklat Senara, and academic experts in the cocoa supply chain.

In this study, primary data and secondary data were used. The data collection method used in this research consists of three methods, namely interviews, observation, and documentation.

1. Interviews were conducted as part of a preliminary study to enhance comprehensive understanding to identify risks in the cocoa supply chain that are directly related to the MSME Kampung Coklat Senara. Interviews were conducted for 45-60 minutes related to the cocoa agro-industry system, supply chain conditions, and constraints in the supply chain. The resources were the representatives of the MSME Kampung Coklat Senara, the Plantation Department of North Lombok Regency, and the Trade and Industry Department of North Lombok Regency.
2. Survey conducted to assess the risk factors in the primary actors of the cocoa supply chain in the MSME Kampung Cokelat Senara and the formulation of risk management strategies in the cocoa supply chain from experts.
3. Observation conducted to capture holistic picture of the actual conditions in the field related to the cocoa supply chain in the MSME Kampung Coklat Senara.
4. Documentation was conducted to collect and ivestigate secondary data from records, files, and related media.

Data analysis conducted by identifying the supply chain in the cocoa agro-industry, managing risk in the cocoa supply chain, and formulating priority strategies for

risk mitigation in the supply chain. The supply chain of the cocoa agro-industry was identified by a qualitative descriptive method and was adapted from the supply chain development method according to the APO (Asian Productivity Organization) (APICS, 2017). The risk management process in the supply chain consists of risk identification, risk estimation, risk assessment, and risk planning (Lund et al., 2010). The risk management procedure can be seen in Figure 3.



Source: Lund et al., 2010

Figure 3
Risk Management Procedures

Stage 1: Discern Risk Factor

The first stage is conducting a preliminary study to find facts and actual conditions regarding cocoa agro-industry, cocoa supply chain, and risks in the cocoa supply chain and determine all aspects that might pose risks in the cocoa supply chain. Risk identification is carried out using a descriptive method using the SCOR (Supply Chain Operation References) approach. The SCOR model is used to review potential risks from the process of planning, making, delivery, and return (Lund et al., 2010).

Stage 2: Estimate Risk

This stage is carried out to analyze the risk factors that exist in the aspects of raw materials, production processes, and marketing. Determine the likelihood of a risky event (possibility of a single adverse event) and the results/impact arising from a risky event (the result of a single adverse event). Risk factor analysis was carried out using the FMEA (Failure Mode and Effect Analysis) method, namely by providing an estimated value of the frequency of occurrence, severity, and detection rate (Lund et al., 2010). The values for each criterion can be seen in Table 1.

Table 1
FMEA Score Criteria

Score	Score Description		
	***Occurrence* (O)**	***Severity* (S)**	***Detection* (D)**
1	Never	No effect	Almost certain
2	Very rare	Very small	Very easy
3	Dairly rare	Small	Easy
4	Slight rare	Very low	Fairly easy
5	Rarely	Low	Fair
6	A little often	Moderate	A little difficult
7	Quite often	High	Moderately difficult
8	Often	Very high	Difficult
9	Very often	Seriously	Very difficult
10	Always happens	Very dangerous	Almost impossible

Source: Mikulak et al., 2017

Stage 3: Assess Risk

This stage is carried out to determine the priority level of risk factors through the aggregation of risk values in each aspect of procurement of raw materials, production processes, and marketing. Quantification is reviewed based on the level of severity (S), occurrence (O), and detection (D) by calculating the RPN (Risk Priority Number) and RSV (Risk Score Value). The RPN (Risk Priority Number) value indicates the priority value of the risk factor in terms of the multiplication result of all criteria according to Equation 1. The RSV (Risk Score Value) value often also referred to as the CN (Critical Number) or the critical value of the risk factor in terms of the multiplication result severity and occurrence levels are in accordance with equation 2 (Mikulak et al., 2017).

RPN = O x S x D ……..(1)

RSV = O x S ……..(2)

Stage 4: Plan Risk

This stage is carried out to determine mitigation strategies to prevent and handle risks in the cocoa supply chain. Risk management strategy planning is carried out using the AHP (Analytical Hierarchy Process) method as a decision-making technique with multiple criteria. The stages of AHP according to Saaty (1989) are as follows.

1. Determine the purpose of decision making
2. Develop a hierarchical structure according to the criteria and alternatives that have been formulated
3. Carry out a pairwise comparative assessment with a pairwise comparison
4. Determine the priority vector
5. Calculating the Maximum Eingen value (λ max)
6. Consistency of comparison of elements (CI < 0.1)

Calculations and weighting to determine priority strategies are carried out in the Expert Choice application. Paired comparative judgments, eigenvalue calculations, and consistency tests were performed for each hierarchical level. The value of the weight of interest ranging from 1 to 8 as described in Table 2 (Saaty, 1989).

Table 2
Weight of Interest in Pairwise Comparative Assessments

Weight of Interest	Description
1	Both are equally important in achieving the goal
3	A little more important than the others
5	Quite important compared to others
7	Very important than the others
9	The absolute most important and most influential than the others
2,4,6,8	Represents the value between adjacent weights

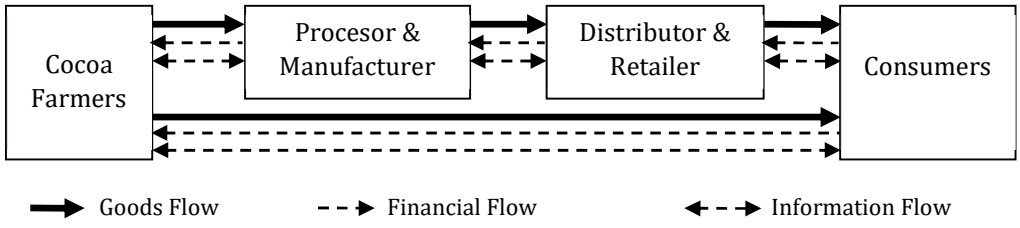
Source: Saaty, 1989

RESULTS AND DISCUSSION

MSME Kampung Coklat Senara's Supply Chain Map

Kampung Coklat Senara (KCS) is a chocolate production center located in Senara, Genggelang Village, Gangga Regency, North Lombok District. Kampung Coklat Senara became a business entity which was established in March 2018 and was inaugurated by the Regent of North Lombok Regency and the Head of the North Lombok Food Security and Agriculture Service under the supervision of the Provincial Government of West Nusa Tenggara. The business entity is the collaborative result of the members of the Bunga Mekar Farmers Group and the Bunga Mekar Female Farmers Group. MSME Kampung Coklat Senara provides educational tours and processes cocoa beans into semi-finished ingredients to produce ready-to-eat chocolate processed products. Products sold include cocoa butter, cocoa powder, chocolate drinks, chocolate bars, and chocolate candies with various flavors. Kampung Coklat Senara uses fermented cocoa beans that come from Genggelang village farmers, especially from the Bunga Mekar Farmers Group. Production activities in 2022 require 15,000 kg of dry cocoa beans in one year to produce 7,800 kg of cocoa powder, 1,920 kg of cocoa butter, and 600 kg of processed chocolate products such as chocolate bars and chocolate candies (KLU Plantation Office, 2022).

The supply chain of MSME Kampung Coklat Senara consists of two members, namely primary actors and secondary actors. Primary actors are those directly involved in the supply chain, namely cocoa farmers, processors and manufacturers, and distributors/retailers. Secondary actors are supporting parties to maintain the continuity of supply chain activity, such as the local and central government. Each actor in the supply chain has an interdependent relationship related to the flow of goods, money, and information. The cocoa supply chain map in MSME Kampung Coklat Senara can be seen in Figure 4.



Source: ; Data Analysis, 2023

Figure 4
Cocoa Supply Chain Flow in MSME KCS

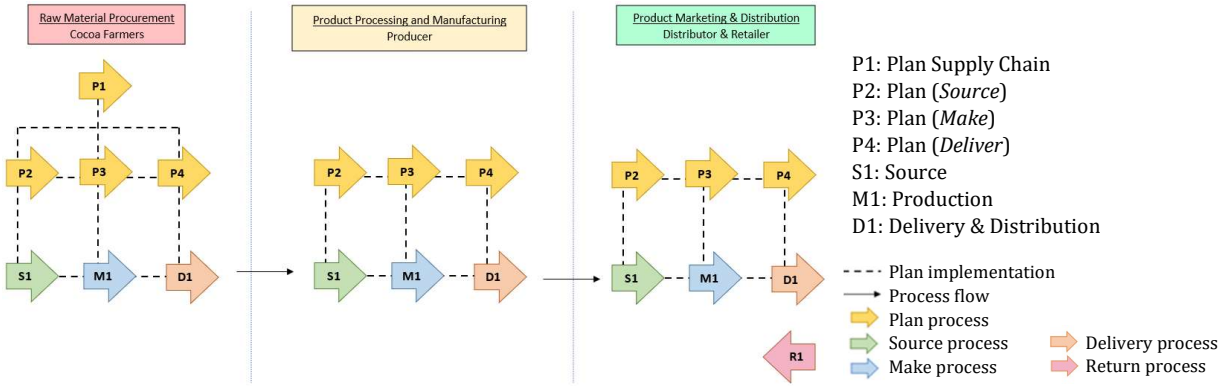
The flow pattern of goods goes from upstream to downstream, where cocoa farmers supply cocoa beans to processors and manufacturers, then the cocoa beans are processed and go through the manufacturing process to become products, then sent to distributors/retailers to be sold to consumers. In addition, a small number of farmers also sell cocoa beans directly to consumers without going through processing. The cocoa agro-industry in MSME Kampung Coklat Senara is highly dependent on the availability of cocoa beans supply as the main raw material.

The flow pattern of money goes from downstream to upstream, where consumers as buyers (processed cocoa products) paid to distributors/retailers, then distributors/retailers paid sales proceeds to processors and manufacturers as producers. Processors and manufacturers paid the cocoa beans as the main raw material from farmers. In a rare case, consumers may have direct transactions with farmers to buy cocoa beans.

Information flow has a two-way flow pattern, from upstream to downstream and from downstream to upstream. Cocoa farmers provide information on selling prices and specifications of their cocoa beans to processors and manufacturers (producers) and consumers. Processors and manufacturers provide information on the purchase price and specifications of cocoa beans needed to farmers, so transactions occur. Processors and manufacturers exchange information with distributors/retailers regarding product demand, product supply and product sales. Distributors/retailers provide information regarding product variants, product specifications, and product prices to consumers. Consumers provide information related to product evaluation and demand. Information related to the price of cocoa and its processed products from the farm level to consumers is very transparent, so that all actors in the supply chain acknowledge about the the market price.

Supply Chain Activity Analysis

The activities of all actors in the cocoa supply chain are identified based on the SCOR approach, which includes planning, procurement, production, and delivery processes (APICS, 2017; Khairani et al., 2023). The activities of each actor in the supply chain are described in Table 3 and illustrated by Figure 5.



Source: APICS, 2017; Data Analysis, 2023

Figure 5
Cocoa Supply Chain Activities based on SCOR

Table 3
Supply Chain Activities in Each Actor (SCOR)

Process	Cocoa Farmers' Activities	Processors & Manufacturers' Activities	Distributor/Retailers' Activities
Plan	Cultivation planning Maintenance planning Harvest planning Delivery planning	Raw material supply planning Fermentation planning Production planning Storage planning Packaging planning Selling price planning Delivery planning	Product supply planning Marketing planning Sales target planning Delivery planning
Source	Seeds procurement Production equipment procurement Cultivation equipment procurement HR procurement	Procurement of raw materials Procurement of production equipment HR procurement	Receive product supplies Receive orders Keep product supply
Make	Cultivation Maintenance Harvest Post-harvest Sorting Storage & Packaging	Receive product orders Fermentation Production & manufacture Packaging Storage	Provide product information Promotion Transaction
Deliver	Marketing Delivery	Marketing Delivery	Packing Delivery Product returns

Source: APICS, 2017; Data Analysis, 2023

Risk Analysis in Supply Chain

The analysis was carried out to examine the risk factors that affect the flow of the cocoa supply chain in MSME Kampung Coklat Senara. Based on the results of the interviews, 10 risk factors were identified that originate from the procurement of raw materials (cultivation) at the cocoa farmer level.

Assessment of each risk factor for cocoa farmers was carried out based on the questionnaire according to Table 4. Based on this assessment, it was found that the priority risk factors at the cocoa farmer level were damage due to pests and diseases during cultivation with RPN values of 440.08 and RSV 84.56. Pests and diseases attack cocoa trees and cause damage to cocoa beans even before the harvest phase. Cocoa pod borer (C. cramella) and black pod disease (P. palmivora) are the dominant pests that attack cocoa trees. The area of attack by the cocoa pod borer (*C. cramella*) reaches 26% of the total area of cocoa fields in NTB, the area of attack by pod rot disease (*P. palmivora*) reaches 38% of the total area of cocoa fields in NTB, and there is no controlled area of attack by the two pests (Directorate of Plantation Protection, 2018). In addition, the two pests have a rapid rate of spread and transmission from tree to tree. This is very dangerous because it can affect the quality and quantity of cocoa beans and hamper the flow of the cocoa supply chain in Kampung Coklat Senara.

Table 4
Assessment of Risk Factors in the Cocoa Farmers Level

Risk Factor	Code	Severity	Occurence	Detection	RPN	RSV
Narrow understanding of production management	R1	6.73	6.53	2.18	96.04	43.98
Limited cultivation land capacity	R2	8.24	7.12	1.24	73.11	58.72
The age of the cocoa tree is too old	R3	9.06	8.16	3.18	235.49	73.97
Limited capital owned by farmers	R4	7.12	6.02	2.82	120.76	42.88
Limited number of human resources farmers	R5	6	5.12	1.57	48.3	30.73
Limited human resource capacity of farmers	R6	9.96	8.49	2.18	184.63	84.55
Damage due to pests and diseases during cultivation	R7	9.8	8.63	5.2	440.08	84.56
Yields are affected by environmental conditions	R8	8.69	6.53	1.59	90.38	56.78
Insufficient storage	R9	5.12	3.96	1.78	36.01	20.28
Delay in delivery of cocoa beans to processors	R10	3.96	3.24	1.76	22.55	12.85

Source: Primary Data Processed, 2023

Based on the interviews, 9 risk factors were identified that originate from processing and manufacturing activities at the producer level. Assessment of each risk factor for processors and manufacturers was carried out based on the questionnaire according to Table 5. Based on this assessment, it was found that the priority risk factors at the processors and manufacturers level were the erratic supply of raw materials with an RPN value of 363.8 and an RSV of 63.7. Raw materials are the core components used to produce products through certain processes. Cocoa as the main raw material has the characteristics of being perishable, seasonal, and requires large space for storage. In addition, other supporting raw materials can only be obtained from the city of Mataram, which is 53 km from the production house, so it requires time, money, and a large mode of transportation. The supply of raw materials is a benchmark for the sustainability of a company. According to Sarinah and Taufik (2014), the uncertain supply of raw materials is the main risk that can cause a decrease in company performance. In addition, Risqiyah and Santoso (2015) stated that the supply of raw materials is a crucial risk in the agro-industry supply chain. Erratic supply of raw materials both in terms of quality, quantity and timeliness can hamper supply chain flow.

Table 5
Assessment of Risk Factors in the Processor and Manufacturer level

Risk Factor	Code	Severity	Occurence	Detection	RPN	RSV
Limited production facility capacity	R1	9.1	8.9	1.4	11.57	81.0
Non-standardized product processing & manufacturing	R2	6.6	6.7	2.0	88.2	44.1
Unstable supply of raw materials	R3	9.3	6.9	5.7	363.8	63.7
Limited financial resources for manufacturing	R4	9.7	5.1	2.3	114.2	50.0

Limited number of manufacturing human resources	R5	7.9	8.9	4.1	288.3	69.6
Limited capacity of manufacturing human resources	R6	6.7	6.1	2.4	100.2	41.2
Production yield non-uniformity	R7	6.7	7.6	5.4	276	50.8
Inadequate product storage	R8	8.6	7.4	2.4	154.6	63.7
Delays in product delivery to distributors/retailers	R9	2.6	3.1	2.6	20.8	8.1

Source: Primary Data Processed, 2023

Based on the results of the interviews, 7 risk factors were identified that originate from marketing and distribution activities at the distributor/retailer level. Assessment of each risk factor in processors and manufacturers is carried out based on the questionnaire, the result can be seen in Table 6. Based on the assessment, it is found that the priority risk factor at the distributor/retailer level is fluctuations in people's buying interest with an RPN value of 373.3 and an RSV of 53.3. The consumers from Kampung Coklat Senara vary, from customers who buy regularly to customers who buy occasionally because they are interested and want to try it. Consumers are usually tourists, chocolate fans, consumers of organic products, and others. This causes very fluctuating market demand, increasing public buying interest, especially during the holiday season and certain moments such as Valentine's Day and World Chocolate Day. In addition, changes in trends and people's preferences also affect the interest in buying chocolate products. According to Seta (2019), the marketing strategy for agro-industrial products greatly influences people's buying interest. Therefore, strategic measures need to be taken to improve the cocoa supply chain at the distributor/retailer level.

Table 6
Assessment of Risk Factors in the Distributor/Retailer

Risk Factor	Code	Severity	Occurence	Detection	RPN	RSV
Total supply of unsold products	R1	9.33	6	4.67	261.3	56
Fluctuations in people's buying interest	R2	10	5.33	7	373.3	53.3
Inadequate product storage	R3	7.33	7.33	4.33	233.04	53.78
Competition between sellers with similar products	R4	6	6.67	1	40	40
Limited market access for MSME products	R5	8.67	8.33	4	288.89	72.2
Limited infrastructure and distribution access	R6	2.67	2	4.33	23.11	5.33
After-sales service for consumers who are not intensive	R7	6.33	6.67	3	126.67	42.2

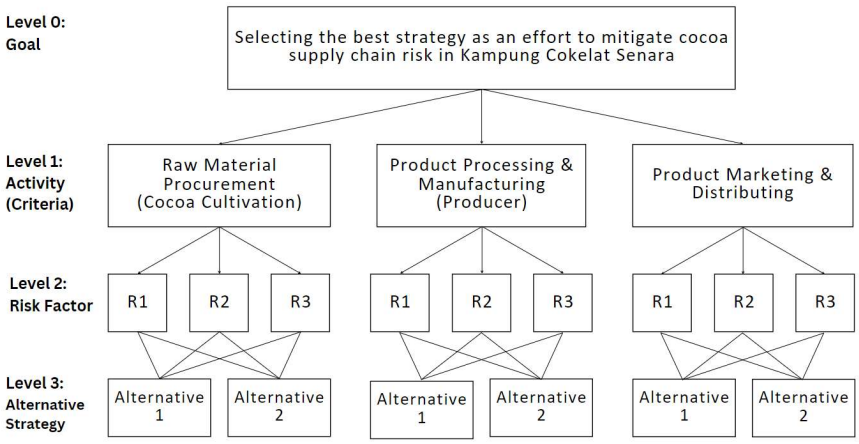
Source: Primary Data Processed (2023)

Risk Mitigation Strategy in Supply Chain

Alternative strategies were formulated to address each risk factor for each actor in the supply chain, namely farmers, producers, and distributors/retailers. Prioritization of alternatives was done using AHP (Analytical Hierarchy Process) analysis. The

hierarchical structure of decision-making for risk management in the cocoa supply chain in Kampung Coklat Senara can be seen in Figure 6.

The results of AHP calculations for selecting priority actors in cocoa supply chain management can be seen in Table 6. It was found that cocoa farmers are the most priority actors in supply chain risk management with an interest weight value of 0.454. Cocoa farmers are priority actors, because the flow of goods moves from upstream to downstream. Cocoa cultivation activity determines the sustainability of other activities in the cocoa supply chain. Procurement of cocoa beans as raw material is a priority activity that needs to be carried out by risk management.



Source: Saaty, 1989; Data Analysis, 2023

Figure 6
Hierarchical Structure of Priority Strategy Selection for Cocoa Supply Chain Risk Management in Kampung Coklat Senara

Table 6
Actor Prioritization in Cocoa Supply Chain Risk Management in Kampung Coklat Senara

Activity	Actor	AHP Weight
Procurement	Cocoa Farmer	0.454
Processing and Manufacturing	Processor & Manufacturer (Producer)	0.324
Product Marketing and Distribution	Distributors/Retailers	0.222

Inconsistency = 0.06

Source: Primary Data Processed, 2023

The formulation of alternative strategies for each risk factor and the results of AHP calculations for selecting priority strategies for supply chain management at the cocoa farmer level can be seen in Table 7. Through FMEA analysis, it was found that the priority risk factors were damage due to pests and diseases. Based on the results of AHP calculations, it was found that the priority strategy for risk management at the cocoa farmer level is to carry out an agricultural intensification program. Agricultural intensification is a production system with intensive management and utilization of resources, including land management, maintenance, and pest and disease management. Demonstration plots are an extension method by creating demonstration plots to provide concrete evidence regarding the impacts and benefits of an agricultural treatment or innovation.

Table 8
Alternative Strategies Selection for Cocoa Supply Chain Risk Management in Cocoa Farmers

Risk Factor in Cocoa Farmers	Alternative Strategies
1.1 Narrow understanding of production management (0.054)	1.1.1 Socialization and assistance for implementing Cultivation SOP (0.325) 1.1.2 Extension for sustainable farming planning (0.675)
1.2 Limited cultivation land capacity (0.065)	1.2.1 Improving the quality of land (0.16) 1.2.2 Creating an integrated irrigation system (0.211) 1.2.3 Building partnership with cocoa farmers (0.629)
1.3 Age of cocoa trees are too old (0.084)	1.3.1 Provising superior cocoa seeds (0.318) 1.3.2 Cocoa regenerating practice (0.682)
1.4 Limited capital owned by farmers (0.140)	1.4.1 Facilitating access to capital services (0.349) 1.4.2 Providing production accomodation (0.210) 1.4.3 Memperkuat kelembagaan ekonomi desa (0.441)
1.5 Limited human resources for farmers (0.125)	1.5.1 Forming a Youth Farmer Group (0.303) 1.5.2 Improving the institutional system and coordination with village stakeholders (0.697)
1.6 Limited human resource capacity of farmers (0.224)	1.6.1 Training related to cultivation according to GAP through Farmer Field Schools (0.718) 1.6.2 Introduction of information technology and agricultural automation (0.282)
1.7 Damage due to pests and diseases during cultivation (0.119)	1.7.1 Plant rehabilitation and rejuvenation (0.258) 1.7.2 Procurement of superior variety seeds (0.288) 1.7.3 Crop Intensification Program (0.454)
1.8 Yields are affected by environmental conditions (0.079)	1.8.1 Application of technology as a detector facility for environmental conditions (0.141) 1.8.2 Development of an integrated quality assurance system management (0.616) 1.8.3 Implementation of an affordable Farming Business Insurance scheme (0.243)
1.9 Insufficient storage (0.077)	1.9.1 Create a controlled storage warehouse (0.198) 1.9.2 Production data collection system through information technology (0.356) 1.9.3 Scheduled stock flow management (0.446)
1.10 Delay in delivery of cocoa beans to processor/manufacturer (0.034)	1.10.1 Comprehensive delivery planning and scheduling (0.373) 1.10.2 Quality and quantity check before delivery (0.627)

Inconsistency = 0.04

Source: Primary Data Processed, 2023

The formulation of alternative strategies for each risk factor and the results of AHP calculations for selecting priority strategies for supply chain management at the processing and manufacturing levels can be seen in Table 8. Through FMEA analysis, it was found that the priority risk factors at the processor and manufacturing levels were the supply of raw materials that were not erratic. Based on the results of AHP calculations, it was found that the priority strategy for risk management at the processing and manufacturing levels was to establish partnerships with farmers to procure cocoa beans. Kampung Coklat Senara as a processor and manufacturer gets supplies of cocoa beans from cocoa farmers in Genggelang Village, especially from the Mekar Flower Farmers Group. Until now, cooperation and transaction agreements between cocoa producers and

farmers have been established on the basis of a sense of kinship. Cooperation has been going on from generation to generation, based on the principle of mutual trust and mutual need for one another. Cocoa farmers sell cocoa beans to processors and manufacturers without being limited in quantity and without being bound by a certain target or time. This is the cause of the erratic supply of raw materials. Therefore, it is necessary to build more intensive partnerships with farmers to procure stable cocoa beans.

Table 8
Alternative Strategies Selection for Cocoa Supply Chain Risk Management in Processor and Manufacturer

Risk Factor in Processing and Manufacturing	Alternative Strategies
2.1. Limited production capacity (0.048)	2.1.1 Providing assistance with quality product processing and manufacturing facilities (0.446) 2.1.2 Increase access to and capacity of energy sources (0.554)
2.2. Not standardized processing and manufacturing of cocoa products (0.071)	2.2.1 Socialization and assistance in the implementation of SOP for Processing and Manufacturing of Cocoa Products (0.599) 2.2.2 Conduct cocoa product certification according to SNI (0.401)
2.3. Unstable supply of raw materials (0.078)	2.3.1 Implement a structured and scheduled manufacturing management (0.390) 2.3.2 Building partnerships with cocoa farmers (0.610)
2.4. Limited financial resources for manufacturing (0.137)	2.9.1 Create a platform that connects investors and strategic partners (financiers) with manufacturers (0.590) 2.9.2 Providing easy access to capital services (0.410)
2.5. Limited number of manufacturing human resources (0.171)	2.5.1 Opening a volunteering or internship program for the public (0.711) 2.5.2 Opening vacancies for outsourced workers (0.290)
2.6. Limited capacity of Manufacturing HR (0.272)	2.6.1 HR training according to GMP and HACCP (0.564) 2.6.2 Educational transformation with partner universities and research institutes (0.436)
2.7. Production yield non-uniformity (0.163)	2.7.1 Standardization and verification of product quality according to SNI (0.482) 2.7.2 Form a Quality Control unit with an automatic monitoring system (0.518)
2.8. Insufficient storage (0.073)	2.8.1 Product recording and labeling, Create a controlled storage warehouse (0.405) 2.8.2 Production data collection system through information technology (0.322) 2.8.3 Scheduled stock flow management (0.274)
2.9. Delays in delivery (0.050)	2.9.1 Comprehensive delivery planning and scheduling (0.290) 2.9.2 Check the quality and quantity before delivery (0.710)

Inconsistency = 0.09

Source: Primary Data Processed, 2023

The formulation of alternative strategies for each risk factor and the results of AHP calculations for selecting priority strategies for supply chain management at the processor and manufacturing level can be seen in Table 9. Through FMEA analysis, it was found that the priority risk factor at the distributor/retailer level is fluctuations in people's buying interest. Based on the results of AHP calculations, it was found that the priority strategy for risk management at the cocoa farmer level is to carry out product specialization according to community preferences. Product specialization involves focusing on one or a few superior products. This is necessary because the MSME in Kampung Coklat Senara has a wide variety of products but does not yet have a superior product. Products sold include cocoa powder, cocoa butter, cocoa powder, coffee-flavored chocolate powder, ginger-flavored chocolate powder, chocolate bars (milk, mild, and dark), and chocolate candies with various flavors. Product specialization can build a strong brand image and become the main destination for consumers who are looking for certain products with specific qualities and characteristics. Product specialization can also help differentiate oneself from competitors and build a loyal market share (Hermawan, 2015).

Table 9
Alternative Strategies Selection for Cocoa Supply Chain Risk Management in Distributor/Retailer

Risk Factor in Distributor/Retailer		Alternative Strategies
3.1.	Total supply of unsold products (0.119)	3.1.1 Planning and recording product inventory (0.146) 3.1.2 Analyze market demand predictions (0.365) 3.1.3 Development of a mediation model between sellers and buyers through information technology (0.489)
3.2.	Fluctuations in people's buying interest (0.123)	3.2.1 Product specialization according to people's preferences (0.631) 3.2.2 Introducing a package purchase program at a discounted price (0.369)
3.3.	Insufficient storage (0.098)	3.3.1 Create a controlled storage warehouse (0.599) 3.3.2 Product inventory and sales data collection with the help of information technology (0.401)
3.4.	Competition between sellers with similar products (0.071)	3.4.1 Improve product quality and uniqueness (0.679) 3.4.2 Online promotion and digital marketing (0.321)
3.5.	Limited market access for MSME products (0.158)	3.5.1 Partner with wholesalers (Souvenir Centers) (0.275) 3.5.2 Collaborate with local and national industry associations (0.725)
3.6.	Limited infrastructure and distribution access (0.263)	3.6.1 Selling products through e-commerce (0.411) 3.6.2 Development of marketing centers (outlets) in strategic areas (0.399) 3.6.3 Road and bridge infrastructure improvement (0.190)
3.7.	There is no after sales service (0.168)	3.7.1 Provide quality assurance and product return services (0.599) 3.7.2 Providing online customer service (0.401)

Inconsistency = 0.04

Source: Primary Data Processed, 2023

This study assesses the priority risk factors for each actor in the MSME Kampung Coklat Senara cocoa supply chain from the results of weighing with FMEA. It found that the most prioritized risk factors at the cocoa farmer level are damage due to pests and diseases during cultivation. This is in accordance with research by Sarpong et al., (2013) who conducted an analysis and evaluation of various risk categories in the cocoa supply

chain in Ashanti, Ghana using the FMEA method. It was found that viruses, pests and diseases were the highest risks in the production aspect of the cocoa supply chain. In general, the dominant pests that attack cocoa plants are the cocoa pod borer (*C. cramella*) and cocoa pod sucking pests (*Helopeltis* sp.). *C. cramella* in its larval phase attacks cocoa plants by eating the rind and flesh of the fruit until it grows into adult larvae. Symptoms of damage caused by *C. cramella* are discoloration of the fruit skin to yellow-green or brown-yellow stripes, perforated fruit skin, black flesh, and stunted seed growth. Attacks by C. cramella can cause a decrease in production of up to 80% (Ministry of Agriculture, 2019). *Helopeltis* sp. In the phase of nymphs and imago attack young shoots and secrete toxic substances that kill plant tissue. Symptoms of damage due to *Helopeltis* sp. are the appearance of black-brown spots, the surface of the fruit skin is deformed, the growth of seeds is stunted, the twigs and leaves dry and wither. The attack of *Helopeltis* sp. could cause a decrease in production up to 50% - 60%. Black pod disease and Vascular Streak Dieback (VSD) are the most dominant diseases because they attack almost all cocoa plantations and cause high losses. Fruit rot disease is caused by *P. palmivora* infection. Symptoms of black pod disease are the skin and flesh of the cocoa pod turning blackish brown, starting with the formation of black spots at the base of the pod. Black pod disease causes a decrease in cocoa production up to 30-50%. VSD disease is caused by Oncobasidium theobromae infection. Symptoms of new damage are seen after 3-5 months of spore infection into the xylem tissue, which is marked by yellowing and wilting leaves, branches having brown stripes, and fruit growth being stunted. VSD disease spreads from one tree to another and can cause a decrease in cocoa production of up to 3-60% (Karmawati et al., 2010). Damage due to pests and diseases during cultivation reduces the productivity of cocoa beans and harvest failure. Pest and disease damage occurs very frequently and is quite difficult to detect because the symptoms can be seen after the cocoa plants are attacked. Therefore, damage due to pests and diseases during cultivation is the most crucial risk factor for farmers.

The priority risk factor at the processor and manufacturing level is the erratic supply of raw materials. This is in line with Anwar's opinion (2013) that the uncertain supply of raw materials is a major obstacle in the agro-industry supply chain, specifically in the market with fluctuative demand. The raw material in the cocoa industry other than cocoa beans, such as milk, emulsifiers, vanilla, natural flavours, and others are also needed in the manufacture of processed chocolate products which affect the continuity of the production process. Cocoa beans as an agricultural product have unique characteristics, which requires large volumes of storage (bulky), perishable, variable product quality (variability), and can only be harvested in certain seasons (Arifin, 2016). Additionally, the distance between the production house and the location of the supplier of raw materials require time, costs, and transportation in large quantities to achieve optimal production which not only punctual but also fullfill the quantity and quality standards. Producers' activities are highly dependent on the supply of raw materials, hence erratic procurement of raw materials is the most crucial risk factor.

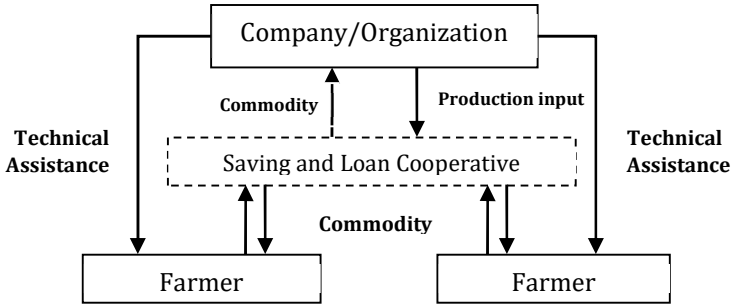
The priority risk factor at the distributor/retailer level is fluctuative buying interest. Purchase intention is an intrinsic tendency that encourages someone to be interested without coercion to decide to buy a product (Engel et al., 1968). Nugroho (2013) explains that buying interest is a process of integration between knowledge and evaluation of two or more alternatives resulting in a desire to behave. Based on research by Bachtiar et al., (2020), interest in buying chocolate products is influenced by promotions, attractive packaging, product quality, taste, perceived value, and price. Fluctuations in people's buying interest can cause losses for companies. A decrease in

buying interest can increase the product's settling in the storage room and increase the potential for losses because the product has decreased in quality or has passed its shelf life. Meanwhile, increased buying interest can lead to non-fulfillment of consumer demand and reduce customer service satisfaction. Therefore, fluctuations in sales are the most crucial risk factor for distributor/retailers.

This study found that cocoa farmers are the most prioritized actors in the cocoa supply chain of MSME Kampung Coklat Senara. Farmers are the foundation of the supply chain and play an important role in directly controling quality of cocoa beans. This is in accordance with the research of Aini et al. (2014) regarding risk management in the cocoa supply chain in Bandung through analysis of supply chain actors with the highest risk using the WFMEA and ANP methods. It was found that farmers are supply chain actors who have the highest priority in cocoa risk management and production risk ranks first as a factor that needs to be considered in preparing a mitigation plan. Similar results were also found by Farhana et al. (2019) who identified the cocoa supply chain at Griya Chocolate Nglanggeran, and analyzed risks to farmers, farmer groups, GAPOKTAN and retailers using the RFMEA method. It was found that there are various risks at each level of supply chain actors, and it was found that farmers as level one suppliers have high risk events and provide a crucial impact on the whole cocoa supply chain. By prioritizing farmers as the most vulnerable actors, it would help improving their livelihoods and ensure the continuity of the supply chain.

As the pest and disease damage become the most crucial risk factors, agricultural intensification program is recommended as a priority strategy. Agricultural intensification involves a combination of methods designed to minimize losses and improve crop yields. Integrated Pest and disease Management (IPM) should be carried out under the supervision of the North Lombok District Plantation Service, where the extension participants are cocoa farmers in Genggelang Village and are not limited to Farmer Group membership. The high price of pesticide and the community's perception that synthetic pesticides are toxic and dangerous, have made cocoa farmers in Genggelang Village reluctant to treat pests and diseases. Therefore, demonstration plots can be an interactive education method for farmers to directly involve them to practice handling the pests and diseases.

In the processing and manufacturing level, the priority strategy is to expand partnerships with cocoa farmers. Partnerships can clarify cooperative relations and provide formal agreements to ensure production continuity. MSME should prioritize farmers to build long-term partnerships that benefit both parties, ensuring that the supply of cocoa beans is not disrupted. Partnerships can also be expanded with cooperative relationships with cocoa farmers from other villages around Genggelang Village to increase business potential and increase the stability of the supply of cocoa beans as the main raw material. The partnership pattern can be a Nucleus-Plasma Partnership as shown in Figure 7. This partnership pattern connects farmers as a partner group (plasma) with the company (nucleus). The company (MSME) receives commodity needs from farmers, accommodates, processes, and produces from these commodities. The Partner Group has the obligation to meet the MSME's needs in accordance with the agreed terms and conditions. MSMEs have an obligation to provide technical guidance and help distribute agricultural production inputs to partner groups. To ensure business relations between companies and partner groups run well, it is recommended to involve farmer cooperatives (Ministry of Agriculture Republic of Indonesia, 2011).



Source: FAO, 2016; Ferroni & Castle, 2011

Figure 7
Core-Plasma Partnership Pattern

Based on the interviews, powdered chocolate drink products and chocolate bars are the most popular products. The key advantage of MSME Kampung Coklat Senara products is that they are made from organic ingredients, preservatives-free, do not use synthetic flavours, have a unique taste, and use single-origin cocoa beans. However, the weakness is that the product easily deteriorates due to changes in temperature and humidity which ruin the original taste, aroma, and texture when it reaches the consumer's location. Therefore, specialization can be done by specializing in the production and sale of organic premium chocolate drinks and chocolate bars of the highest quality. Product specialization will be better if it is accompanied by market mapping to strengthen product sales targets according to people's preferences. In addition, product specialization must be followed by improvement of product quality and stability to strengthen the brand image as the main cocoa products from Lombok.

It can be inferred that MSME Kampung Coklat Senara as the main business entity that procure the cocoa bean from the local farmers are recommended to help channel broader assistance for agricultural aids and provide technical guidance to ensure the procurement of the production. Moreover, it is important to strengthen the collaboration with the local government, especially the Plantation Department, to conduct comprehensive education and distribute agricultural aids. Moreover, to maintain the continuity of the supply of raw materials (cocoa beans), the MSME Kampung Coklat Senara as a processing and manufacturing company is advised to implement a PIR (Inti-Plasma) partnership to strengthen cooperative relations between suppliers and producers. This partnership can be built with mediation from the village government and the agricultural service. To strengthen sales and distribution, MSME Kampung Coklat Senara needs to improve the quality of specialize product (chocolate drink and chocolate bars). Product specialization should be followed by product education and digital marketing to reach a wider target market.

CONCLUSION AND SUGGESTION

Identified 10 risk factors in procurement of raw materials (cultivation) at the cocoa farmer level, 9 risk factors in processing and manufacturing activities at the cocoa product producer level, and 7 risk factors in marketing activities at the distributor/retailer level that affect the flow of the cocoa supply chain in MSME Kampung Coklat Senara, Lombok. Priority risk factors at the cocoa farmer level that affect the supply chain at the Kampung Coklat Senara MSME are damage due to pests and diseases with an RPN value of 440.48. The priority risk factor at the producer level that affects the

supply chain at Kampung Coklat Senara MSME is the erratic supply of raw materials with an RPN value of 363.08. The priority risk factor at the distributor/retailer level that affects the supply chain at Kampung Coklat Senara MSME is a decrease in people's purchasing power with an RPN value of 373.33.

Cocoa farmers are priority actors with an AHP weight value of 0.454. The priority strategy for supply chain risk management at the farm level is the Crop Intensification Program through Demonstration Plots (AHP weight=0.454). The priority strategy for supply chain risk management at the producer level is to build partnerships with farmers (AHP weight=0.61). The priority strategy for supply chain risk management at the distributor/retailer level is to carry out product specialization according to people's preferences (AHP weight=0.631).

This study has several limitations, where FMEA as a risk factor analysis method has limitations, namely it is only able to identify risks that have occurred and cannot detect risks that have the potential to arise in the future. In addition, the AHP method is used as a decision-making method for risk mitigation strategies in the supply chain. The AHP method has the disadvantage of having a high level of complexity if more levels of criteria and sub criteria are used so that the hierarchy becomes more complex. In addition, the AHP method has limitations in dealing with dynamic changes, where the preferences and weight given by experts (stakeholders) are considered to remain constant and do not change during the decision-making process. Therefore, further research is needed to produce a more comprehensive identification of risk factors through predictive analysis methods that utilize forecasting models and statistics to consider future trends. The level of accuracy and risk assessment can be increased by expanding the number of respondents and the level of consistency in decision making can be increased by adding expert assessors from various fields of expertise who were not previously involved.

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