

## Implementation of QFD in Food Supply Chain Management: A Case of Processed Cassava Product in Indonesia

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**Abstract**— Processed cassava products are common agroindustrial products in Indonesia food market. Low of product improvement is still common problem faced by cassava food producers. Evaluation of this product is strongly needed to improve quality of processed cassava products. Recently, evaluation of consumer expectation is required to be conducted to improve product quality and to answer consumer expectation as well. The objectives of this study was to evaluate the consumer's needs as a basic to reach a sustain supply chain in processed cassava product. In this study, Quality Function Deployment (QFD) method was implemented to evaluate consumer expectation and to develop a sustainable supply chain of processed cassava products. Information were gathered from many resources such as suppliers, outlet owners, producers, workers, processing operators and marketing staff from four famous processed cassava production units. Based on House of Quality (HOQ) the results of this study showed that 4 attributes from consumers were taste, colour, smell and texture which were answered by nine technical responses. These results would be a basic term of sustainable of supply chain in processed cassava products. In term of supply chain, production execution and quality control as processing activities have strong correlation to all items of technical response, followed by capacity planning and production and inventory control, and also raw material procurement activities.

**Keywords**— QFD; supply chain; cassava; agricultural commodity

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### I. INTRODUCTION

In Indonesia, Cassava is recognized as an agricultural commodity with a huge market potential, which could be further processed for various food and non food products. Some of the cassava based products is processed cassava traditional food products such as fermented cassava, cake, fig and candy. Small and medium industries are utilizing cassava as a raw material to produce these products, which add more economic value to the products. The huge food market potential of food product creates an intense competition in the business. Reference [1] explained that consumer research is one of the approach which frequently used by businessman to reach consumer's satisfaction, through assessing, evaluating and predicting their behaviour.

Regarding to consumer's satisfaction, QFD is a tool which is used to implement Total Quality Management (TQM) to support product development in agroindustrial products [2]. QFD is a method that can help the organization to identify the clients' needs to be translated into various forms of strategy and planning company that would be able to contribute to the continuous improvement of a given service or product produced [3]. In food industry, QFD is a technique of product development to translate

customer requirements for product development activities and services. Potential use of QFD for the development of food products is to increase the chances of success, producing high quality products, reduce costs and development time [4]. Quality Function Deployment using a House of Quality matrix which is required to describe the needs and expectations of consumers and the company's technical ability to design and produce goods or services according to customer desires [5].

In term of supply chain activities, [6] defined that supply chain is a network of organizations with same objective, which is supply and distribution of materials. Connected points alongside chain with different role are called stakeholders. A clear relationship between stakeholders and farmers would give a clear mechanism of pricing process from farmers to stakeholders. Reference [7] explained that in supply chain perspective, the main activities are classified into six activities such as product development, raw material procurement, planning and control, production, distribution and product return. Related to food supply chain, food industries have some unique characteristics. Food supply chains can be distinguished into "fresh agricultural products" such as vegetables or fruits, and "processed food products" such as convenience food or soft drinks [8]. It has a large variety of different supply chain partners such as retailers,

wholesalers, distributors, various traders, processors, marketers/storage, and farmers or farm as raw material suppliers [9]. In processed cassava supply chain, [10] found that required raw material (cassava) of selected processed cassava products such as fried cassava, cassava chip and fermented cassava were supplied by big collectors due to high number of industrial requirement. In term of material requirement, [11] found that building relation with supplier was the most preferred resilience strategy to mitigate the vulnerabilities of supply chain in some industries.

Limited information and evaluation about consumers expectation of processed cassava product, is a strong reason why this product face difficulties in product quality improvement. On the other side a long process of production activities as a sustain supply chain should also support to quality improvement of product. The objectives of this research were to identify consumer needs and expectations through product attributes and consumer's expectations of processed cassava product. This result would be integrated with basic supply chain activities to improve the quality of product and to reach sustainable supply chain of processed cassava products.

## II. METHOD

In this study, some recognized brands of processed cassava products (cassava cakes) were used to be evaluated using QFD method. Questionnaire was provided to reach data and information which was used to find Consumer's need, Importance to Consumers, Consumer Satisfaction Performance, and Competitive Satisfaction Performance as part of House of Quality in a complete QFD. Questionnaire was addressed to production unit's employer, owners of food store and loyal consumers. In term of technical response other questionnaire was addressed to the owner of processed cassava products, to obtain information such as quantity of sugar, fermented cassava, milk, food preservatives, mixing process, cooking process and packaging process. The data were analyzed based on the components in House of Quality (HOQ) as a part of QFD method and presented in HOQ chart.

Analysis results of HOQ-1 (part of complete QFD) were correlation between consumers need and technical response of process would be used to integrate with basic supply chain activities. Basic functional activities of supply chain used in this study were product development, raw material procurement, planning and control, production, distribution and product return. These basic functions were elaborated to be sixteen activities of supply chain in HOQ-2. This integration would be presented into matrix table which was implemented into processed cassava production activities. Strong, medium and low levels were used in this study to explain correlation between items.

## III. RESULT AND DISCUSSION

In this study, based on the analysis results of the questionnaire and some information from respondents, figure 2 shows the house of quality (HOQ) and explains general condition of consumer's needs and comparison among selected processed cassava products.

### A. Consumers Need (Expectation)

From Table 1 this study found that taste, texture, colour, and aroma were the attributes (expected by consumers) of processed cassava products in the market. This also means that taste was the most important attribute to the consumers, compared to other attributes such as colour, aroma, and texture. It means that the consumers use taste (first rank) and colour (second rank) attributes as priority in purchasing (buying) process of this product. In term of satisfaction level, the best brand (BJ) of was the highest performance compares to other brands processed cassava products. This means that consumers have better preference to this brand compare to other brands.

### B. Technical Responses to Support Consumer Needs

The result of this study based on HOQ-1 analysis (Table 1) shows that nine technical responses which give effect to product performance (attribute) and response consumers needs were quantity of sugar, quantity of main raw material (fermented cassava), quantity of milk, quantity of other materials, mixing process, cooking process, sandy process, shaping process and packaging process. According to this result, producers of this product should pay more attention to these activities (technical responses) because of direct influence to quality of the product, including product performance as attribute of product.

Table 1 also explains that the taste has a strong correlation with quantity of sugar, quantity of main raw material (fermented cassava), quantity of milk, quantity of other materials, mixing process. Compare to other attributes, taste has more items numbers of technical response which has strong correlation. All of these items would give direct effect to product taste. It also means that producers should give more attention to these technical response items to maintain better taste of product. Texture has strong correlation with quantity of sugar, quantity of main raw material (fermented cassava), cooking process, and sandy process. Colour has strong correlation with quantity of sugar, quantity of milk, quantity of other materials, and cooking process. The aroma has strong relationship with quantity of main raw material (fermented cassava), quantity of milk, quantity of other materials. All of attributes in this study has strong and medium correlation to quantity of sugar and quantity of main raw material (fermented cassava). This means that producers should pay more attentions to these items as the main technical response which gives direct influence to the quality of product. Another result of study found that packaging has medium correlation to all attributes. It means that packaging process gives impact to all attributes of the product. Poor packaging process would has a probability to low quality includes taste, texture, colour, and aroma. Perfect of packaging process is also needed as attention to maintain product quality.

### C. Elaborated Basic Activities of Supply Chain

Another result of this study was HOQ-2 analysis as elaborated basic activities of supply chain in processed cassava product. This figure provides correlation between nine technical response and sixteen elaborated basic supply chain activities. The results (Table 2) shows that the four highest rank of supply chain activities are production

execution, quality control, capacity planning, production and inventory control, raw material and supplier activities, maintaining of supplier relationship, and demand planning

and forecasting. This means that all of four basic activities give direct effect to technical response items.

TABLE I  
HOUSE OF QUALITY (HOQ-1) ANALYSIS OF TECHNICAL RESPONSE

House of Quality of Processed Cassava Product (Fig / Candy)		Weight Value	Quantity of sugar	Quantity of Fermented cassava	Quantity of milk	Quantity of other materials	Mixing	Cooking	Sandy process	Shaping	Packaging
Customer Needs	Taste	9	●	●	●	●	●	○			○
	Texture	3	●	●			○	●	●	▲	○
	Colour	7	●	○	●	●	○	●			○
	Aroma	5	○	●	●	●	○	○			○
	<b>Total</b>	186	174	189	189	126	132	27	3	72	
	<b>Rank</b>	2	3	1	1	5	4	7	8	6	

TABLE II  
HOUSE OF QUALITY (HOQ-2) ANALYSIS OF BASIC ACTIVITIES OF SUPPLY CHAIN

Elaborated Basic Activities of Supply Chain (processed cassava product)		Weight Value	New product development	Supplier involvement	Supplier selection	Evaluation of supplier performance	Purchasing of raw material	Supply risk monitoring	Maintaining of supplier relationship	Demand planning and forecasting	Capacity planning	Production and inventory control	Production execution	Quality control	Distribution network planning	Distribution scheduling	Maintaining of distribution relationship	Monitoring on distribution level
Technical Response	Quantity of Sugar	7	●	●	○	●	●	○	○	●	●	●	●					
	Quantity of Fermented cassava	9	●	●	○	●	●	○	○	●	●	●	●					
	Quantity of milk	7	●	●	○	●	●	○	○	●	●	●	●					
	Quantity of other materials	5	●	●	○	●	●	○	○	●	●	●	●					
	Mixing process	7							▲	▲	●	●	●	●				
	Cooking process	7							▲	▲	●	●	●	●				
	Sandy process	5							▲	▲	○	○	●	●				
	Shaping process	3							▲	▲	○	○	●	●				
	Packaging	5									●	●	●	●	○	○	▲	▲
	<b>Total</b>		252	252	84	252	252	106	106	447	447	495	495	15	15	5	5	
	<b>Rank</b>		3	3	5	3	3	4	4	2	2	1	1	6	6	7	7	

Correlation of basic activities

▲ = 1 = Low      ○ = 3 = Medium      ● = 9 = Strong

In the first rank (Table 2), production execution and quality control as processing activities have strong correlation to all items of technical response. It means that to maintain quality of processed cassava, it should pay more attention in processing activities especially in production execution and quality control. Capacity planning and production and inventory control is the next rank of basic activities which also need more attention to support quality of product. These items have strong correlation to quantity of materials (sugar, fermented cassava, milk and others), mixing and cooking process, and medium correlation to sandy and shaping process. In term of supply chain management of processed cassava, it could be explained that

planning, control and quality (production process) as a part of basic activities are the important items to support quality of product. This is in line to the study [12] which found that quality improvement and process integration are the top priority enablers to reach an agile food industries. Other result [13] stated that related with quality and inventory control in agro-food industries (including processed cassava product), more attentions such as capital investment to replace old equipment with new ones, adequate storage facilities and training improvement in processing activities are strongly required to support integrated supply chain among others.

Based on HOQ analysis the next rank is supplier involvement, supplier selection, purchasing of raw materials and supply risk monitoring. All of these items were close to the raw materials procurement system. In term of production system, it means that raw material has close relationship to product quality including taste, texture, colour and aroma. In term of supply chain activities, raw material is the first step of whole supply chain in production system. This is related with other study [14] explained that as a difference character of food supply chain from other supply chains, a nonstop attention should be paid, from the time the raw materials enter the production process to the time the product achieves the consumers, for the safety and quality of food products.

In processed cassava production system, supplier activities in quantity, quality, and continuity of raw material should be maintained properly to support quality of product. Contract system is recommended to maintain raw material procurement. This in line with the result of other study [10], it was common for the farmers have a contract with industries or big collectors to make sure about number (quantity), price and quality of raw materials. In case of processed cassava, detailed of quantity, quality, time schedule to send raw material should also explained to the supplier. All of these ways strongly required to producers to maintain quality of product.

#### IV. CONCLUSIONS

This study found that taste, texture, colour, and aroma were the attributes (expected by consumers) of processed cassava products in the market. Taste was the most important attribute to the consumers, compared to other attributes such as colour, aroma, and texture. This study shows that nine technical responses, which affect product performance (attribute) and response consumer's needs were quantity of sugar, quantity of main raw material (fermented cassava), quantity of milk, quantity of other materials, mixing process, cooking process, sandy process, shaping process and packaging process. In case of elaborated basic activities of supply chain, production execution and quality control as processing activities have strong correlation to all items of technical response, followed by capacity planning

and production and inventory control, and also raw material procurement activities.

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