

## SUPPLY CHAIN ANALYSIS OF CASSAVA AGROINDUSTRY TO IMPROVE NATIONAL FOOD SECURITY

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### ABSTRACT

*The considerably high consumption of rice needs to be solved by conducting substitution for other foods able to meet prerequisites of food security. Cassava is a second-greatest crop product, after rice. Problems occurring in the agro-industrial supply chain of cassava in order to fulfill availability of substitutes for rice include productivity, consistency of qualities, availability of human resources and technologies and market information. To cope with those issues, strategy planning conducted using AHP was proposed. Priorities of strategy implementation resulted are as follows: Institutions, GAP, socialization and promotion as well as food industrialization. Implementing proposed strategies above may contribute to enhancing functions of cassava as a substitute for rice in the attempt to promote national food security.*

*Key words : Institutions, GAP, socialization and promotion, food industrialization*

## 1. INTRODUCTION

### 1.1. Background

Indonesia can possibly position itself as the basis for food security. This argument contained in the Masterplan for Acceleration and Expansion of Indonesia's Economic Development 2011-2025 (MP3EI) is due to global dynamics occurring and considering potentials and opportunities of geographical and resource advantages present in Indonesia and taking into account the principle of sustainable development.

Food security comprises an activity holding an important role in maintaining viability of the people in Indonesia and for lowering the poverty line in Indonesia. This is not an issue easy to cope with since the number of Indonesia population rises increasingly. As the number of population grows, food demands continuously increases.

According to the Minister of Home Affairs, Gamawan Fauzi, in [sinarharapan.co](http://sinarharapan.co), the number of Indonesia population, by September 2014 was 245,862,034 people and pursuant to Moniaga (2011), the Minimum Physical Needs (KFM) relied on the calorie requirement per person per day is 2600 or equal to 256 kilograms of rice per

person per year. This fact may worsen the food availability of rice unless followed by an increase in availability of agricultural land and rice productivity.

Moniaga (2011) ) argued that the agricultural land as a place in which farmers perform activities increasingly experiences a decline in its total amount. This situation happens because of more increased pressure of population put on agricultural land. The number of population steadily grows and activities of development conducted have been widely consuming functions of agricultural land to produce foods and eventually switched to other utilizations such as residences, office buildings, etc.. As a result, the capability of agricultural land to fulfill national food demands continually reduces.

As stated by KEMNKOPMK (2015), the role of food commodities in the poverty line is more significant rather than that of non-food commodities (residences, clothing, education and health). Contribution of the Food Poverty Line to the Poverty Line in September 2014 was recorded at 73.47 percent. Food commodities greatly influencing the value of the Poverty Line in urban areas is relatively similar to those in rural areas, one of them is rice.

The Minister of Agriculture, Suswono, in the online *Republika* dated 4 April 2012 said that the consumption of rice as a staple food per capita in Southeast Asia was considerably high. Today the consumption of rice in Indonesia is amounted to 316 grams per capita per day, even though the sufficient amount is only 275 grams per capita per day. Whereas the consumption of root and tuber crops is only at 40 grams per capita per day, of the ideal amount 100 grams per capita per day. Conforming to Cahyadi (2012), this fact exists as Indonesian people have opinions that rice is an unchangeable staple food.

Setiawan (2012), stated that consumption of rice in Indonesia constitutes the highest in the world. The high consumption of rice should be immediately overcome by implementing substitution for other foods able to meet requisites of food security. The food security is established when community is able to access foods that are safe, nutritious and in affordable price making up a basis for healthy and active life.

One of commodities that can be an alternative for carbohydrate source is cassava. Unfortunately, cassava agro-industries also deal with various problems including low productivity of cassava in Indonesia which is about 12.22 tons/Hectare on average and is highly fluctuating. From 1998 to 2005, Special District of Yogyakarta particularly Gunung Kidul Regency faced the fluctuation in productivity of cassava between 127 quintals/Hectare and 174 quintals/Hectare and the highest was reported at 812,321 tons (Martono and Sasongko, 2007) Further, based on information gained from Ministry of Industry of Directorate General of Agro-industries, the national land area of cassava plantation in 2010 was around 1.7 million Hectares accompanied with average production of only 13.6 tons per Hectare.

To tackle problems regarding productivity in cassava above, a thorough analysis should be carried out in order to identify causes of the low productivity in cassava mentioned. The analysis can be performed through the agro-industrial supply chain analysis of cassava, so as different problems occurring in it can be defined and improvement in order to create sustainable

food security of agro-industrial cassava can be conducted in the attempt to develop local food-based agro-industries. Availability of raw materials constituting local resources is the main factor. Furthermore, other factors needed to be envisaged are processing technologies, human resources, markets and government policies.

Once improvement based on the design for a supply chain model is obtained, model designing of the food security system of cassava agro-industries is conducted in several steps commencing from the food availability aspect, the food affordability aspect to the food consumption aspect

## 1.2. Purpose

- Identify problems in cassava agro-industry supply chain
- Control problems hindering the sustainability of cassava agro-industry as a source of food security

## 2. THEORETICAL BACKGROUND

### 2.1. Cassava

Cassava (*Manihot utilisima*) is a crop and commodity that has been strongly cultivated for a long time by farmers. Cassava is perceived as the main cultivation on the basis of results of survey and market analyses reporting that numerous industries such as food industries, pharmacy industries, chemical industries, building material industries, paper industries and biofuel industries utilize cassava as their raw materials in a remarkably high amount (Badan Agribisnis Departemen Pertanian. 1999; Wargiono et al. (2006), Hasanuddin, dan Suyamto, 2006; Wargiono and Supiandi (2007).

Cassava is perceived as a cash crop. As a crop, it produces the greatest amount of starch per land area unit up to sevenfold that of sugar cane per hectare widely deriving products such as *gaplek*, cassava flour, ethanol, liquid sugar, sorbitol, MSG, aromatic flour and pellet. In addition, cassava is also a carbohydrate source for approximately 500 million people in the world.

## 2.2. Supply Chain

As reported by Chopra and Meindel (2007), a supply chain is integrity among planning, coordination and control of entire processes and activities incorporated in it aimed to meet consumer demands at the lowest prices. The supply chain does not merely consist of producers and suppliers but also it has dependency on flows in logistics,

transportations, storages, or warehouses, retailers and consumers their selves.

## 3. RESEARCH METHOD

The reason cassava is picked as one of food security resources substituting for rice is that cassava is able to be processed to be numerous products as seen in Fig 1.



Figure 1 Trees cassava industry

Source : <https://foodiepelago.files.wordpress.com/2013/10/gernas-singkong-sejahtera-b.jpeg>

- Fresh cassava: food products (chips/crackers, fermented cassava, *lemet*, etc.)
- Intermediate products
  - Oyek flour → food products (*oyek rice*, etc.)
  - *Gaplek* flour → food products (*tiwul*, cookies, etc.)
  - Caasava flour → food products (breads, noodles, biscuits, etc.)
- Tapioca:
  - Traditional food products (*biji salak*, layer cakes, crackers, etc.)
- Modern food products (porridge, instant milk, seasoned flour, biscuits/snacks, meat products, etc.)
- Modified starch □ gelatinized starch, oxidized starch, starch phosphates, etc. □ breads (bakery), iced cream, meat products, candies, etc.
- Hydrolyzed starch □ dextrin, maltodextrin, glucose syrup, high fructose syrup (HFS), sorbitol, etc. □ formula milk, instant milk porridge, snacks, sauce, candies, jams/jellies, etc.
- Monosodium Glutamate (MSG)

A wide range of food products are made of cassava, nevertheless Indonesian people have not yet used it as a rice alternative. This condition needs to be analyzed so as appropriate solutions can be drawn. The first step is performed by analyzing the agro-industrial supply chain of cassava. The second step is performed by identifying different problems occurring in relation to agro-industries of cassava as a source of national food security. The third is performed by implementing proposed strategies using AHP to overcome problems occurring. These are illustrated in Fig 2.

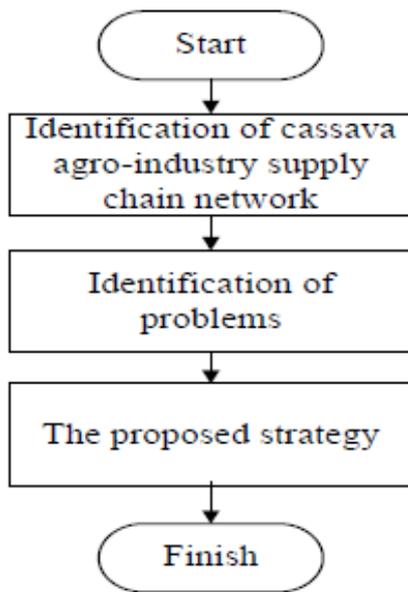


Figure 2 Research stage

#### 4. RESULT AND DISCUSSION

##### 4.1. The Network of Cassava Agro-industrial Supply Chain

Based on the observation conducted at Kandri Village Semarang, it is indicated that the cassava agro-industrial supply chain is not overly long, which means cassava originated from farmers can be processed immediately to be different products including modern *getuk*, *wingko babat* and fried *getuk*. Supply chain network overview can be seen in Figure 3.

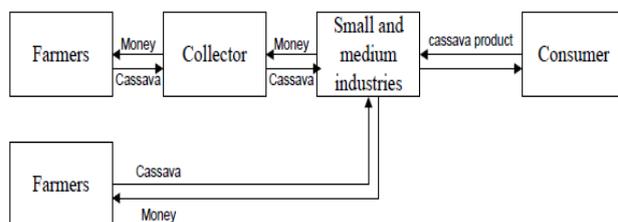


Figure 3 Cassava Supply chain

##### 4.2. Problem Identification

Problem identification is relied on problems occurring throughout agro-industrial supply chain of cassava. This is undertaken on the basis of literature investigation and direct observation and is guided by indicators of logistic performance for supply chain of

agricultural products (Vorst, 2006) and it can be seen in Table 1.

Table 1. Indicators of logistic network performance for supply chain of casava

Indicators of performance	Description
Availability of the product	<ul style="list-style-type: none"> <li>Having potentials of abundance and availability throughout the year due to the suitable climate to growth of cassava plants</li> <li>The species cultivated is the sweet cassava characterized by nearly black outer root peel and leaves mostly preferred as a green vegetable source and cooked as meals.</li> </ul>
Qualities of the product	<ul style="list-style-type: none"> <li>Inconsistency qualities of the product are due to lack of knowledge of farmers and small-medium industries.</li> </ul>
Responsiveness	<ul style="list-style-type: none"> <li>The time cycle of supply chain demands in not consistent. One of its causative factors is the technical/technological constraint, in which performance of machines and cassava processor tools, availability of human resources and availability of raw materials are not consistent.</li> </ul>
Reliability of Shipment	<ul style="list-style-type: none"> <li>Shipment cannot be promptly undertaken due to factors of human resources and technologies.</li> </ul>
The total cost of supply chain	<ul style="list-style-type: none"> <li>The total cost of supply chain charged by farmers is not clearly measured since prices are set by the processing industries or traders.</li> <li>Lack of interest of farmers to market their cassava crops their selves reflects uncertainty in the marketing network.</li> </ul>

##### 4.3. Problem Analysis

Pursuant to Zahra (2011), barriers to raw material inputs comprise unavailability of continuity in the supply of raw materials meeting standard of qualities and rate of prices expected by manufacturers. To date, the supply chain of cassava existing commonly are only the trade system not well-organized thereby merely favoring certain parties. While, other problems associated to indicators of agricultural supply chain performance are as follows.

###### 4.3.1. Availability of the product

Availability of cassava in Indonesia is potentially abundant despite its low productivity. One of its underlying reasons is well-processing (GAP and GHP) of cassava not conducted.

Availability of cassava as a raw material may be able to be used for feeding Indonesia. As investigated in <http://www.ift.or.id/2012/03/beras-singkong-layak-sebagai-makanan.html>, it is found that one of cassava processing products is cassava rice. Its raw material consists of combination between white cassava and yellow cassava containing a low HCN level. In fact, technology of cassava rice has been developing in Philippines and some areas in Indonesia. The method to make it is relatively simple in which cassava is soaked for several days before cleaned thoroughly

to remove odors and dirt, followed by processed as flour and dried. Drying generally is undertaken under open sun. This cassava rice enables comparatively long storage when drying is completely performed or the relatively low water content is gained. It tastes nearly same as paddy rice. The cassava rice may be consumed with side dishes just as paddy rice.

#### 4.3.2. Qualities of the product

One product derived from cassava as explained in the availability of the product section mentioned is cassava rice. The serving size of 100 grams of paddy rice is equal to one handful of cassava rice. Each of 100 grams of cassava rice contains 34 grams of carbohydrates and 121 calories. Furthermore, the cassava rice comprises 40 grams of phosphorus and 34 grams of potassiums (<http://www.ift.or.id/2012/03/beras-singkong-layak-sebagai-makanan.html>).

In spite of the fact that nutritional contents of cassava rice is not inferior to that of paddy rice, people still believe that rice cooked from cassava is less prestigious. The other reason is that some Indonesian people still embrace paradigm paddy rice only selected as a staple food. Furthermore nowadays cassava is commonly consumed by some lower class communities prone to food shortages. That situation is resulted from limitedness of community awareness and lack of socialization covering cassava processing thereby needing an effort to approach communities directly to provide understandings for them concerning benefits of cassava rice as a substitute for paddy rice. This attempt is conducted to achieve food security through diversification of cassava products as alternative foods.

#### 4.3.3. Responsiveness

The performance of machines and cassava processing tools not optimal, limitedness of human resources and limitedness of raw materials result in the inconsistency time cycle of supply chain demands thus cassava products are not readily available.

#### 4.3.4. Reliability of shipment

To ship the product promptly, optimal production planning favored by human resources and technologies has to be set.

#### 4.3.5. Total cost of the supply chain

To be able to gain benefits from supply chain actors particularly farmers, clear information on market prices should be delivered in order that farmers are becoming motivated to process the cassava appropriately.

### 4.4. Strategy Planning

Some strategies suggested to deal with problems in utilizing cassava as a source of a rice alternative are described as follows.

#### 4.4.1. Good Agricultural Practices

Conforming to explanation in availability of the product section above, it is indicated that the main problem in cassava agro-industries is GAP. Therefore, in order to reach high productivity GAP has to be applied.

#### 4.4.2. Socialization and promotion

The culture of consuming imported food needs to be fixed though campaigns and promotions. Japan despite the fact that it is a powerful and developed country starts thinking to change its food consumption pattern by not merely depending on imported foods (wheat and meat) and changing towards local resources based-food consumption (Rahmawati, 2013). Problems regarding socialization were also stated by Zahra (2011), that there was lack of socialization and promotion of potentials and benefits of cassava flour utilization.

#### 4.4.3. Food industrialization

Indonesia as a developing country consisting of a large number of population has to start implementing local resources based-food diversification. The Food Diversification Program is very acceptable to our societies constituting which is through 'industrialization' of alternative foods incorporating production, distribution,

marketing and promotion activities (Rahmawati, 2013).

**4.4.4. Institution**

Problems of delays in shipment occur due to lack of human resources, market information not recognized and performance of small and medium industries not well-integrated thus the presence of institution is required. This was argued by Zahra (2011) that the main institutional barrier is lack of understanding of an expected institutional

model among related parties, and consequently sectors touching the cassava commodity are not truly harmonious.

In the logistic performance analysis of supply chain above, 4 strategies used to conquer problems occurring in the cassava agro-industrial supply chain are suggested. Implementation of those strategies should be conducted gradually. To recognize all of those the level of interest of the strategies was selected using AHP. The hierarchical structure of AHP is presented in Fig 4.

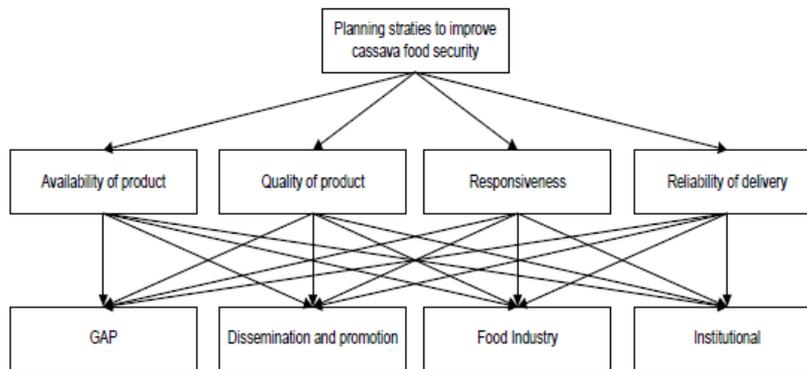


Figure 4 the hierarchical structure of cassava food security

Hierarchical structure in Figure 4, then processed using software expert choice. The weight of the interests acquired is the institutional strategy(0547), GAP (0254), food industry (0105) and the dissemination and promotion (0094). It can be seen in Figure 5.

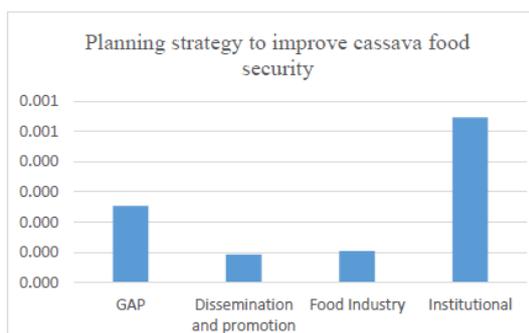


Figure 5. The weight of the interests

Institutional is a major strategy because it can design a good cooperation between supply chain actors and able to provide information to farmers on market prices and the processing of cassava good.

**5. CONCLUSION**

Based on results of problem identification, it is indicated that there are some problems in the cassava agro-industrial supply chain in order to meet availability of substitutes for rice. Those problems include productivity, consistency of qualities, availability of human resources and technologies and market prices. Whereas, priorities of strategy implementation are following: Institution, GAP, socialization and promotion as well as food industrialization. Implementing those proposed strategies above may contribute to enhancing functions of cassava as a substitute for rice in the attempt to promote national food security

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