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Analysis for Development of Mocaf-Based Functional Food Industry in Indonesia

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ABSTRACT. Indonesia is a country having abundant natural resources, including nutritious plants as a source of food and medicine. Along with the increasing public awareness of the importance of healthy living, there is a great shift in the demand of food. At present, people do not only want foods that have good nutritional composition as well as attractive appearance and taste, but also the ones that have certain physiological functions for the body. The foods that have such functions are known as functional foods. One ingredient that has the potential to be developed into functional food is mocaf flour. It is made from cassava which is made from the fermentation principle by modifying the cassava cells. This study aims to reveal the conditions for the development of the functional food industry made from mocaf flour in Indonesia using the value chain approach. This study was a qualitative research by using multiple case studies along the value chain. The data were collected from review of secondary data, in-depth interviews, and observations in each case study. The case study locus was the center of the mocaf-based food industry in West Java. The results showed that (i) the mocaf-based functional food industry in Indonesia was not developed; (ii) the development of mocaf-based industries was constrained by the high cost of cassava raw materials; (iii) the productivity of cassava plants was still low; (iv) the role of R & D institutions was very much needed; and (v) government intervention is needed.

Keywords: *mocaf, functional food, value chain analysis*

JEL Classification: L88, O00, Q18

INTRODUCTION

Indonesia is a country having abundant natural resources, including nutritious plants as a source of food and medicine. Along with increasing public awareness of the importance of healthy living, there is a great shift in the demand of food. People does not only want foods that have a good nutritional composition as well as attractive appearance and taste, but also the ones that have certain physiological functions for the body. Foods that have such functions are known as functional foods.

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The functional food industry is growing rapidly throughout the world. In recent years, the global functional food market has experienced innovation and economic expansion due to the increasing consumer awareness of health and nutritional benefits. The market opportunity for functional food products reached around USD 129 billion in 2015 and it is predicted that it will continually increase to around USD 275.7 billion by 2025 (Grand View Research, 2019). This condition is a great opportunity for Indonesia, which is rich in functional food potential because it has a history in traditional food, which has certain health benefits. However, in Indonesia itself, the circulation of functional food is low. The functional food market in Indonesia, which is still small, is filled with expensive functional food in the form of imported products, because the local industry has not yet developed.

One ingredient having potential to be developed into functional food is mocaf. Mocaf as flour is modified cassava flour which means modified cassava. Mocaf, also known as MOCAL, is a cassava-based product (Manihot Esculenta Crantz) which is processed using the principle of modification of cassava cells by fermentation, where microbial BAL (Lactic Acid Bacteria) dominates during the fermentation process (Kartikasari, Sari, & Subagio, 2016) (Frediansyah, Kurniadi, Nurhikmat, & Susanto, 2012). Microbes produce pectinolytic and cellulolytic enzymes that can destroy the walls of cassava cells and liberate starch granules. The microbes also produce enzymes that hydrolyze starch into sugar and then convert it to organic acids, especially lactic acid. This will cause changes in the characteristics of the flour produced such as increased viscosity, gelation ability, rehydration power, and ease of dissolution. Likewise, the taste of mocaf becomes neutral because it covers the image of cassava flavor by up to 70% (Subagio, 2007).

Table 1. Composition and Organoleptic Properties of Mocaf and Cassava Flour

Parameters	Mocaf	Cassava Flour
Composition:		
Water content (%)	Max. 13	Max. 13
Protein content (%)	Max. 1.0	Max. 1.2
Ash content (%)	Max. 0.2	Max. 0.2
Starch content (%)	85 - 87	82 – 85
Fiber content (%)	1.9 - 3.4	1.0 - 4.2
Fat level (%)	0.4 - 0.8	0.4 - 0.8
HCN (mg/ kg)	Not detected	Not detected
Organoleptic properties:		
Color	White	White brown
Aroma	Neutral	Cassava impression
Taste	Neutral	Cassava impression

Source: (Subagio, 2007)

According to Subagio (2007), the chemical composition of mocaf is not much different from cassava flour, but mocaf has specific organoleptic characteristics. The chemical composition and organoleptic characteristics between mocaf and cassava flour presented in Table 1. Based on chemical tests, the resulting mocaf color is much whiter compared to the color of ordinary cassava flour. This is because of the lower mocaf protein content, when it is compared to cassava flour. In this case, the higher protein content can cause the dark brown color when dryied or heated.

With the characteristics of mocaf that is white and new in nature, mocaf can be used to substitute various kinds of flour. Historically, mocaf was first made to substitute wheat flour (Frediansyah et al., 2012). The comparison of the chemical composition of mocaf and wheat flour is displayed in Table 2.

Table 2. Chemical and Organoleptic Properties of Mocaf and Cassava Flour

Parameters	Mocaf	Wheat Flour
Water content (%)	6.9	12
Protein content (%)	1.2	8 - 13
Ash content (%)	0.4	1.3
Starch content (%)	87.3	60 – 68
Fiber content (%)	3.4	2 – 2.5
Fat content (%)	0.4	1.5 - 2

Source: (Salim, 2011)

Wheat flour contains protein in the form of gluten, which plays a role in determining the elasticity of foods made from flour. This gluten is the main protein content in flour, which plays a role in baking (Gunawan et al., 2017) (Frediansyah et al., 2012). Gluten is formed from gliadin and glutenin. The protein in wheat flour for the production of these cakes must be in high quantities so that the resulting cake becomes soft. Meanwhile, the protein content in mocaf is very small (Table 1), so it is often mentioned that mocaf is free of gluten (known as gluten-free). The condition of mocaf which is gluten-free and contains relatively higher fiber compared to wheat flour is the rationale that mocaf can function as a functional food ingredient, especially for sufferers of certain diseases such as people with autism and sileac disease types that are not gluten resistant. Mocaf is also needed as a functional food by certain groups of people who want to maintain their health conditions by replacing wheat flour with mocaf (Supadmi, Murdiati, & Rahayu, 2016).

The development of the functional food industry needs to be supported by research and development of science and technology in the fields of food, even in pharmaceuticals and health. Besides that, it is necessary to develop formulation technology that is able to produce functional food that can be accepted by consumers. Besides, the procedure of a company in making functional food claims in Indonesia takes a long time. This is due to the higher costs and the standards of functional locally based food that have not been widely developed. This condition requires government intervention to provide a harmonized guiding framework which does not only encourage industrial development, but also at the same time protects the consumers. The government needs to design policies that support the industry and consumers. Industrialization is a process of social change and economic development, which is usually accompanied by technological innovation. Industrialization often occurs within the global and national value chain framework (UNIDO, 2009).

UNIDO (2009) explained that value chain analysis helped in understanding the critical conditions and situations in industrial development, related to weak competitiveness and stagnant development that can coincide at various levels along the value chain. The results of value chain analysis could reveal which parts of the value chain should be considered for development interventions and provide insight on how these interventions should be designed.

Simatupang, Piboonrungroj, & Williams (2017) mention that the value chain concept was first introduced and popularized by Michael E. Porter in 1985. A value chain shows how a product moves from the production stage of raw materials to the end stage, the consumer. This includes a wide range of activities to handle a product or service from its conception through various phases of production (involving a combination of physical transformation and input from various service producers), delivery to the final consumers, and final disposal after being used.

Almost the same as the Porter view, ECLAC (2014) mentioned that the value chain covers the entire range of activities needed for a product or service to move through various stages of production, from the original design to shipping to the consumers and final disposal after being used. Each stage: conception and design, production of goods or services, transportation of merchandise, consumption and handling, and final recycling - is generally referred to as a link. The number of links of value chains varies significantly according to the type of industry and activities or links in the chain that can be carried out by one or more companies.

Hellin & Meijer (2006) mention there are three interrelated components in the value chain, namely: (ii) value chain actors, (ii) supporting environment (infrastructure and policies, institutions and processes that shape the market environment), and (iii) service providers (external business or services that support value chain operations such as R & D).

According to Collins, Dent, & Bonney (2016), there are many dimensions that can be included in value chain mapping. These dimensions are used to provide a basis for the steps to be taken in value chain mapping. It was further stated that the first step before mapping the value chain was to determine the entry point. Based on this concept, the entry point in this study of the Mocaf-Based Functional Food Industry Development Model is an industry that processes mocaf into functional food. The next thing that needs to be mapped is to go back to the producers of raw materials/input production (upstream chain) and advance on the final consumption of mocaf-based functional food products (downstream chain).

The results of the literature review showed that research in functional food areas in Indonesia, especially mocaf, is dominated by production technology research. No research was found on the development of the mocaf industry itself. The novelty of this research is the in-depth studies carried out on the entire mocaf-based functional food industry value chain in Indonesia, in which this research previously was not conducted.

Therefore, to develop a mocaf-based functional food industry in Indonesia, a research needs to be carried out that aims to: (i) understand the conditions of the current mocaf-based functional food industry; (ii) understand the extent to which efforts have been made to develop it; (iii) provide solutions on the problems faced in the development of the mocaf-based food industry; and (iv) improve the quantity and quality of cassava production in the mocaf value chain.

RESEARCH METHOD

This research was carried out by combining the value chain approach of Heillin and Meijer (2006), UNIDO (2009) and (Collins et al., 2016). There are three approaches showing a similarity in the substance that act as the focus of value chain mapping, although there are variations in the techniques/steps of mapping used.

This research was a qualitative research, using multiple case studies in each part of the value chain. The data were collected through a review of secondary data content, in-depth interviews, and observations in each case study.

The interview respondents were identified using snowball techniques. Starting from the upstream value chain, the interviews were conducted with mocaf farmers in Bogor, West Java to find out the condition of cassava supply as the raw material for mocaf, including the continuity of supply and the price fluctuations. Furthermore, the interviews were conducted with MOCAF researchers from the Ministry of Agriculture and from research institutes to find out the development of research on MOCAF. On the downstream side, the interviews were conducted with the mocaf processed product industry, to find out information about the national mocaf market conditions. In addition, to get information about policies related to mocaf, interviews were conducted with BPOM (*Badan Pengawas Obat dan Makanan*) as the regulator of food policy. Interviews were also conducted to BSN to obtain information about SNI mocaf.

Value chain analysis seeks to understand how value chains function and in what ways they enable effective participation of various types of actors. Value chain analysis helps understand critical conditions and situations in industrial development, related to deficits in competitiveness and development bottlenecks that can occur simultaneously at various levels and linkages of the value chain. Basically, the results of value chain analysis can reveal whether and which parts of the value chain should be considered for development interventions and provide insight on how these interventions should be designed.

The case study locus was the center of the mocaf-based food industry in West Java. The activities in this study are described as follows.

First, the researchers identified and mapped out the actors involved. In this stage, they needed to identify and map the actors involved in the core process, public and private service providers (those who support the chain functions including transportation, packaging and handling, certification, financial support, etc.), value-enhancing agents (such as: government agencies, aid agencies and international organizations that carry out support and intervention activities to encourage the development of value chains) and the conditions of the framework that affect the development of the value chain (including regulatory frameworks, policies, trade regimes, market interventions, infrastructure, etc.). The identification of these value chain actors was carried out through snowballing in-depth interviews that start from producers of functional food made from mocaf. Furthermore, these actors could be classified as: legal status, the scale of business, activities, etc. This detailed value chain analysis resulted in an understanding of overlapping distance or activities, whether there was potential for upgrading, or simply provided a better understanding of the situation.

Second, the researchers mapped out the product lines along the value chain. This activity included the identification of products at each stage of the process when the product undergoes a transformation from input/production facilities of raw materials into intermediate materials, and become the final product, including standard requirements or desired markets/consumers. Mapping the flow created a clear picture of what product forms were handled, changed and transported at each stage of the process in the value chain.

Third, the researchers mapped out the flow of knowledge and information. The knowledge and information held by value chain actors was invisible; thus, it was generally more difficult to identify it in a visual map. Therefore, it requires resilience from the researchers and it needs special methods to capture it. By analyzing (mapping and diagnosing) variations/differences in knowledge, skills, and technology in various chains, how the product flow occurred, why, how much was exported, imported, etc., the state of demand and supply.

Fourth, the researchers mapped out the relationships between value chain actors. This step was done by identifying: coordination arrangements, regulations and regulations, product standards and their impact on the development of the value chain.

Fifth, the researchers mapped out the obstacles. Barriers occur at almost all levels of the process in any value chain, for example, the barriers in the efficiency and upgrading obstacles. Initial identification of these obstacles was carried out at all levels of the process and the potential solutions were also projected.

RESULT AND DISCUSSION

A supportive environment consists of critical factors and trends that shape the value chain environment and value chain operational conditions. These supportive environmental factors are generated by structures (national and local authorities, research institutions, etc.), and institutions (policies, regulations and practices) that are beyond the direct control, but may be shaped by the economic actors in the value chain. The purpose of mapping out this supportive environment was not only to map out the status quo of the value chain and its linkages, but also to understand the trends that affect the entire value chain, and examine the strengths and interests to drive the change towards a better value chain. This knowledge could help determining the paths and opportunities for carrying out realistic actions, lobbying and carrying out policies to support entrepreneurship.

In the most effective value chains, the main actors forming the chain (transacting the main products) are supported by business and services from other companies and other supporting organizations. There is a need for value chain actors to access services from various types of markets and technicalities. Therefore, it is necessary to map these services that potentially support the value chain to be efficient because these were the key linkages.

The value chain of the mocaf-based food industry in Indonesia is relatively simple, because this industry in Indonesia is not yet sufficiently developed and the number of companies is still very limited. This condition is indicated by the National Agency of Drug and Food Control (NA-DFC) database which shows that there is only one mocaf producer company and three mocaf starch producers in Indonesia having registered at BPOM. These four companies are registered within the general food category and not registered in functional food companies.

Whereas, most of the other companies are home industry companies (PIRT, *Pangan Industri Rumah Tangga*) that had not been registered in BPOM. The number of mocaf-based food PIRTs was also still limited. The Bogor City and Regency Health Office that issue the PIRT permit, stated that the mocaf field and its derivative products in this region were very limited in number. In the city of Bogor, there were only four food and beverage factories, even though the Bogor region was one of the centers of cassava in West Java Province.

Figure 1 shows the results of mapping out the mocaf industry value chain in this study based on the analytical framework used. The value chain is explained through three main components: (i). The main value chain, (ii). the enabling environment, and (iii). The business services and development from organizations outside the main value chain.

Main Value Chain

The main value chain (Figure 1) consists of producers (cassava farmers, mocaf producers, mocaf processed food producers), mocaf trading activities (middlemen, retailers, farmer groups), and markets for the mocaf market (local markets, niche markets, markets export).

a. Cassava farmers

The potential for mocaf in Indonesia is very high, because cassava plants can grow well in all regions from Sabang to Merauke. However, cassava farmers in Indonesia generally control narrow strips of land with low productivity. It is rare for cassava farmers to control land up to 1 ha or more. For the West Java region, the harvested area of cassava is 85 thousand hectares with production of 2 million tons and productivity of 23.45 tons per hectare. The biggest producer of cassava in West Java is Garut Regency with 629 thousand tons. Bogor Regency occupies the fourth position of cassava producer with 132.5 thousand tons with a productivity level above the average in the West Java regencies with 24.91 ton/ha (Table 3).

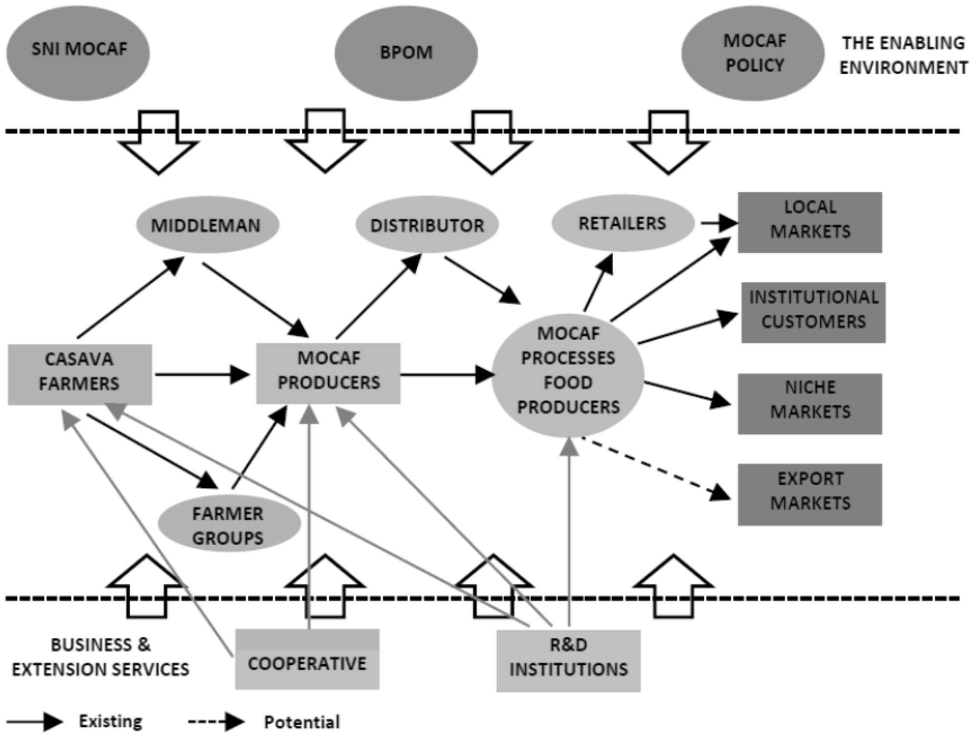

Figure 1. Results of mapping the mocaf industry value chain

The productivity of cassava is still relatively low compared to the productivity of cassava in ASEAN countries, like Thailand. The low productivity is due to the traditional cultivation of cassava with minimal fertilization and using makeshift cassava seeds from the cuttings from the harvested plants. The combination of narrow land tenure and low productivity causes the decrease of the farmers' income, even though the selling price of cassava is currently relatively expensive (around Rp. 1500 to 2000 per kilogram). As an illustration, a cassava farmer, member of the Setia Cooperative in Bogor Regency who owns 1000 square meters of land will get a profit of 1.5 million rupiahs in one planting season. With the calculation of one planting season it takes around 9 to 11 months, meaning that in one month, the farmer gets a profit of around 150 thousand rupiahs.

Mocaf production can be done massively in places where it can produce cassava at a price of approximately Rp 500 to 600 per kg and this is very possible if the cassava cultivation is done optimally. For this reason, mocaf production should be carried out by companies or farmer groups that are maximally fostered by the government.

Table 3. The Main Production Areas of Cassava in West Java Province, 2015

Regency	Area size	Production	Productivity
	x 1000 ha	x 1000 ton	ton/ha
Garut	25.6	629.4	24.6
Tasikmalaya	11.1	261.1	23.5
Sukabumi	7.5	232.7	31.2
Cianjur	6.2	147.8	23.9
Sumedang	8.4	134.2	16.0
Bogor	5.3	132.5	24.9
Ciamis	3.6	103.9	29.0
Bandung	5.5	89.5	16.3
Purwakarta	3.3	73.2	22.3
Bandung Barat	3.4	68.4	19.9
West Java	85.3	2000.2	23.5

Source: (BPS Jawa Barat, 2018)

The cassava farmers market their crops in several ways: to middlemen, through cooperatives to factories (mocaf companies, plastic companies, fodder companies), to retail, housewives and traditional food traders. The selling prices to middlemen, factories and cooperatives are the same, while the sales at retail prices are higher.

This means that the cassava market occurs in perfectly competitive market conditions and the prices depend on the conditions of supply and demand. When there is an oversupply, the price of cassava can fall at the lowest price of up to Rp. 400 per kilogram.

b. Mocaf manufacturer

Technically, the method of processing mocaf is very simple. It is similar to the way in processing ordinary cassava flour, but it is continued by a fermentation process. The stages of the process of making mocaf are displayed in the flow chart below (Figure 2).

The technology used at each stage of the production process above will determine the quality of mocaf produced (Figure 2). In the process of slicing cassava, the current slice technology cannot be used for large-scale mocaf production. For industries with a capacity to produce tens of tons, it will not be enough to use the slice technology. Mocaf production must be hundreds of thousands of tons, if you want to compete with wheat flour. There is a thought that it is better to use rasp technology as used by tapioca factories. Thus, if the mocaf industry can develop rapidly, it may utilize a tapioca factory that has a high level of capacity to produce mocaf.

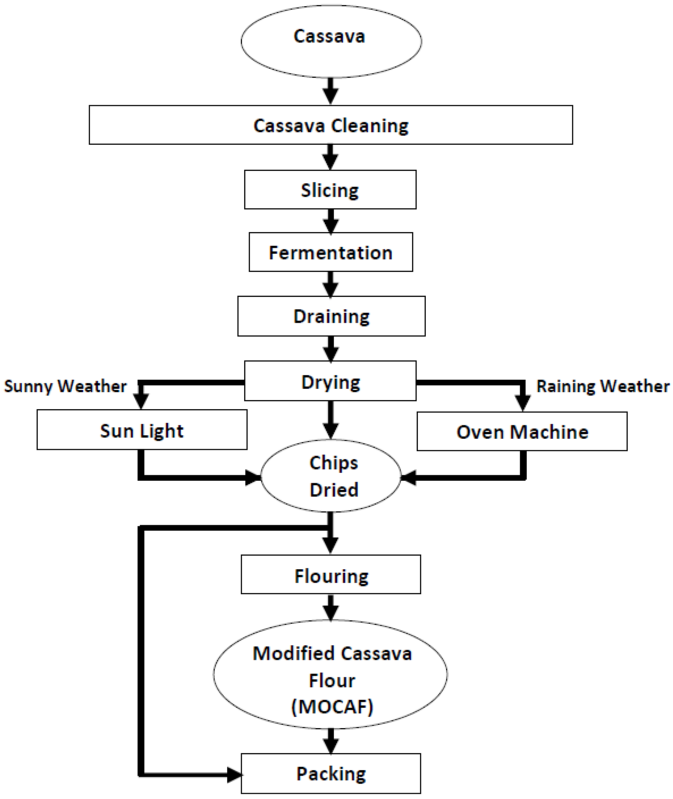

Figure 2. Flow chart in making mocaf flour

In choosing the quality of cassava, the mocaf craftsmen in Bogor Regency prefer the type of *manggu* cassava as the raw material for making mocaf because the starch content is suitable for mocaf. Four kilograms of fresh cassava produced 1 kilogram of mocaf, but there are also those who claim that 3 - 3.5 kg can produce 1 kg of mocaf depending on the quality or where the cassava originated.

In the fermentation process, the mocaf workers consider the fermented starter. Some of them pay attention to the halal aspect of the fermented starter, while the other craftsmen pay more attention to the quality of the mocaf that is produced, especially from the color that is pure white and from the one that does not smell of cassava (musty). Related to the starter used by mocaf companies in Indonesia, there are two sources; East Java and West Java. The starter from the eastern region was developed by the University of Jember, which called it an enzyme even though it is actually not an enzyme while from the western region a starter was produced by the Post-Harvest Center for Agriculture (Ministry of Agriculture). Both east and west both use Lactobacillus, they distinguish it from the level of strains that will distinguish the flavor of the mocaf produced. There are two opinions related to flavor. Some argue that the cassava flavors should be removed in the mocaf, while others argue that there is flavor between mocaf and non-mocaf cassava which does not need to be removed but stored.

There are problems often faced in the process of making mocaf related to drying. The mocaf craftsmen do the drying under the hot sun. This technique is better than using an oven; thus, the flour becomes whiter. However, the production still cannot depend on sunlight, especially for large companies (factories) and during the rainy season. The drying process must be carried out optimally until the mocaf water content having maximum 12%. If the water content exceeds 12%, it causes the mocaf to smell like cassava.

The mocaf industry in Indonesia was not developed because the number of business actors is still limited. The BPOM database shows that there is only one mocaf producing company that has been registered by BPOM, while the other company is a PIRT. The mocaf market is also still limited to specific market segments. Other consumers use mocaf for other purposes, such as training and demonstrations, that are used as market opportunities for mocaf producers. Mocaf producers prefer marketing their products through retailers in order to obtain a continuous market.

c. Mocaf processed food producers

Mocaf as a special cassava flour is a relatively new product in Indonesia. With the characteristics described above, mocaf can be used as a food ingredient with extensive use. The product development trials show that mocaf can be used as raw material for various types of food, ranging from noodles, bakery, biscuits, cookies to semi-wet foods. The use of mocaf flour as a food ingredient is usually used mixture with other flours, especially wheat flour for several reasons (Frediansyah et al., 2012). For example, as a raw material, mocaf requires a mixture of other flours to keep the noodles chewy and the bread still swell.

A food product is legally referred to as functional food (claimed food) if it registered by BPOM in accordance with BPOM Regulation Number 13 of 2016 (BPOM, 2016). Functional food identical to the one referred to in the Regulation as claimed food, where the food is claimed to have a substance that has certain physiological functions. Until now, there is not any mocaf-based food product applying for a registration permit or has been registered by BPOM with such claims. In order to register claimed the processed food products, the producers must show the results of their product tests in standard government laboratories or private laboratories, in which the test results show compliance with certain substance thresholds set out in BPOM Regulation No. 13 of 2016. Likewise, there is not any mocaf-based PIRTs daring to claim it as a functional food product. They only claim that the food products are gluten-free because they use mocaf as the raw material. Regarding the requirements for gluten-free food, one of the reasons food manufacturers use mocaf is as a substitute for other ingredients, such as banana flour which costs more than mocaf (Gunawan et al., 2017).

d. Middlemen, retailers, distributors and farmer groups

The trade aspects of the mocaf value chain are carried out by distributors, retailers, middlemen and farmer groups. The most upstream value chain of mocaf is the harvest of cassava produced by farmers. Some farmers sell their crops directly to traditional markets, but some sell them through intermediaries. The results of the study showed that farmers sell the harvested cassava to the middlemen and through the farmer groups. The case study in the farmer group showed that the farmers who sell cassava through farmer groups benefit from a stable cassava purchase price. Whereas, farmers who sell their crops to middlemen will get a relatively volatile purchase price of cassava.

Distributors purchase large quantities of mocaf from mocaf producers, usually in the form of mocaf in sacks. Furthermore, distributors sell mocaf to mocaf processed food producers and distributors who pack bulk mocaf into smaller packs, which are branded and marketed. One of the mocaf distributors in the West Java region markets mocaf with the brand name Prodes.

Retailers function in marketing mocaf processed food products. Most marketing of mocaf-based food products is carried out through retailers in outlets, including souvenir shops. The selection of a marketing model like this is due to the consideration of a limited market segment.

e. Local markets, niche markets, and export market potential

The market aspect of the mocaf industry consists of local markets, niche markets, and the mocaf export market potential. Judging from the aspect of the local market, market acceptance of the mocaf is low, so development of the mocaf industry is constrained by lack of demand. As a substitution commodity for wheat flour, mocaf is unable to compete because of the price difference. The current mocaf price per kilogram is around Rp. 12,000 to Rp. 15,000, while the price of wheat flour is only around Rp. 6,000. The high price of mocaf is due to the high price of the raw materials in which fresh cassava costs Rp 1,500 to Rp 2,000 per kilogram. In order to compete with wheat flour, the stability of cassava prices is needed at a maximum level of Rp 500 per kilogram.

It is no longer relevant to put mocaf as a substitute product of wheat flour, because both have different chemical structures. Thus, the usage is different. Among them, wheat flour is needed as raw material for bread because of its nature which causes the bread dough to expand unlike mocaf. On the contrary, mocaf can be used as one of the ingredients of crispy food. Therefore, mocaf and other flour can be complementary.

The second market aspect is the niche market of mocaf products. Mocaf as a health food commodity has a special market niche, which is consumed by people with autism, celiac disease (a disease that is intolerant to gluten) or in Indonesia known as chronic ulcer, as well as a consumer group with healthy lifestyle by consuming foods that are gluten-free. The consumers in this niche market have no problem with the use of mocaf which is more expensive than wheat flour causing a higher priced product. Even so, this mocaf as functional food (gluten-free) has many competitors because besides mocaf, there are still many other food sources that are gluten-free, such as banana flour and corn flour.

In addition to local markets and niche markets, mocaf also has the potential for export. Data showed that as many as 0.2 - 0.6% of Americans suffer from celiac disease, whereas in Europe an average of 1% are affected by celiac disease (allergic to gluten), so they must consume foods that are gluten-free. This market potential is a large market for the mocaf industry if it can be realized. However, to be able to successfully export mocaf or processed mocaf products, it is necessary to develop the mocaf industry related to the industrial scale and the quality of the mocaf in order to meet the strict European export market requirements.

The Enabling Environment

Heillin and Meijer (2006) suggest that the innovation value chain of an industry is not only formed from the main value chain. There is also an enabling environment that influences the performance of the main value chain. This supporting environment is composed of: (i) formal aspects such as tax, trade and financial policies and regulations, and quality assurance regulations; and (ii) non-formal aspects such as trends in consumer needs and tastes in the market. The data collected during this study showed that in addition to the main value chain, the mocaf-based functional food industry also needs a supporting environment including food regulatory agencies namely BPOM and the Health Office in each city/district, National Standardization Agency (BSN) and relevant policies related to mocaf, such as BPOM, Regional Health Office, and Indonesian National Standard (SNI) of Mocaf.

Mocaf and the form of processed mocaf products, before being marketed, actually need to have a PIRT permit issued by the local City or District Health Service. This rule applies to every producer, both SMEs and large companies that produce food products, even though in reality not all SME food products on the market already have PIRT permit numbers.

Whereas, BPOM in the mocaf value chain acts as an institution that has the authority to register mocaf and mocaf processed products. More specifically, within the framework of functional food, BPOM is an institution that has the authority to determine whether a product is a functional food or not. This is stated in BPOM Regulation No. 13 of 2016 which regulates "claimed food registration". This regulation does not mention the nomenclature of "functional food" but it is replaced with "claimed food" in which the meaning is the same as processed food products that have added value for health (Supadmi et al., 2016). BPOM data shows that there are only four mocaf-based products were registered. Likewise, data from the Bogor City Health Office showed that there were only three mocaf products that received PIRT permits. Mocaf SNI relates to further development of mocaf as standardized processed mocaf guarantees. Mocaf SNI will be discussed further in the next section, which is a relevant policy.

Functional or claimed food has the potential to develop because it can provide health and economic benefits to the community. This was anticipated by the government through the Regulation of the Head of BPOM Number HK 00.05.52.0685 of 2005 concerning the Basic Provisions for Functional Food Control. In BPOM Regulation, it was stated that functional food is processed food containing one or more functional components based on scientific studies that have certain physiological functions, proven to be harmless and beneficial to health.

The Regulation of the Head of BPOM Number HK 00.05.52.0685 of 2005 was revoked and updated with BPOM Regulation No. HK.03.1.23.11.11.09909 in 2011 concerning Supervision of Claims in Labels and Processed Food Ads (BPOM, 2011). In this regulation, BPOM defines the (i) functional food and (ii) claims. The definition of functional food has improved (compared to the definition of 2005); that is, the food containing one or more food components based on scientific studies that has certain physiological functions beyond its basic functions and it is proven to be harmless and beneficial to health. Whereas, claims are defined as "all forms of description which state, suggest or indirectly state the specific characteristics of food relating to the origin, nutrient content, properties, production, processing, composition or other quality factors".

In order to protect the consumers, this regulation stipulates that in the inclusion of nutritional claims and health claims, the producer must meet certain requirements and states that the claims must be true, not misleading, and prohibit manipulating consumer fears. This is why the 2011 BPOM RI regulates the scope of claims, claim requirements, permitted claims, as well as the procedures for submitting new claims and regarding prohibited claims. BPOM Regulation (2011) requires that food with certain claims (in this case functional food) must include scientific evidence in protecting consumers, especially from the advertisements that mislead or cause misperception.

However, the impact of this regulation is very visible in the registration data of functional food products in Indonesia that has decreased since 2011. Looking at the decline in the number of functional food product registration, the Head of BPOM RI acknowledged that this was indeed the impact of the issuance of the regulation (Sparringa, 2014).

In 2016, the POM revoked Regulation Number HK.03.1.23.11.11.09909 in 2011 and replaced it with Regulation Number 13 of 2016 concerning Supervision of Claims in Processed Food Labels and Advertisement to conform to the development of science and knowledge in the field of processed food. At the BPOM regulation, the terms and definitions of functional food are not included. The POM Regulation defined Processed Food as a food or beverage resulting from a process by a certain method or methods, with or without additional ingredients. The processed food can get a claim on the label after fulfilling the specified requirements.

The increasing production of mocaf and as processed food based on mocaf should be supported by policies that foster a good business environment and the extensive use of mocaf. However, the policy of accelerating the production and use of mocaf is still limited (DG PPHP, 2012). Most policies are still technically in the production sector, especially the determination of quality standards and development of processing Standard Operating Procedures (SOPs). One of the existing policies related to the standard of mocaf has been published through SNI 7622-2011. The SNI manufacture of mocaf flour aims to protect the consumers, to guarantee honest and responsible food trade, and to support the development and diversification of the mocaf industry and mocaf users. Thus, the government gives attention to the production aspects of mocaf with good quality.

Business Services

a. R & D institutions

Mocaf in Indonesia was first developed and introduced by Prof. Achmad Subagio from the University of Jember, East Java (Subagio, 2007). In the mocaf industry and its processed products, R & D institutions and universities have a role as producers to disseminate the knowledge and technology. The results of data collection showed that the small-scale mocaf producers (SMEs) lack the knowledge about how to process the cassava as the raw material into mocaf (Subagio & Windrati, 2012) (Putri, Herlina, & Subagio, 2018) (Diniyah, Subagio, Nur Lutfian Sari, Gita Vindy, & Ainur Rofiah, 2018) (Kartikasari et al., 2016). In addition, cassava farmers are accustomed to selling raw (fresh) cassava either to middlemen or cooperatives.

Mocaf researchers from universities and R & D institutions look for SMEs or farmer groups that have cassava as the raw material stocks, and through guidance or extension activities, they are then able to produce mocaf. This coaching process is a process of technology transfer from the researchers to the SMEs or farmer groups. In this process, the farmer groups and SMEs learn from the researchers on how to process the raw cassava into mocaf, starting from the process of stripping, peddling, fermentation, drying, and after sifting stage that turns into mocaf.

One focus of the mocaf research is the mocaf "starter". The mocaf starter is used in the fermentation process (Kartikasari et al., 2016) (Frediansyah et al., 2012), where the chopped cassava is then soaked in water (fermentation) for 12-24 hours with the addition of the mocaf starter in the fermentation process (Diniyah et al., 2018). This starter allows the fermentation process to produce bacteria to convert cassava into mocaf. The mocaf starter is in powder form, so it is easy to either buy or sell it. Since it was first introduced in 2003, there are now various types of mocaf starters, with various advantages, one of which is to shorten the fermentation time in reducing the production time of mocaf. The fermentation time varies from 8 hours, 12 hours, 24 hours, 48 hours to 3 days depending on the type of starter mocaf used. The processing of 1-2 tons of cassava requires 1 kg of mocaf starter. One obstacle in the technology transfer process is in changing the habits of farmers and SMEs to process cassava in good procedures. For example, after fermentation, the drying process is done by drying directly using the sunlight.

Indonesian Institute of Sciences (LIPI, Lembaga Ilmu Pengetahuan Indonesia) as an official R & D institution also conducted research on mocaf from upstream: cassava cultivation and downstream: making mocaf-based noodles, mocaf-based ASI slurry. One of the upstream results of research was the development of beta-carotene cassava seeds (KBK). KBK cassava seeds were developed in two ways: (i) results of selection of local varieties where the tuber is rich in beta carotene (CBC), (ii) breeding plant seeds through genetic engineering.

The multiplication of CBC cassava seeds is carried out through tissue culture using radiation, which does not change the characteristics of the seed.

b. The cooperatives

The cassava trade as a raw material for mocaf is still traditional, in which many farmers sell their crops to the middlemen. Because of limited capital, many cassava farmers also carry out "bonded" systems in which the middlemen pay upfront before the harvesting cassava. It is actually detrimental to the farmers because they have to accept the selling price of cassava according to the middlemen's offer who has bargaining position that disadvantages the farmers. The ineffectiveness of the cassava value chain is one of the causes of the fluctuations in the price of cassava on the market.

One effort to minimize this condition is the initiation of cooperative establishment. The cassava farmers can get more profit if they sell their crops through cooperatives, compared to the amount they get when they sell them to the middlemen. One of the mocaf cooperatives in Bogor Regency states that the effort to provide stable cassava prices to farmers is through a cooperative. This mocaf cooperative becomes fresh cassava supplier to a company, so that the price of cassava is stable throughout the year. The reciprocity requires cassava farmers to cultivate cassava organically by following the requirements of the company. In addition, the planting schedule system is also managed and carried out by farmers. Thus, throughout the year, the harvested cassava can be obtained for supply to the company and for mocaf raw materials. The initiative of the cooperative will have a positive impact if it is carried out by many national cassava farmer groups.

Policy Implication

To provide a solution to the problems faced in the mocaf-based food industry, an active role is needed from R & D institutions from the upstream to downstream chains and to develop the mocaf-based food industry with support from government through policy intervention.

Based on research findings, government intervention carried out through policies can improve efficiency from upstream to downstream food products based on mocaf through the provision of sustainable cassava raw materials, development and protection of the mocaf industry, and mocaf-based processed food.

a. Provision of sustainable cassava raw materials

The development of processed mocaf-based food industry will not occur if the raw material for cassava is not available in the appropriate quality, quantity and time. The development of cassava commodities is faced with several problems such as the quality of cassava, the availability of raw materials, and the seasonal production. The farmers are reluctant to cultivate cassava due to the market uncertainty and the large price fluctuations. The development of processed food industry based on mocaf can be a large and sustainable market opportunity for the cassava farmers. To make cassava production available in sufficient quantities and sustainably, it is necessary to increase the production through the addition of extensive planting, improving maintenance and harvesting (Pramesti, Rahayu, & Agustono, 2018).

Comprehensive improvement starting from the development and the use of good cassava varieties, standardized cultivation and handling result are in accordance with the standards in order to meet the needs of the mocaf industry. The development of cassava commodities as raw material for making mocaf must pay attention to the up-farm (on-farm) agribusiness institutions.

This can be achieved through the improvement of production facilities, such as superior seeds, fertilizers, medicines, as well as agricultural tools and machinery. It needs to be focused on adopting the cultivation technology and strengthening farmer institutions (farmer groups, joint farmer groups, cooperatives).

b. Development and protection of the mocaf flour industry

Increasing the production and use of mocaf as raw material for substituting for other flour and mixing with local flour (corn, tapioca, beans) can result through policies that foster a pleasant business environment for the widespread use of mocaf (see also Frediansyah, Kurniadi, Nurhikmat, & Susanto, 2012; Subagio, 2007).

Ruriani, Nafi, Yulianti, & Subagio (2013) stated that the potential use of mocaf in the province of East Java was very high. Food SMEs using wheat fluor in East Java are quite high, in 54%. MOCAF as an ingredient substituting flour for making various flour-based products has a profitable position, power and big opportunity in its growth. Thus, there is very significant market expansion opportunity of this product.

At present, the policies issued by the government are limited to technical policies in determining the quality standards and development of processing SOPs in the form of issuing mocaf flour standards (SNI 7622: 2011) in order to make good quality of the produced mocaf.

c. Manufacture of mocaf-based processed food

Mocaf can be used as raw material in substituting wheat flour. Various types of processed food products can be made from it, such as cookies (*nastar*, and *kastengel*), wet cakes (layer cake, brownies, spongy), and white bread (see Gunawan et al., 2017). Besides, mocaf can also be used in making rice noodles and other product mixtures made from wheat flour or rice flour. Processed food products made from mocaf produce processed products that are not much different from products that use other flour or rice flour (Subagio & Windrati, 2012). The substitution of flour with mocaf at the factory scale shows that to produce good quality noodles, mocaf can be used up to 15% as substitute flour, while to produce low quality noodles, flour can be substituted with mocaf up to 25%. The studies regarding the noodle quality by using mocaf as the substitute were carried out by Afifah & Ratnawati, (2017) and Agustia, Subardjo, & Ramadhan (2019).

Furthermore, some R & D results show that the substitution of wheat flour with mocaf for industrial ingredients of instant noodles, bread and biscuits can be done up to 30% without significantly affecting the quality of the products produced. Thus, it is a very good opportunity for the mocaf in the processed food industry to be developed as the substitute or combination with other flours (Gunawan et al., 2017). Improvements in the downstream side of processed food products based on mocaf can be done through post-harvest handling, development of the mocaf processing industry, product distribution and marketing systems, and product development and promotion of mocaf-based processed food products.

The partnership pattern between mocaf raw materials and mocaf processed food products needs to be done in order to create a value chain for mocaf-based processed food industry entrepreneurs.

CONCLUSION AND SUGGESTION

Cassava is a strategically important plant, especially in tropical countries. In Indonesia, cassava plants can grow from Sabang to Merauke. Cassava has become a staple food after rice and corn. Further development of this commodity can be used as the raw material for the food industry. One of the cassava products being developed is mocaf. Mocaf is cassava flour made from a fermentation process. The mocaf production was originally intended as a substitute for wheat flour (Frediansyah et al., 2012).

In its development, mocaf is used as raw material for the functional food industry because it has specific organoleptic characteristics. However, the mocaf-based functional food industry in Indonesia is generally still undeveloped. In the upstream chain, the productivity of cassava plants is still low because the cultivation of these plants is still traditionally done using the low-quality seeds. In the market, mocaf cannot compete and become a substitute for wheat flour because the selling price of mocaf is more expensive. Meanwhile, as a functional food product, the market of mocaf is limited. This condition makes the number of mocaf businessmen and their processed products small.

Efforts to develop a mocaf-based functional food industry have been carried out through various research conducted by R & D institutions and universities. In terms of the upstream chain, the role of R & D institutions is needed to increase the productivity of cassava plants through improving the quality of superior cassava seeds and improving cultivation. The results of LIPI's research on this matter can potentially provide solutions to the problems in the upstream chain.

The assembly related on superior seeds and seedling propagation conducted by LIPI aims to produce cassava seedlings with superior characteristics: high production, starch content and composition, nutrient content (beta-carotene, protein and minerals), drought stress, and postharvest tuber storage capacity. This research, besides being able to increase productivity, can also improve the quality of mocaf which is rich in nutrients (protein and beta carotene) as functional food raw materials. This means expanding the spectrum of mocaf benefits, so that it does not only act as functional food that is gluten free but also as the one that is rich in beta carotene and other health benefits.

LIPI has also succeeded in developing biological organic fertilizer (POH), which in recent years has been successfully disseminated to various provinces in Indonesia. This research, besides being able to increase cassava crop production, can also improve the soil structure which is caused by the excessive use of chemical fertilizers and the damage of the cassava continuous cultivation.

Meanwhile, the value chain downstream of mocaf production and processed products has been carried out by LIPI and other research institutions such as the Ministry of Agriculture Post-Harvest Center, Agency for the Assessment and Application of Technology (BPPT), and universities (Bogor Agricultural Institute and Jember University).

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