Value Chain Improvement for Cocoa Industry in Indonesia by Input-Output Analysis

Arinda Soraya Putri, Wahyudi Sutopo, Socia Prihawantara, Ryan Corinus Dato Matheos

Abstract- **Cocoa is one of the leading commodity in Indonesia. Indonesian cocoa industry is the third largest producer of cocoa beans in the world after Ivory Coast and Ghana. Nevertheless, the Indonesian cocoa industry has low competitiveness compared to both countries. Cocoa industry resources and industries related to the cocoa industry has not been optimized to support the development of the cocoa industry. This article uses the input-output analysis to determine the relationship cocoa industry and other industries as well as providing improvements to enhance the value chain through the sectors supporting the cocoa industry. Input-output analysis is a method to determine the amount of inter-industry flows in relation to the level of production in each sector. There are some industries that play a role in supporting the national cocoa industry, but there has not been a good value chain to increase cocoa production. Value chain improvement in this study aims to analyze the value added between entities to optimize the role of sectors supporting the cocoa industry in accordance with their contribution to the quadrant position input-output analysis.**

Index Terms—cocoa bean, cocoa industry, input-output analysis, value chain

I. INTRODUCTION

As one of the country in the world with abundant natural resources and opportunities, Indonesia certainly has the potential to create a good industrial system by developing a variety of existing industrial potentials and connecting the production chain from upstream to downstream industries. One of the industry that is potential to be developed in Indonesia is the cocoa processing industry.

Indonesia is one of the world's largest producers of cocoa beans and is currently the third largest cocoa beans producer in the world, after Ivory Coast and Ghana [1]. Production share of cocoa bean in 2010 of Ivory Coast and Ghana made up 74.9% of the world's total cocoa bean production, while Indonesia made up 12.2% of the world's total cocoa bean production. Most of the exported products are cocoa beans

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and still a bit derivative products are exported in the form of cocoa butter, cocoa powder, cocoa cake and cocoa liquor [2]. Although Indonesia has become one of the world's leading cocoa producer, the country's competitiveness in the cocoa industry is considerably low.

Though the cocoa tree has great potential to be processed into derived products that have high added value. A wide variety of derivative products with the addition of value added can be seen on the following of the cocoa industry diagram.
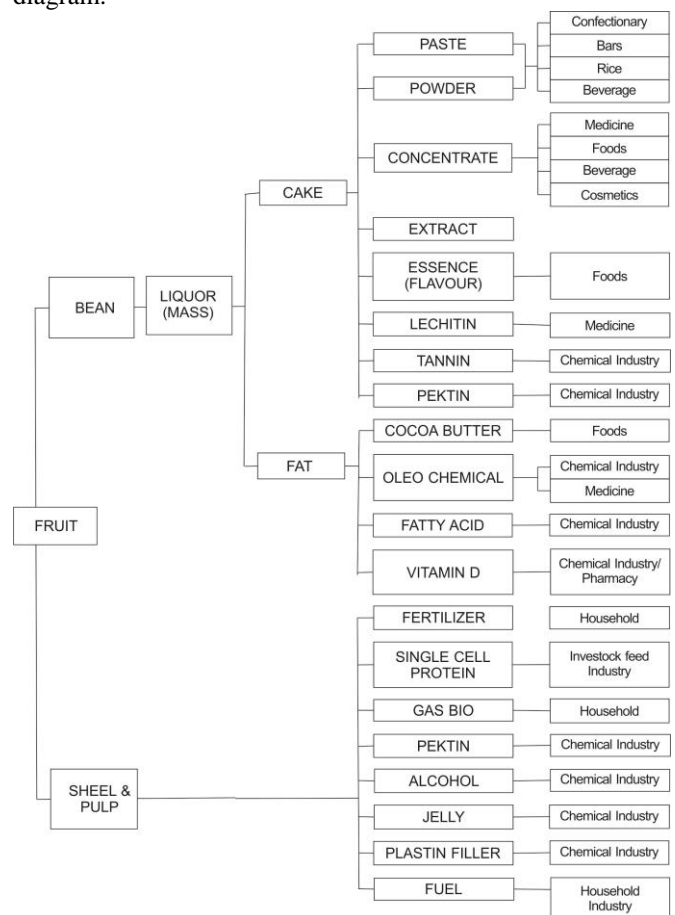

Figure 1. Cocoa Industry Diagram

Cocoa bean production in Indonesia is very abundant, but a few years fluctuated increase and decrease due to various factors, such as weather conditions, soil conditions, and the age old plants [3]. However cocoa industry in Indonesia has not been able to utilize the initial output of cocoa products to input cocoa processing industry which has high added value.

Cocoa is one of the leading commodity owned by Indonesia. Nationally, cocoa produces the third largest foreign exchange earner after oil palm and rubber. Net of cocoa in 2009 reached USD 1.38 billion (derived from cocoa beans and processed). Processed cocoa beans produce

cocoa butter (cocoa butter) and cocoa powder (cocoa powder) that is needed by the people of the world, especially in America and Europe, where demand for cocoa reached 2.5 million tons per year. Indonesia targets in 2025 is capable of producing 2.5 million tons of cocoa beans with an export value of USD 6.25 billion [4].

According to data from ICCO (International Cocoa Organization) world cocoa demand continues to grow around 2-4 percent per year, even in the last 5 years to grow 5 percent per year (3.5 million tons/year). China and India with a large population into the market potential of Indonesian cocoa.

The hypothesis of the study is the relationship between the entities in the Indonesian cocoa industry is still so low that less relevant sectors to support the development of the national cocoa industry. In addition, value added among entities is still low. Indonesian cocoa products are exported in the form of cocoa beans reached 80%, while the rest is processed in the country. Indonesia also imported cocoa in the form of cocoa beans, cocoa powder, cocoa liquor, cacao cake, and cocoa butter [2]. There has been no research on the cocoa industry with input-output analysis, whereas the input-output analysis can be used to enhance the economic competitiveness of a country or region. Therefore, the input-output analysis (I/O analysis) is needed to identify the competitiveness of Indonesian cocoa industry.

The following figure is a schematic representation of the global cocoa-chocolate value chain as identified by the research.
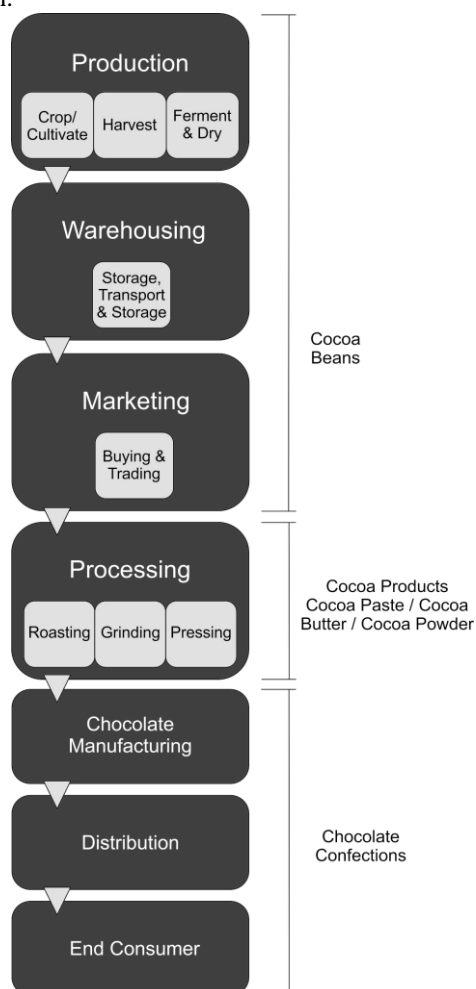

Figure 2. Cocoa Industry Value Chain

A value chain is the full array of tangible and intangible value-adding activities that are performed to bring a product from conception to eventually its end-of-life, and sometimes beyond [5].

In the cocoa industry value chain of figure 2, we described it based on some previous results, i.e. cocoa value chain from farmer to consumer [16], cocoa value chain review [17], evaluating opportunities for enhancing Mondelēz' sourcing strategies to ensure the sustainability of its cocoa supply [18], small-scale producers in the development of cocoa value-chain partnerships [19], cocoa and coffee value chains in west and central Africa [20], Indonesia cocoa bean value chain case study [21], and a holistic feasibility study framework to determine valuable chain in palm oil Industry [22].

Cocoa industry value chain beginning from farmers grow cocoa trees on small farms in tropical environments, within 15-20 degrees north and south of the equator. Cocoa is a delicate and sensitive crop, and farmers must protect the trees from the wind and sun. They must also fertilize the soil and watch for signs of distress, including attack from pests and disease. With proper care, most cocoa trees begin to yield pods at peak production levels by the fifth year, which can continue for another 10 years [15].

The growing season in the tropics is continuous. Ripe pods may be found on cocoa trees at any time, however, most countries have two periods of time per year of peak production. A farmer can expect 20-50 beans per pod, depending on the variety of cocoa [15].

Once the beans have been removed from the pods, the farmer packs them into boxes or heaps them into piles. The piles are covered with mats or banana leaves. The layer of pulp that naturally surrounds the beans heats up and ferments the beans. Fermentation is an important step, lasting three to seven days, that produces the chocolate flavor we know when the beans are roasted. The beans are then dried. In the sunlight, this usually takes several days.

After the beans are dried and packed into sacks, the farmer sells to a buying station or local agent. The buyer then transports the bags to an exporting company. The exporting company inspects the cocoa and places it into burlap, sisal, or plastic bags. The cocoa is trucked to the exporter's warehouse near a port.

The exporting company finalizes the time and place of shipment and the beans are loaded onto ships. Once the ship reaches its destination, the cocoa is removed from the hold and taken to a pier warehouse. Cocoa is stored in bags or bulk in the warehouse. The buyer will conduct a quality check to accept delivery and cocoa is usually stored until requested by the processor or manufacturer. Trucks or trains carry the cocoa in large tote bags or loose in the trailer to the manufacturer's facility on a "just-in-time" basis.

The beans are first thoroughly inspected and cleaned. The inside of the cocoa bean is called the nib. Depending on preferences, beans can be roasted with the shell intact, or the nib can be roasted alone. Once the beans have been shelled and roasted (or roasted and shelled), the nib is ground into a paste. The heat generated by this process causes the cocoa butter in the nib to melt and creates "cocoa liquor."

To make chocolate, cocoa liquor is mixed with cocoa

butter, sugar and in some cases, milk. The mixture is then placed into conches—large agitators that stir and smooth the mixture under heat. As a rule, the longer chocolate is conched, the smoother it will be. Conching may last for a few hours to three full days, or even longer. After conching, the liquid chocolate may be shipped in tanks or tempered and poured into moulds for sale in blocks to confectioners, dairies, or bakers.

The cocoa, chocolate, and confectionery industry employ hundreds of thousands of people around the world and is a key user of other agricultural commodities such as sugar, dairy products, nuts, and fruits.

II. LITERATURE REVIEW

There are many studies related to cocoa production are constantly being developed, for examples biodiversity conservation in cocoa production landscapes [6], the major constraints of cocoa production [7], improvement of cocoa production on small farms [8], restructuring processes in the cocoa sectors of the major producer countries [9], and environmental impacts of cocoa production and processing [10]. Research conducted in many countries in the world's largest cocoa producer. Most aim to improve the productivity of cocoa plantations.

However, few studies discussing the cocoa industry competitiveness. There are supply chain to enhance the competitiveness [11], the competitiveness of cocoa production systems [12], and the impact of structural adjustment and adoption of technology on competitiveness [13]. Research on the competitiveness of Indonesian cocoa industry is needed to boost the national economy.

Research with an input-output analysis tool is still lacking in agriculture, especially cocoa.

III. METHOD AND MODELING SYSTEM

To improve competitiveness and increase the value chain between entities cocoa industry in Indonesia, conducted value chain analysis to determine the value added between entities and input-output analysis to determine the forward linkage and backward linkage cocoa industry and related industries, distribution of final demand cocoa sector; and distribution of gross value added cocoa industry sectors that affect the competitiveness of the cocoa industry.
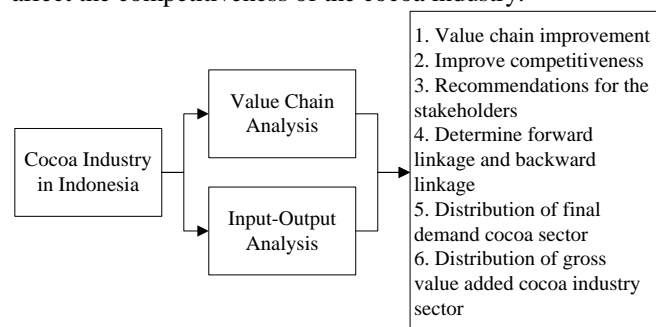

Figure 3. Methodology

Input-output analysis using input-output tables as a descriptive framework to express the relationship between industries and sectors and between inputs and outputs and measure the effect of changes in final demand for a sector of the production of all sectors in the economy.

Input-output is a statistical description in the form of a matrix of rows and columns that describe the transaction of goods and services as well as the relationship between a sector with other sectors. The dependence of a given sector to another sector is determined by the inputs used in the production process and the amount of output allocated to meet the demand for intermediate and final demand. Thus the development of a sector cannot be achieved if it is not supported by other sectors.

As a statistical description relating to input and output sectors of the economy, input-output can give an idea of the structure of the economy that includes input structure, the structure of output and value added, the structure of the supply of goods and services, demand, exports, and imports from each sector.

TABLE I
GENERAL FRAMEWORK INPUT-OUTPUT TABLE

I (n x n) Transactions between sectors/activities	II (n x m) Final demand and imports
III (p x n) Primary input	IV (p x m)

General framework consists of IO Table 4 quadrants, namely:

Quadrant I: shows the flow of goods and services produced and used by economic sectors in the production process. Transactions that occur in quadrant I, better known as a transaction between (intermediate transactions).

Quadrant II: shows the final demand and imports, as well as describe the provision of goods and services. Final demand consists of household consumption, government consumption, gross fixed capital formation, changes in stocks, and export.

Quadrant III: shows the primary input production sectors in the form of wages/salaries, operating surplus, depreciation, and net indirect taxes.

Quadrant IV: shows the primary inputs are directly distributed to final demand sectors. This information is used in the system of socio-economic balance (SAM). In the preparation of this quadrant IO tables are not presented.

Each quadrant is over expressed in a matrix form. Quadrant size n x n matrix indicates the number of sectors are calculated according to the sector classification by taking into account economic activity are considered potential in regions/areas. Input-output national cocoa industry in 2011 using size 19 x 19 sectors, resulting in quadrant I, consisting of 19 rows and 19 columns. Determining the sectors related to the cocoa industry conducted by experts.

TABLE II
RELATED INDUSTRIES IN THE INPUT-OUTPUT COCOA INDUSTRY

I-O Code	Sectors
22	Cocoa
40	Agricultural Services
64	Ice Cream Industry
84	Chocolate and Candy
92	Cakes Industry
95	Concentrated Animal Feed Industry
122	Single Primary Macro Nutrients Artificial Fertilizer Industry

129	Pesticide
133	Pharmaceutical Industry
198	Agricultural Infrastructure
199	Roads, Bridges and Ports
229	Other Trade Services
230	Restaurant Services
231	Hospitality Services
233	Road Transport Services
257	Bank
258	Other Financial Institutions
271	Research and Development of Technology and Engineering Science (Private)
278	Research and Development of Technology and Engineering Science (Government)

IV. RESULT AND ANALYSIS

Based on figure 2 and table 2, can be related to the industry classification to the cocoa industry in every stage of the value chain cocoa industry. In the stage production that includes crop/cultivate, harvest, ferment and dry, related industries are cocoa, agricultural services, concentrated animal feed industry, single primary macro nutrients artificial fertilizer industry, pesticide, and agricultural infrastructure. At stage of warehousing (which includes storage, transport and storage), related industries are roads, bridges and ports, and road transport services. At the stage of marketing (which includes buying and trading) and distribution, related industries are roads, bridges and ports and other trade services, road transport services. Research and development of technology and engineering science (private and government) to act on the stage of production, processing, and chocolate manufacturing. At the stage of chocolate manufacturing and the customer, industry involved is ice cream industry, chocolate and candy, cakes industry, pharmaceutical industry, restaurant services, and hospitality services. Banks and other financial institutions relating to all stages of the value chain of cocoa industry.

Degree of sensitivity index is a quantity that describes the impact that occurs on the output of a sector as a result of changes in final demand in each sector of the economy that performed the analysis. Because of this magnitude to explain the formation of the output in a sector that is affected by the final demand of each sector of the economy, then this measure is useful to see how the forward (forward linkage) between sectors of the economy [14].

TABLE III
DEGREE OF SENSITIVITY INDEX COCOA INDUSTRY AND
RELATED SECTORS OF COCOA

I-O Code	Sectors	Degree of Sensitivity Index
22	Cocoa	0,283
40	Agricultural Services	2,042
64	Ice Cream Industry	0,282
84	Chocolate and Candy	0,290
92	Cakes Industry	0,115
95	Concentrated Animal Feed Industry	1,915
122	Single Primary Macro Nutrients Artificial Fertilizer Industry	1,825

129	Pesticide	1,623
133	Pharmaceutical Industry	1,458
198	Agricultural Infrastructure	0,105
199	Roads, Bridges and Ports	0,132
229	Other Trade Services	1,010
230	Restaurant Services	0,498
231	Hospitality Services	0,753
233	Road Transport Services	1,054
257	Bank	1,403
258	Other Financial Institutions	1,873
271	Research and Development of Technology and Engineering Science (Private)	1,688
278	Research and Development of Technology and Engineering Science (Government)	0,100

If the calculated average value of the value of the degree of sensitivity index in table III, then the value will be an average of 0.98. From table III it can be seen that the value of the degree of sensitivity index of the cocoa industry sector is under the average of 0.98. In this case, it is known that cocoa industry sector is not a domestic-oriented industries because it has a degree of sensitivity index values below the average. That is, the cocoa industry sector is more to sell its output to meet the needs of final demand (e.g. cocoa beans are available in the country directly exported abroad without any further processing to obtain value-added). Thus it can be said that the cocoa industry sector has a weak forward linkages to other sectors in the national economy.

Power of dispersion index is a quantity that indicates the impact that occurs on the output of a sector as a result of changes in final demand of a sector of the economy of the entire output of the economic sector in a region or country. This index is a measure of the spread is to look backward linkages economic sectors in a region or country [14].

TABLE IV
POWER OF DISPERSION INDEX COCOA INDUSTRY AND
RELATED SECTORS OF COCOA

I-O Code	Sectors	Power of Dispersion Index
22	Cocoa	0,420
40	Agricultural Services	0,449
64	Ice Cream Industry	1,556
84	Chocolate and Candy	1,324
92	Cakes Industry	1,618
95	Concentrated Animal Feed Industry	1,603
122	Single Primary Macro Nutrients Artificial Fertilizer Industry	0,893
129	Pesticide	1,271
133	Pharmaceutical Industry	1,423
198	Agricultural Infrastructure	1,293
199	Roads, Bridges and Ports	1,292
229	Other Trade Services	0,803
230	Restaurant Services	1,351
231	Hospitality Services	0,927
233	Road Transport Services	1,270
257	Bank	0,830

258	Other Financial Institutions	0,828
271	Research and Development of Technology and Engineering Science (Private)	0,948
278	Research and Development of Technology and Engineering Science (Government)	1,233

If the calculated average value of the power of dispersion index in table IV, it will obtain an average value of 1.13. From table IV it can be seen that the cocoa industry sector is not a sector of the domestic industry based on the input side because it has an power of dispersion index is less than one or less than the average value of the scatter index. That is, the cocoa industry sector is less use of intermediate inputs from domestic production. In the other words, the cocoa industry sector more use imported inputs (e.g. high-tech machines for processing cocoa imported from abroad because some processing machines are not fully produced in the country). So, it can be said that the cocoa industry sector has a weak backward linkage to other sectors in the national economy.

In the case of forward linkage, it is known that the cocoa industry sector is not a domestic-oriented industries because more sells its output in the form of exports abroad. This is indicated by the degree of sensitivity index value smaller than the average value of the degree of sensitivity index. Thus, it can be said that the cocoa industry sector has a weak forward linkages to other sectors in the economy.

In the case of backward linkages, it is known that the cocoa industry sector is not a domestic input-based industrial sector because it has an average value of the power of dispersion index is smaller than the average value of the power of dispersion index. Thus, it can be said that the cocoa industry sector has a value of weak backward linkages to other sectors in the economy.
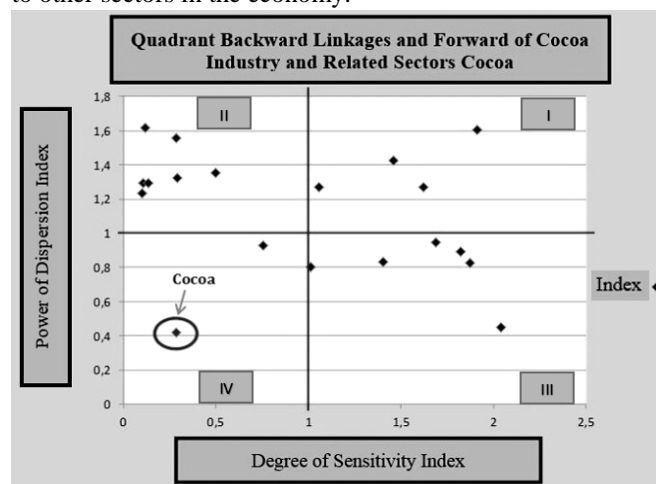

Figure 4. Inter-Sector Linkage Diagram and Related Cocoa Industry

Based on the data processing input-output table is obtained distribution related industries cocoa. Chart linkages between sectors of the economy showing the position of each sector of the economy associated with the degree of sensitivity index and the power of dispersion index. The usefulness of this chart is to find a strong and/or weak linkages between sectors of the economy so that it can be done the preparation of an economic development strategy for a region or country.

To see the position of the cocoa industry sector position in

relation to other industrial sectors, use the chart/diagram 4 quadrants linkages between sectors are processed from the power of dispersion index and the degree of sensitivity index [14]. Based on the picture can be seen that the cocoa industry sector is in Quadrant IV. That is, the cocoa industry sector is underdeveloped industrial sector in Indonesia because it has power of dispersion index and degree of sensitivity index indices are weak. In other words, the Indonesian cocoa industry sector is underdeveloped industrial sector, both in terms of the input and output side.

Agricultural services sector plays an important role for human resources contained, it can act as a liaison/intermediary between the upstream and downstream sides of cocoa, i.e. between farmers and producers/manufacturers of technology that can improve the quality of cocoa cultivation required by the industry. For example, the use of agricultural extension workers can make the delivery of information about the use of fertilizer produced SRF national research institutions to farmers will be able to increase the use of fertilizers SRF and desired quality of the cocoa beans processing industry. Sector banks and financial services sector plays an important role because these sectors can create schemes/financing mechanisms and financing legal and appropriate, in accordance with the needs of farmers and the industry in the development process and the cultivation of the national cocoa industry.

Sector research and development of science and engineering technology (both private and government) also plays an important role in the creation of innovative products needed cocoa sector. To be able to produce innovative products needed interaction/cooperation between actors in the field of continuous research and development of science and engineering technology, namely academia, government research institutes and private research institutions in an innovation system framework. Thus, it is expected to occur and continuous cooperation is able to improve the competitiveness of the national cocoa industry through the creation of innovative products needed national cocoa industry.

In terms of output, it is known that the output of the cocoa sector more distributed to meet the needs of final demand. Things that need to be explored further is wherever the cocoa output distributed to meet final demand and on what components of the cocoa sector more distributed. For it is worth exploring further IO table used in the distribution of final demand cocoa sector. The following table shows the value distribution of the final demand cocoa sector.

TABLE V
DISTRIBUTION OF FINAL DEMAND COCOA SECTOR

Distribution of Final Demand Cocoa Sector	Value Distribution
Consumption	0.027
Government Spending	0
Gross Fixed Capital Formation	0.003
Change in Stock	0.0116
Export	0.819

The small size of the output distribution for the cocoa industry sector gross fixed capital formation that is the one of the causes of the weakness of the cocoa industry sectors to improve competitiveness.

In conjunction with the output distribution, the next question is where the primary input distribution or

commonly known as gross value added. In order to determine the distribution of the primary input, needs to be more data on the IO table below.

TABLE VI
DISTRIBUTION OF GROSS VALUE ADDED COCOA INDUSTRY SECTOR

Distribution of Gross Value Added	Value Distribution
Wages and Salaries	0.146
Surplus Business	0.642
Shrinkage	0.003
Indirect tax	0.005
Subsidy	0

From the table it can be seen that the distribution of primary inputs or commonly known as Gross Value Added has been enjoyed by employers as operating surplus by 81%. As for the acquisition of operating surplus is largely in the form exports of cocoa beans that have not been processed further. The second largest portion of gross value added enjoyed by workers in the form of wages and salaries, which amounted to 18%. The remaining 1% enjoyed by the government in the form of indirect tax revenue.

V. CONCLUSION

We propose that the cocoa industry has added value among entities is still low, indicated by inter-sector linkage diagram. It can be said that cocoa industry sector in Indonesia is weak or underdeveloped and dependent on conditions national economy. Things to do was increase the cocoa derivative products in the form of cocoa paste, cocoa butter, cocoa powder, cocoa cake and cocoa liquor at the stage of processing. It can provide value added between industrial entities. Also, it can be an increase in the use of cocoa products for domestic production in ice cream industry, chocolate and candy industry, cakes industry, pharmaceutical industry, restaurant services, and hospitality services.

Cocoa output should distributed to meet the demand end of the consumption component. This is a significant effect on improving competitiveness caused by the added value given to domestic consumption. The distribution of primary inputs or commonly known as gross value added, more distributed on operating surplus, mostly in the form of exports of cocoa beans that have not been processed further so that value added is low.

Future research is needed to study the appropriate policy to leverage the resources related industries in order to increase the value added between industry entities. In addition, needed to study about the sustainability of the national cocoa industry sector by considering the investment credit mechanism and policy research budget in favor of the development of the cocoa sector.

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