Analysis of comparative and competitive advantages of maize, rice and cocoa commodities in Gorontalo, Indonesia

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Abstract. The objectives of the study were to determine the profitability, comparative and competitive advantages, and to analyze the impact of government policies on the competitiveness of maize, rice and cocoa farming in Gorontalo Province, Indonesia. The study was conducted in 5 districts on 2019. The Policy Analysis Matrix (PAM) was used. Maize, rice and cocoa farming in Gorontalo was profitable and feasible to implement; based on the value of private profitability and social profitability and the value of RC-ratio. Maize, rice and cocoa farming in Gorontalo had a competitive advantage of 0.74, 0.58 and 0.31 respectively. Maize, lowland rice and cocoa commodities had comparative advantages of 0.5, 0.5 and 0.27 respectively. The results of the PAM analysis showed that regional policies on the three commodities were a disincentive to output. To increase the competitiveness of maize, rice and cocoa farming in Gorontalo, it is necessary to control the output price at the farmer level; so that prices are not manipulated by collectors and the price received is in accordance with the government purchase price. This imply the need to increase technical efficiency, allocative efficiency, and improve the quality of results through intensive application, technology assistance and counseling.

1. Introduction
Maize is one of the leading food crop commodities and the main export commodity of Gorontalo Province, Indonesia. The export volume in 2008 reached 8,4448 tons, and was the largest in the first 10 years. In the following years the volume of maize exports fluctuated. In 2011, maize exports fell dramatically to only 8,400 tonnes [1]. In 2012, Gorontalo maize exports increased again to 28,500 tonnes, however in 2013 there was no maize export [2]. The largest export of Gorontalo maize occurred in 2015, reaching 109,599 tonnes, but in 2016 there was no export of maize again. In 2018 maize exports reached 9,000 tonnes [3]. This condition reflects the production and cultivation constraints of maize which can be caused by various factors such as climate change, production efficiency, price levels, and changes in the level of competitiveness of maize in Gorontalo. In 2014, 2015 and 2017, maize commodity in Gorontalo had strong competitiveness, but in 2013 and 2016 competitiveness decreased because there was no export [4]. In a 2018 study, maize farming in Gorontalo was technically inefficient and had no competitiveness [5]. At the national level, maize farming in Indonesia has strong competitiveness [6,7].

Meanwhile, another main food crop commodity of Gorontalo, namely rice, is facing the problem of widespread conversion of rice fields into settlements, offices and shops, as well as the high rate of pest and disease attacks in recent years, threatening rice production and productivity in Gorontalo. Data
shows that the growth of rice fields in Gorontalo has decreased, namely -0.80% [8]. Another problem is the price of rice in the local market which is very volatile. This condition will have an impact on changes in the competitiveness of rice commodities compared to maize in Gorontalo. According to a research [9], rice farming in Gorontalo does not have a comparative advantage and is not financially profitable if farmers only apply a rice monoculture system with a relatively small land area.

On the other hand, the Gorontalo government is also serious in developing a plantation commodity, namely cocoa, with a one million cocoa program to increase regional income and farmers’ income. Cocoa is a commodity for international trade that has high value, and Indonesia is the third largest cocoa producer in the world [10]. The planted area for cocoa in Gorontalo in 2019 reached 14,938 ha, with the largest planted area in Pohuwato and Boalemo Districts [3]. The problem is that currently many maize farmers have switched to cocoa, so it is feared that the level of competitiveness of maize as the second staple food in Gorontalo will gradually be displaced by cocoa.

A database of competitiveness levels (comparative and competitive advantages) for maize, rice, and cocoa on a sustainable basis is needed, to determine whether these commodities have increased or decreased competitiveness in the current year. This is because the comparative advantage is dynamic and at any time the advantages it possesses can be taken over by other commodities in one area and / or other commodities from other countries. For this reason, it is important to update data on the level of competitiveness of corn, rice and cocoa in Gorontalo, as a reference for local governments in determining policies so that Gorontalo maize and paddy commodities remain competitive, and cocoa as an export commodity can still be developed without sacrificing other commodities.

The objectives of this study were to: 1) determine the profitability of maize, rice and cocoa farming, 2) to determine the comparative and competitive advantages of maize, rice and cocoa farming, 3) to determine the impact of government policies on the competitiveness of maize, rice and cocoa farming in Gorontalo Province, Indonesia.

2. Research methods

The study was conducted in five regencies in Gorontalo Province, namely Gorontalo Regency, North Gorontalo, Boalemo, Pohuwato and Bone Bolango in 2019. The research location was determined purposively based on the consideration of the potential for developing maize, rice and cocoa farming in the form of productivity levels and the distance to the provincial capitals and regency cities.

This study uses primary and secondary data. Primary data were collected using a survey method using a structured questionnaire list and in-depth interviews with 180 respondent farmers scattered in maize, rice and cocoa production centers in Gorontalo. Observations were made at the farm household level (RTT). Determination of respondents using simple random sampling method. Meanwhile, for other respondents who acted as key informants such as Field Agricultural Extension (PPL), the collecting traders were purposive as many as 20 people (PPL 15 and 5 traders) in order to facilitate the acquisition of more in-depth and targeted information. Secondary data were obtained from the Provincial and Regency/City Central Statistics Agencies (BPS), Provincial and Regency/City Agriculture Offices, Provincial and Regency/City Regional Development Planning Agencies (BAPPEDA), Provincial and Regency/Municipal Industry and Trade Offices, Customs and Excise Anggrek Kwandang Harbor and Gorontalo City, as well as Gorontalo Pelindo.

The study used the Policy Analysis Matrix (PAM) analysis method with the formula presented in table 1. From this data (Table 1), various indicators were analyzed as follows:

2.1. Profit analysis

2.1.1. Private profitability: \( D = A - (B + C) \). Private profitability is an indicator of the competitive advantage of a commodity system based on technology, output value, input costs and existing policy transfer. If \( D > 0 \), it means that the commodity system is making a profit above normal. This implies that the commodity is capable of expansion, unless resources are limited or there are alternative, more profitable commodities.
2.1.2. Social profitability: \( H = E - (F + G) \). Social profitability is an indicator of comparative advantage or efficiency of a commodity system in conditions where there is no divergence and efficient policy implementation, if \( H > 0 \). Conversely, if \( H < 0 \), it means that the commodity is unable to compete without assistance or intervention from the government.

**Table 1. Policy analysis matrix analysis method**

| Description                          | Revenue | Cost                                  | Profit         |
|--------------------------------------|---------|---------------------------------------|----------------|
| Financial value (private price)      | A       | B                                     | C              | \( D = A - B - C \) |
| Economic value (social price)        | E       | F                                     | G              | \( H = E - F - G \) |
| Divergence / policy impact and market distortions | I = A - E | J = B - F | K = C - G | \( L = D - H = I - J - K \) |

*aSource : [11]*

Note: \( D = \) private profitability; \( H = \) social profitability; \( I = \) output transfer; \( J = \) input transfer; \( K = \) factor transfer; \( L = \) net transfer

2.2. Analysis of comparative and competitive advantage

2.2.1. Domestic resource cost ratio (DRCR) = \( G / (E - F) \). The DRCR value is an indicator of the capacity of the commodity system to finance domestic factors at social prices. If the DRCR is \( > 1 \) then the commodity system cannot survive without government assistance or intervention. Thus, wasting scarce domestic resources. Conversely, if the DRCR is \( < 1 \) and or smaller, the commodity system will be more efficient and have high competitiveness (comparative advantage).

2.2.2. Private cost ratio (PCR) = \( C / (A - B) \). The PCR value describes how much the commodity system can generate to pay for a domestic factor and remain in a competitive condition. If the PCR is \( < 1 \) and or the value is smaller, it means that the production system of a farm is able to finance its domestic factors at private prices and its capacity is increasing or has a competitive advantage.

2.3. Impact of government policy

2.3.1. Output policy. (1) Output Transfer: OT (I) = A - E: If the value of OT is \( > 0 \) indicates a transfer from society (consumers) to producers, and vice versa. In the sense that society buys and producers receive a price higher than the price it should be, vice versa if OT is \( < 0 \) (negative). (2) Nominal Protection Coefficient on Output: NPCO = A / E : is the revenue ratio calculated based on the private price to the revenue calculated based on the social price which is an indication of the output transfer. NPCO shows the impact of policies (market failures that are not corrected by efficiency policies) that cause divergences between private and social prices to output prices. The policy is protective towards output if the NPCO value is \( > 1 \) or in other words the government raises the output price in the domestic market above its efficient price (world price), and vice versa, the policy is disincentive if the NPCO is \( < 1 \).

2.3.2. Input policy. (1) Input Transfer: IT (J) = B - F. If the value of IT is \( > 0 \) (positive), this indicates a transfer from producer farmers to tradable input producers, and vice versa, or in other words, it shows the amount of transfers (incentives) from producers to the government through the application of import tariff policies. (2) Nominal Protection Coefficient on Input: NPCI = B / F: an indicator showing the level of government protection against domestic agricultural input prices. The policy is protective towards input if the NPCI value is \( < 1 \), it means that there is a subsidy policy for tradable inputs.
Conversely, if NPCI > 1 means that the government increases the price of tradable input in the domestic market above its efficient price. This implies that the sector that uses the input price will suffer from the high purchase price of production inputs. (3) Factor Transfer: FT (K) = C - G. If the FT value is > 0 or positive, it means that there is a transfer from producer farmers to non-tradable input producers, or in other words there is a government policy that protects domestic factor producers by providing positive subsidies, vice versa, if negative or FT < 0 then the policy is more in favor of farmers.

2.3.3. Input-output policy. (1) Effective Protection Coefficient: EPC = (A - B) / (E - F). The policy is still protective if the EPC value is > 1. The greater the EPC value, the higher the level of government protection for domestic agricultural commodities. Conversely, if the EPC value < 1, the government policy will not run effectively. (2) Net Transfer: NT (L) = D - H. The value of NT > 0, indicates additional producer surplus caused by government policies applied to input and output, and vice versa. (3) Profitability Coefficient: PC = D / H. If PC > 0, it means that the overall government policy makes the profits received by producers smaller than without the policy. This means that producers must spend a certain amount of funds to the public (consumers). (4) Subsidy Ratio to Producer: SRP = L / E or (D - H) / E. If the SRP value < 0 (negative) indicates that the prevailing government policies have caused producers to spend more production costs than the opportunity cost, and vice versa.

3. Results and discussion

3.1. Farm profitability

Based on the analysis of private costs and benefits, it showed that the farming of maize, lowland rice and cocoa, whether in terms of domestic factors, incurs land rental costs or not, were considered profitable. Meanwhile, social or economic cost and benefit analysis showed that the cultivation of maize, rice and cocoa were profitable. Where the value of profitability, the size of the private benefits enjoyed by farmers, both for food crop commodities and plantations, was lower than the economic benefits. This phenomenon was an indication that the input price paid by farmers was higher and/or the output price received by farmers was lower than the social price. This means that farmers in the research location experience disincentives in producing the three commodities in their development if there were other commodities that have higher financial competitiveness.

The results of the profitability analysis of maize, rice and cocoa commodities in Gorontalo are presented in table 2.

Table 2. Financial and economic analysis of maize, lowland rice and cocoa farming in gorontalo province per planting season in 2019.

| No | Commodity | Financial | Economy |
|----|-----------|-----------|---------|
|    |           | Net Profit (IDR/season) | Net Profit (IDR/season) | Net Profit (IDR/season) |
|    |           | No include land | Include land | No include land | Include land |
| 1  | Maize     | 4,277,410 | 1.8 | 2,230,410 | 1.3 | 7,855,846 | 2.4 | 5,808,846 | 1.7 | Feasible |
| 2  | Rice      | 14,019,891 | 2.2 | 11,519,891 | 1.8 | 15,086,429 | 2.02 | 12,586,429 | 1.7 | Feasible |
| 3  | Cocoa     | 9,500,327 | 2.90 | - | 10,896,467 | 3.23 | - | Feasible |

Source: Primary Data, 2019

It can be seen in table 3 that the private value of maize farming was smaller than the social profitability compared to the private profitability of lowland rice farming. This difference occurs in
maize farming, presumably due to the practice of monopsony in the research location. The reality in the field showed that the dependence of farmers on village collector traders, or in other words, collector traders in each research village are the only buyers of crops and are the place where farmers depend for financial aspects and input procurement. So that these collector traders have the power to control the input and output markets, as a result, the selling price of inputs is high while the purchase price of output is suppressed. This result is in line with Pearson S et al [12] that one of the causes of divergence is market failure, where one of the causes is the practice of monopsony (buyers control the market price).

Another cause of divergence is distorted government policies. The application of distortionary policies to achieve goals that are non-efficient (equity or food security) will hamper the efficient allocation of resources and will automatically create divergences. For example, rice import tariffs are applied to increase farmers’ income (equalization purposes) and increase domestic rice production (food security purposes), but on the other hand it will cause efficiency losses if the price of imported rice it replaces is cheaper than the domestic costs used to produce it. domestic rice, so a trade off will arise [12]. Policymakers must give certain weight to each of these conflicting objectives to determine whether the import tariff policy should be applied or not.

**Table 3.** Results of policy analysis matrix analysis of maize, rice and cocoa farming in gorontalo province.

| Commodity | PAM Analysis | Revenue | Tradable inputs | Domestic factors | Profit |
|-----------|--------------|---------|-----------------|-----------------|--------|
|           |              |         |                 | Labor | Capital and Land |
| 1. Maize  | Private      | 9,524,416 | 1,677,882       | 3,593,076 | 2,242,748 | 2,010,710 |
|           | Social       | 13,296,671 | 1,867,251       | 3,593,076 | 2,177,499 | 5,658,846 |
|           | Divergensi   | -3,772,255 | -189,369        | 0      | 65,249   | -3,648,135 |
| 2. Rice   | Private      | 25,986,300 | 3,916,100       | 9,809,304 | 3,004,005 | 9,256,891 |
|           | Social       | 29,737,889 | 4,506,153       | 9,809,304 | 2,836,003 | 12,586,429 |
|           | Divergensi   | -3,751,589 | -590,053        | 0      | 168,002  | -3,329,537 |
| 3. Cocoa  | Private      | 14,500,000 | 1,963,879       | 3,714,000 | 148,794  | 8,673,327  |
|           | Social       | 15,766,379 | 1,883,716       | 3,714,000 | 99,196   | 10,069,467 |
|           | Divergensi   | -1,266,379 | 80,163          | 0      | 49,598   | -1,396,140 |

*Source: Primary Data, 2019

3.2. Comparative and competitive advantage

The results of PAM analysis for maize, rice and cocoa commodities in Gorontalo can be seen in table 4. The PCR values of maize, rice and cocoa farming based on the results of PAM analysis showed that the PCR values were 0.74, 0.58 and 0.31, respectively. These results indicate that maize, lowland rice and cocoa farming in Gorontalo Province had a competitive advantage because it had a PCR value ≤1. This means that financially the three commodities had competitiveness at the farm level. From the PCR value of the three commodities, it can be seen that cocoa had the highest competitiveness (competitive advantage) with a PCR value of 0.31. This means that to produce Rp. 1 added value, Rp. 0.31 of domestic resources is needed, the most efficient compared to the other two commodities. The results of the analysis showed that lowland rice farming had more competitiveness (competitive advantage) than maize farming.

**Table 4.** Results of policy analysis matrix for maize, rice paddy and cocoa commodities.

| No | Commodity | Simulation Analysis | Note                                      |
|----|-----------|---------------------|-------------------------------------------|
|    |           | PCR | DCR |                  |                                           |
| 1  | Maize     | 0.74| 0.50| Had a competitive and comparative advantage |
| 2  | Rice      | 0.58| 0.50| Had a competitive and comparative advantage |
| 3  | Cocoa     | 0.31| 0.27| Had a competitive and comparative advantage |

*Source: Primary Data, 2019*
The three DRCR values of the three commodities showed that maize, rice and cocoa farming still had a comparative advantage with DRCR values of 0.50, 0.50, 0.27 respectively. This value means that to produce maize, rice and cocoa in Gorontalo, it only requires domestic resource costs of 50%, 50% and 27% of the required import costs, respectively. In other words, for every US $ 1.00 needed to import these products, it only requires domestic costs of US $ 0.50, US $ 0.50, and US $ 0.27 for the production of maize, rice and cocoa.

DRC < 1 and PCR < 1 values indicated that the researched cultivation of maize, rice and cocoa had comparative and competitive advantages. This means that to produce one-unit value added output at the social price and the private price, it only takes less than one unit of domestic resource cost. This result is different from the study Mantau Z et al [5] that maize farming in Gorontalo has no competitive or comparative advantage, with PCR and DRCR values of 3.81 and 1.85.

3.3. Government policy impact analysis

The results of the analysis on the impact of government policies are shown in table 5. The results of farm output transfer (OT) for the three commodities in table 5 showed a negative value, meaning that the output price in the domestic market was lower than the international price. The OT results were also supported by the NPCO (Nominal Protection Coefficient Output) values for maize, lowland rice and cocoa, which were 0.72, 0.87 and 0.92. It means that because of the tax levy policy on these three commodities in Gorontalo, the total output value of maize (28%), lowland rice (13%) and cocoa (8%) was lower than the efficiency price (international price). This indicates that regional policies regarding maize, rice and cocoa farming were disincentive to output. This means that there was no government assistance or intervention either through purchase price subsidies or protection or control over purchasing prices at the market level for the output of these three commodities. The condition that occurs in the field was that the price received by farmers tends to be lower than the government purchase price because the price was determined by middlemen or collecting traders. This occurs because there was no control or supervision in the field from the government to maintain the minimum output price according to government purchase price.

The Nominal Protection Coefficient of Input (NPCI) values for maize and rice farming were 0.90 and 0.87 (NPCI < 1), which means that the government policy was protective of maize and rice production inputs in Gorontalo. In contrast, the NPCI value for cocoa farming was 1.04, which means that government policies tend to be less protective of cocoa production inputs. The fact in the field was that there were government subsidies for the input of seeds and fertilizers to maize and rice farmers. The fertilizer input subsidies carried out so far had been ineffective [9,13]. According to Mantau Z et al [9], it was ineffective because in reality farmers have to spend additional money, namely transportation costs to buy subsidized fertilizers. However, in reality input subsidies were very meaningful for farmers because they can increase their farming efficiency, that is, they can reduce production costs and increase farming profits. Sibande L et al [14] revealed that input subsidies for farmers have an impact on increasing the productivity of maize farmers in Malawi. As an alternative, Susila W R [15] suggested two alternatives to fertilizer subsidies to make them more effective, namely 1) direct subsidies in the form of inputs that are easier to distribute and achieve more effective targets, such as seed subsidies or credit subsidies, and 2) indirect subsidies in the form of facilitation of farmers supports increased productivity, for example machine subsidies, improvement of agricultural infrastructure and marketing systems.

The value of Effective Protection Coefficient (EPC), Net Transfer (NT), Profitability Coefficient (PC) and Subsidy Ratio to Producers (SRP) for farming of the three commodities in Table 5 showed that in general these results indicated a low level of protection for farmers' maize yields, which impact on reducing the surplus of producer farmers. The PC values showed that the profit ratios of maize farming were only 36%, 74% and 86% or with a negative NT IDR -3,648,135, IDR -3,329,537 and IDR -1,396,140 only brought profit ratios of 36%, 74% and 86%. The SRP value means that the government should be able to implement an import tariff policy on imported products of 27%, 11% and 9% so as to increase the selling price of domestic products, the impact on increasing the level of
farmer acceptance and private profitability. In conclusion, the low level of government protection for farmer yields causes most government policies regarding the farming of these three commodities to run ineffectively, this is indicated by the EPC value which is less than one. There is a negative divergence between private and social benefits (net transfer) indicating that there is a tax effect on producers (farmers) [16]. Tax effects can be from government intervention or market imperfections or both.

**Table 5.** Results of analysis of the impact of government policies on maize, rice and cocoa farming in Gorontalo province*

| Commodity | Policy Impact Indicator | Value       |
|-----------|-------------------------|-------------|
| 1. Maize  | Output Transfer (OT)    | IDR. -3,772,255 |
|           | Nominal Protection Coefficient Output (NPCO) | 0.72 |
|           | Input Transfer (IT)     | IDR. -189,369  |
|           | Nominal Protection Coefficient of Input (NPCI) | 0.90 |
|           | Factor Transfer (FT)    | IDR. 65,249    |
|           | Effective Protection Coefficient (EPC)  | 0.69 |
|           | Net Transfer (NT)       | IDR. -3,648,135  |
|           | Profitability Coefficient (PC) | 0.36 |
|           | Subsidy Ratio to Producers (SRP) | -0.27 |
| 2. Rice   | Output Transfer (OT)    | IDR. -3,751,589  |
|           | Nominal Protection Coefficient Output (NPCO) | 0.87 |
|           | Input Transfer (IT)     | IDR. -590,053   |
|           | Nominal Protection Coefficient of Input (NPCI) | 0.87 |
|           | Factor Transfer (FT)    | IDR. 168,002    |
|           | Effective Protection Coefficient (EPC)  | 0.87 |
|           | Net Transfer (NT)       | IDR. -3,329,537  |
|           | Profitability Coefficient (PC) | 0.74 |
|           | Subsidy Ratio to Producers (SRP) | -0.11 |
| 3. Cocoa  | Output Transfer (OT)    | IDR. -1,266,379  |
|           | Nominal Protection Coefficient Output (NPCO) | 0.92 |
|           | Input Transfer (IT)     | IDR. 80,162     |
|           | Nominal Protection Coefficient of Input (NPCI) | 1.04 |
|           | Factor Transfer (FT)    | IDR. 49,598     |
|           | Effective Protection Coefficient (EPC)  | 0.90 |
|           | Net Transfer (NT)       | IDR. -1,396,140  |
|           | Profitability Coefficient (PC) | 0.86 |
|           | Subsidy Ratio to Producers (SRP) | -0.09 |

*Source: Primary Data, 2019

4. Conclusions and suggestions

Maize, rice and cocoa farming in Gorontalo was profitable and feasible to implement, based on the value of private profitability and social profitability value > 0, and the value of the RC-ratio > 1. Maize, rice and cocoa farming in Gorontalo Province had a competitive advantage because it had PCR values < 1, namely 0.74, 0.58 and 0.31 respectively. This means that financially the three commodities had competitiveness at the farm level. Maize, lowland rice and cocoa farming in Gorontalo Province had a comparative advantage because it had a DRCR < 1, namely 0.5, 0.5 and 0.27, respectively. Regional policies regarding maize farming were disincentive to output. There had been no intervention, protection or control over purchasing prices at the farm level for the output of these three commodities.

To increase the competitiveness of maize, rice and cocoa farming in Gorontalo, it is necessary to determine the regional purchase price and the existence of supervision or control at the field level, so that prices at the farmer level are not manipulated by collector traders. Policies in maize, rice and cocoa farming: increasing technical efficiency (productivity), allocative efficiency, and increasing the
quality of products through intensive technology assistance and counseling. It is necessary to develop cocoa derivative products so that not only primary products such as raw cocoa beans, but also efforts to shift excellence from primary products to processed cocoa products such as cocoa powder and cocoa butter are necessary because they have a greater added value than exports of cocoa beans.

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