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A Model Policy to Increase Maize Production and the National Economy

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Abstract

Regional economic development has many aspects that continue to change dynamically, planned and coordinated when viewed from a planning framework of the regional economic development, whether regionally, nationally or internationally. The regional economic development is aimed to the achievement of national development sub-system targets that organized territorially or spatial. The research method that was used is a dynamic system approach. The data that were used are secondary data obtained from various instances. Method of data analysis used dynamic system software. The results showed exponential growth trend of maize production. The pattern illustrates that an increase in national maize production over time. Developed scenarios model with scenario#1 (extension of planting areas increased from 4% to 8% per year) and scenario#2 (land intensification with an average of the increase of land productivity was 2.0 tonnes per hectare per year), could answer the national maize availability. Availability of national maize that supports the increasing of the national economy, with an increase in production by 7.03 percent in 2015, so that it made an increase of 3.77 percent of the national economy.

Keywords: Meize production; national economics; regional economics; dynamic models.

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1. Introduction

The regional economic development is an increase of people's income which is the increase of entire added value that occurred in that region. The increase of people income measured in riel value, it means that expressed in constant price. It also illustrates the recompense for production factors that are operating in the area (land, capital, labor, and technology). The prosperity of the region also depends on how much of transfer-payment that occurred which is a part of income that flows out of region or gets the fund from outside of region. It also stated that economic development is the increase proses of per capita output in the long term [1, 2]. Furthermore Tarigan, 2002 stated that regional income is the people's income level in the analysis area. The income level can be measured from the income total of region or the average income of people in that region. The development region should be concerned with the increase of people's income in that region and commonly it means the average income (income per capita) of the community. Basically, the development of region was done by utilizing natural resources optimally through the development of local economy, based on economic activity occurred in the region. Broadly, the development of region defined as an attempt to formulate and apply a theoretical framework into economy policy and the development program including the consideration of region aspect by integrating the social aspects and environment aspects toward the achievement of optimal and sustainable prosperity [3]. The regional economic development has many aspects that continue to change dynamically, planned and coordinated when viewed from a planning framework of the regional economic development, whether regionally, nationally or internationally. The regional economic development aimed to the achievement of national development sub-system targets that organized territorially or spatial. Although practically, the regional economic development needs to enforce the basic explanation that is theoretical which has a relationship between the regional economic development and spatial planning. In other words, the process of regional economic development must consider the approach of spatial planning aspect such as region, geographical, human resources, interaction between regions. The increase of regional income should prioritize the use of local resources, especially on labor. Due to the use of existing resources, it is resulting in a lower margin cost for the provision of labor operations and it has an impact in reducing the unemployment rate of the region. Utilization of domestic resources should be adjusted to the characteristics and potential of a region so that the formulation of policies accord with the region type. The regional development is an integral part of national development to achieve the development targets adjusted with potential and development problems in the region. By such treatments, the paradigm of economic development of the region are expected to be created, namely the strengthening of the economic base which has a principle of balance (equity) which supports economic growth (growth), and sustainability (sustainability), so that the core of development, namely sufficiency, self-esteem and freedom can be achieved by each person and the community through the construction [4]

2. Method

2.1. Data Collection Method

Data that were used in this research are secondary data, concerning with national maize production. Source of data obtained from reports, agricultural statistic books, and other secondary data. Methods of data collection, detailed as follows:

Table 1: Types and source of data

No	Type of Data	Source of Data
1	National maize production data (2010-2015)	Agriculture Ministry
2	Maize hectarage data (2010)	Agriculture Ministry
3	Productivity level of national maize land (2011-2015)	Agriculture Ministry
4	Land potential extensive of national maize	Agriculture Ministry
5	National maize price at the farmer level	BPS
6	The volume of maize consumption demand	BPS
7	The volume of maize demand as the raw material of feed and food industrial	BPS
8	Import and export volume of maize	BPS
9	The volume of national maize demand level (2011-2015)	BPS
10	Maize retribution value	BPS
11	Land tax value (PBB)	BPS
12	value-added tax (PPn)	BPS

2.2. Data Analysis Method

Data analysis method that was used in this research is dynamic system method. The use of dynamic system is more focused on the goal of the improved understanding about how the behavior arises from the policy structure in the system [5]. Furthermore, it mentioned that this understanding is very important in effective policy planning. According to [6] that the dynamic system is more on the goal to understand about how the behavior arises from the policy structure in the system, to design the effective policy that define a system as an entity, consisted of a part related to each other to achieve goals in complex environment. The analysis stages of dynamic system are as follows:

- Organizing causal loop diagram, which is the description of the relationship or structure linkage (between elements) in the model. The relationship can be unidirectional/semi direction (S) or opposite (O). Besides that, it also shows the loop of the model that was built, is it reinforcing (R) or balancing (B).
- Organizing the flow diagram; which is a description of causal loop diagram arranged in the form of a flowchart.
- Organizing a mathematical equation; which defines the existing variables in a mathematical unit.
- Inputting data in each variable, flow and stock/level.
- Running software

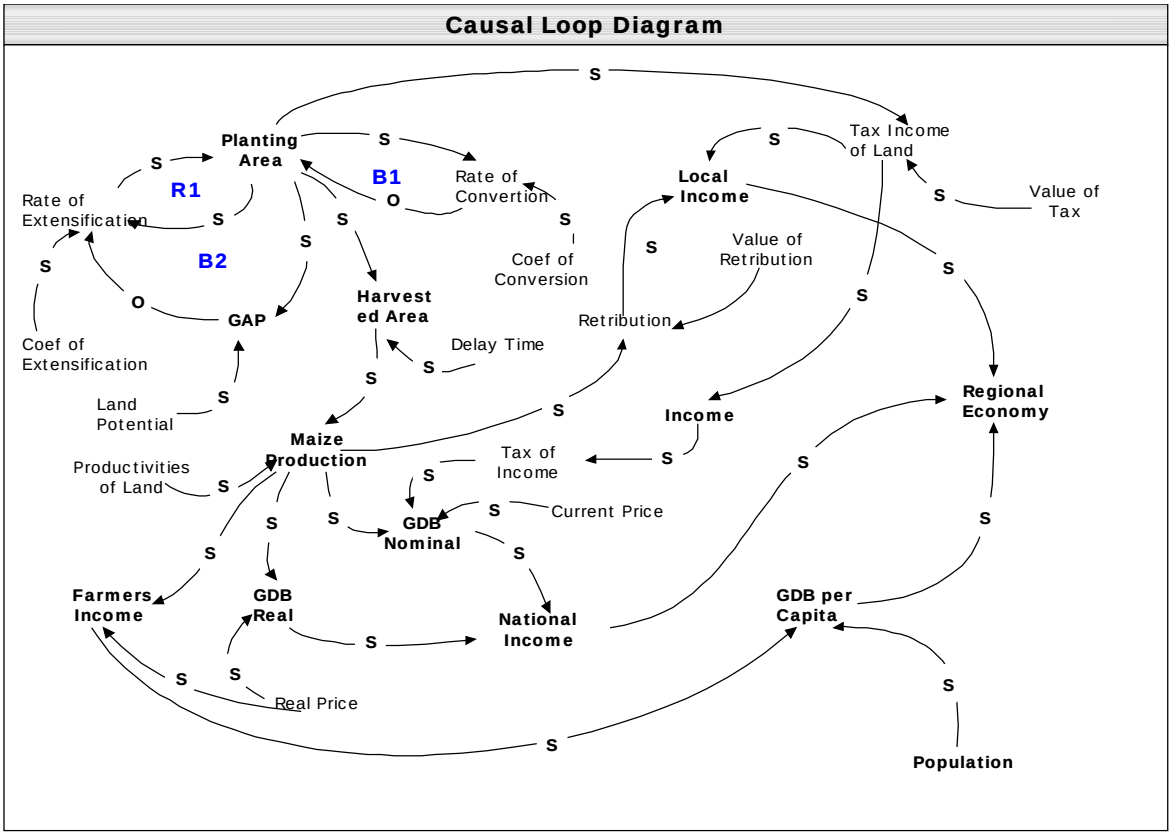

Figure 1: causal loop diagram

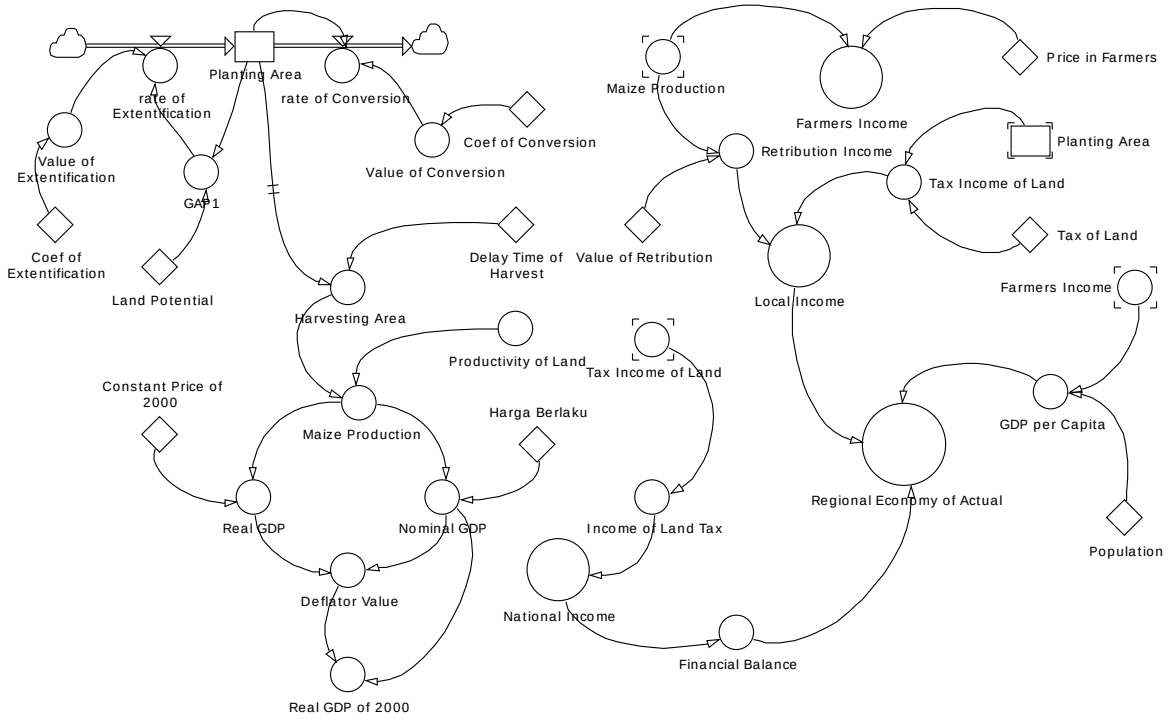

Figure 2: flowchart

Table 2: Mathematical equation

Variable	Defenition	Unit	Value
Planting area	Total national maize planted area in 2010	Ha	4,131,676
Harvested area	The total area of land that can be harvested annually	Ha	DELAYMTR(Planting Area*0.8,Delay Time, 1.4131676)
Extentification rate	The number of additional National maize planting area cultivated per year	Ha/yr	Potential Land*Coef of Extensification
Conversion rate	Total reduction in National maize planting area per year due to land conversion to other uses	Ha/yr	Coef of Conversion*Planting Area
Potential Land	Maximum target of national maize land area	Ha	17,757,652
Coef of Extentification	The growth rate of the National maize planting area per year	%/yr	0.04
Conversion coefficient of lhn	Conversion level of national maize potential areas per year for other land uses	%/yr	0.1
Land Productivity	National maize productivity level which is the ratio between production and harvest area per year	Tonne / Ha	GRAPH(TIME,2010,1,{4.44,4.57,4.90,4.84,4.96,5.18//Min:-1;Max:11////MIN:4,MAX:6//}<<1>>)
Delay Time	Estimated time of planting to harvest in one planting period	month	4
Maize Production	Production total of national maize per year	Tonne	Land Productivity*Harvested Area

- Validating structure which is a test of validity against the real condition. The test was carried out by using statistical methods [5,7], one of them is the test method of MAPE (Mean Absolute Percentage Error) or the median value of absolute percentage error by the formula:

$$MAPE = \frac{1}{n}\sum \frac{X_m - X_d}{X_d} x100\%$$

A model is very accurately depicting the actual condition if the value of MAPE is <5%, between 5%, until 10% includes quite right, and >10% is not accurate in describing the actual condition [8].

- Policy simulation (scenario model). A scenario was included to obtain the best model by making changes in the structure and variable as well as considering the time.

  In this research, the scenario made in two parts, namely a) Scenario-1; the increasing of production (through extension as much as 2% of the average in previous year which is from 4% to 6% per year), b) Scenario-2; by doing the intensification, by the increasing of land productivity which increased from 4,82 tonnes/ha to 5,82 tonnes/ha.

3. Results

3.1. Model Validation

A best model is a model that represents the actual condition, or a model that has a similarity with the actual condition [9]. The validation test was done against two sub main models, namely a production sub-model and a need sub-model.

3.1.1. Validation of Production Sub-model

The validation of production sub-model was intended to see the similarity between data of actual production and production data simulation results. Similarities between actual and model showed the validation level of the model. More detail can be shown as follows:

Table 3: The validation of maize production sub-model

Year	Actual Data (tonne)	Model Data (tonne)
2010	18.327.636	18.344.641
2011	17.643.250	17.937.671
2012	19.387.022	19.362.755
2013	18.511.853	19.899.187
2014	19.008.426	21.488.925
2015	21.621.435	23.721.387
	MAPE	3,19%

The MAPE value of production sub-model validation was 3, 19% which indicated the value of less than 5%. It can be concluded that the simulation of production sub-model which was done was valid and very appropriate to the real world.

Reference [8] stated that when a model has the MAPE value which is less than 5%, it means that the model can be classified as very accurate to depict the actual condition. It can be shown in the graph between actual data and model data in the period of 2010 to 2015. The graph can be shown in the figure below.

3.1.2. Validation of Need Sub-model

The validation of need sub-model was intended to see the similarity between the actual data of national maize demand rate with the simulation results data of national maize demand rate.

The similarities between the actual data and the model showed the level of the model validation model. More detail can be shown as follows.

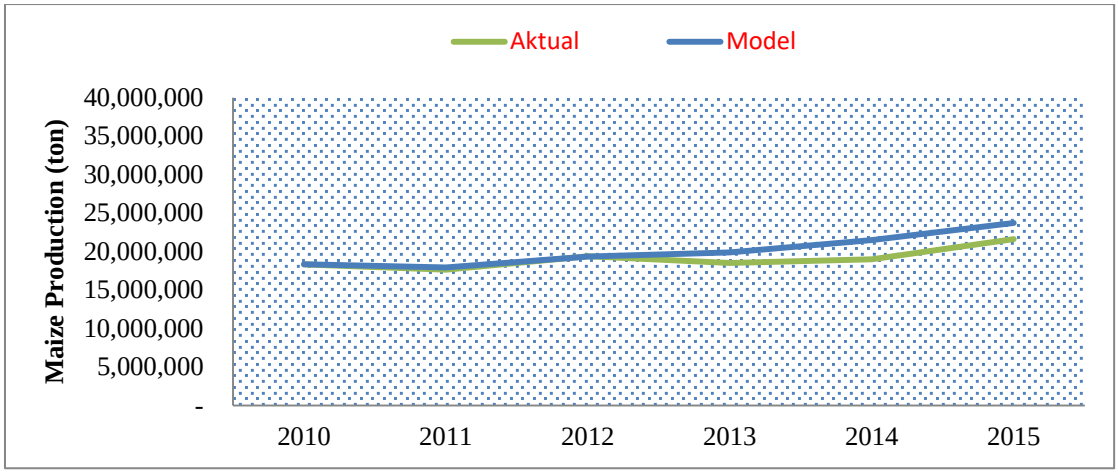

Figure 3: graph of maize production sub-model validation

Table 4: Validation of need sub-model

Year	Actual Data (tonne)	Model Data (tonne)
2010	28.273.501	28.273.501
2011	28.867.151	29.919.627
2012	30.362.342	31.668.038
2013	32.774.118	33.525.459
2014	34.311.986	35.499.076
2015	35.713.001	37.596.570
	MAPE	1,89%

The MAPE value of maize need sub-model validation gained 1,89%, showing a value of less than 5%. It can be concluded that the simulation of maize need sub-model that was done was valid and very appropriate to the real world. [8] stated that when a model has the MAPE value which is less than 5%, it means that the model can be classified as very accurate to depict the actual condition. It can be shown in the graph between actual data and model data in the period of 2010 to 2015. The graph can be shown in the figure below.

3.2. Model Behavior

Model behavior is a description of pattern/dynamics from model constructed. Model simulation was done in the period of 2010 to 2015. The simulation included: the simulation of production sub-model, the simulation of need sub-model, the simulation of supply-demand and the simulation of regional economy sub-model.

3.2.1. Simulation of Production Sub-Model

Production sub-model behavior was intended to see the dynamics pattern from production simulation in the period of 2010-2025. Production is an overview of supply to fulfill the national maize demand. Production is largely determined by the increase of land area planted and land productivity.

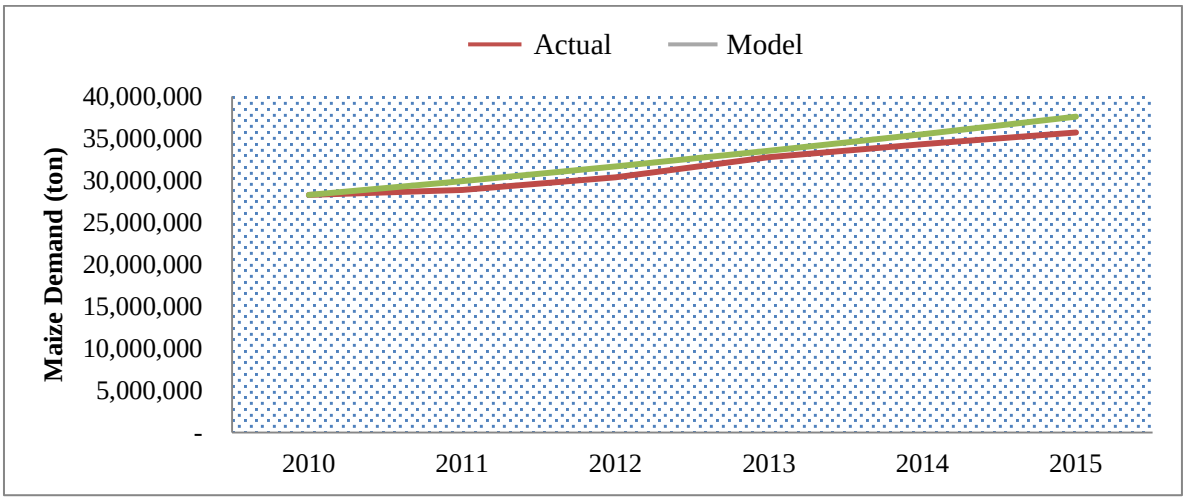

Figure 4: graph of maize need sub-model validation

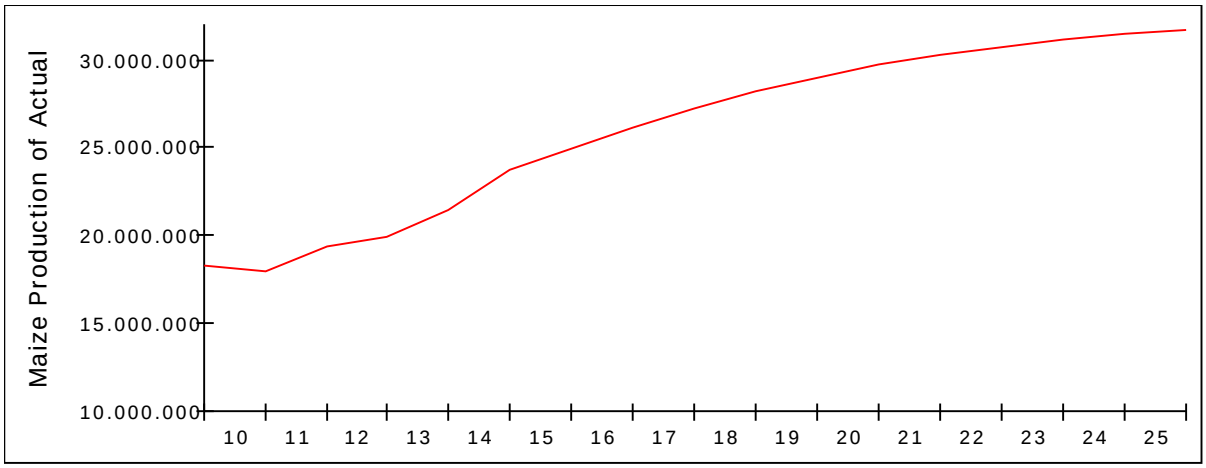

Figure 5: graph on maize production sub-model behavior (tonne)

National maize production in the last 5 years (2010-2015) showed a fluctuating production. The data showed that national maize production in 2015 reached 19.621.435 tonnes by total of demand level was 37.596.570 tonnes. Thus, the increasing of national maize production was needed, so that it can meet the national demand. Here is a graph of national maize production growth in the period of 2010-2025.

The simulation result showed that maize production model indicated trend and pattern of exponential growth, the maize production increased overtime. The significant growth occurred in 2015, 2014 to 2020. After 2020 the national maize production growth will slow. The slowdown was caused by the increase of planting area that was

starting to slow down as the declining potential of land to plant maize. National maize production in 2025 is estimated at 31.48 million tons. On the other hand, the production growth showed a slowdown graph over time, especially after 2023. The production growth was also seen very slow which only grew 1.0-2.0% per year. The increase of national maize production substantially can be further improved with an increasing of production factors such as the addition of planted area (extension) and increased productivity of planting areas (intensification). It can be done by looking at the land potential of maize, which reached 47,468,611 hectares, which by 2015 can just be planted about 4,131,676 ha, or approximately 8.70%. it is similar to the level of land productivity that has recently reached an average of 4.81 tonnes / ha.

3.2.2. Need Sub-Model Behavior

Need sub-model behavior was intended to see the dynamics pattern from the simulation of national maize demand including the need for consumption, the need for feed ingredients and the need for the food industry, in the period 2010-2025. The need is a picture of demand of maize nationally. The demand of national maize determined by the level of population growth, the high diversification of food made from maize, and the demand for livestock feed and fish farming. High demand of maize by itself will require the availability of sufficient stock as well as the effort to fulfill the demand. Based on data from Agriculture Ministry in 2015, showed that the total of national maize demand reached 37,596,570 tonnes, of which the demand level for consumption is the highest level of demand, reaching 18,326,249 tonnes, while the demand level for feed ingredients reached 16,885,118 tonnes and the demand level for food industry approximately 501 634 tonnes. Here is a graph of the national maize demand growth in the period of 2010-2025.

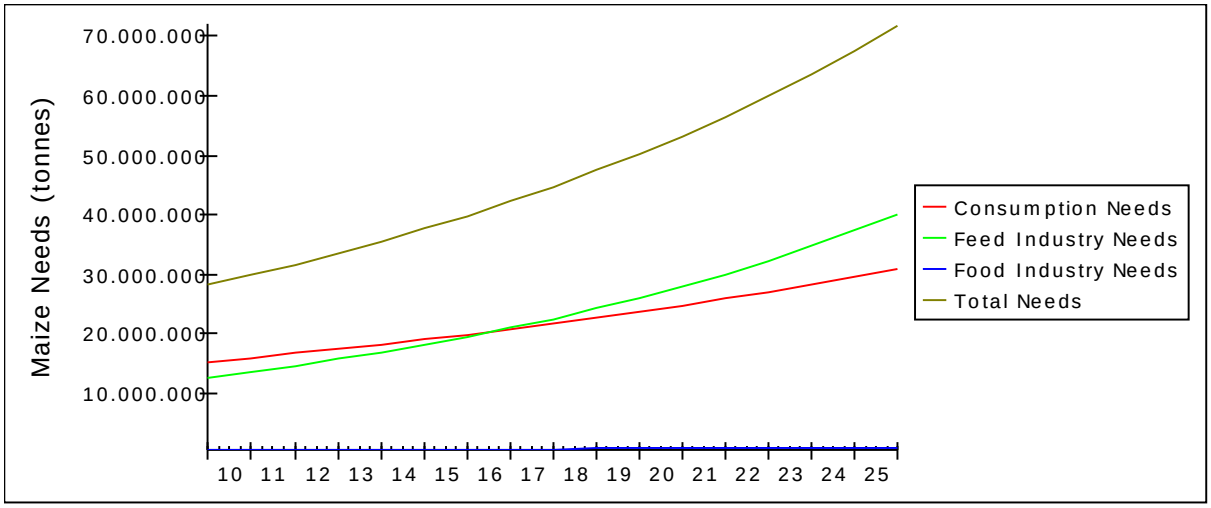

Figure 6: the behavior of sub-model graph of maize demand (tonne)

The simulation results showed that the maize demand model indicated a trend or pattern of exponential growth, the demand for maize increased as the overtime. Significant growth continued until 2025, moreover, especially to the level of demand of maize as feed ingredients and food industry. While behavioral model for consumption is relatively stable with an increase that occurred relatively slowly, compared to the other two demand models. The demand for national maize in 2025 is expected to reach of 67.51 million tonnes, of which the demand for

feed materials is the greatest demands, reaching 37.30 million tonnes, while the demand for consumption, reaching 29.49 million tonnes and the demand for the food industry around 734.24 thousand tonnes.

3.3. Provision Policy Simulation and the National Maize Demand

Model scenarios was intended to intervene to existing models with the aim of changes to the expected purpose. The developed scenario models were strongly associated with the supply-demand model and an increase in the value of the region's economy. Changes that occur in the model, will greatly assist in the development of national maize potential optimally. Scenario were done in two ways namely; Scenario # 1; the increasing of production (through extension or expansion of planting area which increased by 2% per year. Scenario # 2: the increasing of land productivity which increased an average of 1.0 tonnes / ha / year.

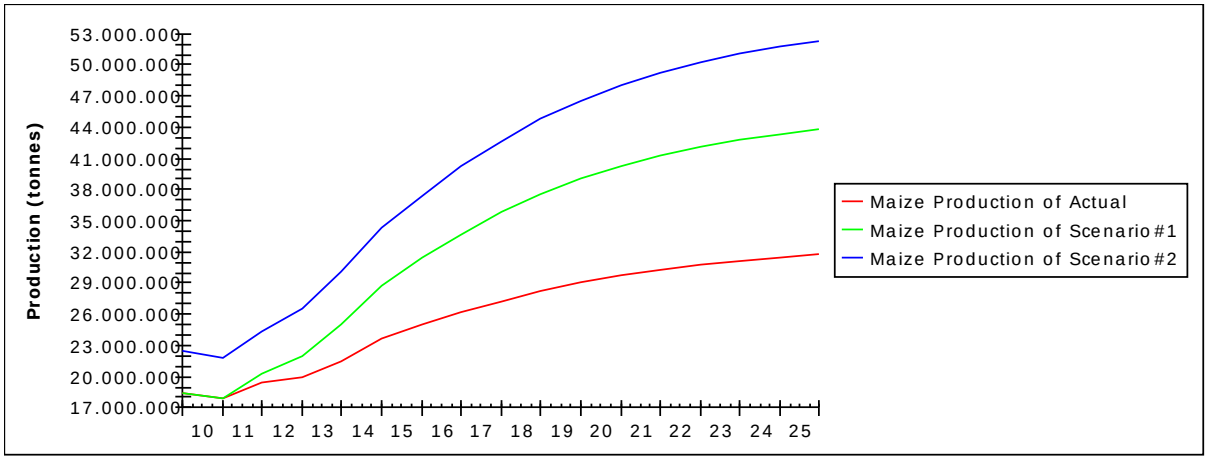

Figure 7: the actual simulation graph, scenario#1 and scenario#2 (production sub-model)

The simulation results indicate that the model scenarios that were done will be increasing the national maize production. It is showed in the graph, where maize production has increased significantly. Pattern or trend of increasing production still follow the behavior of the actual model of exponential growth, the increase in production over time will slow down.

On the other hand, the increasing in maize production will provide the income growth in general, both farmers' income, revenues, national income, and the economy of the region. Production activity by agricultural industry based is very important, especially in improving the regional economy. More details as follows.

The simulation results indicate that the model scenarios will improve the regional economy. It is presented in the graph, where the economy of the region has increased significantly. The increasing patterns or trends occurred was following the actual model behavior that was logarithmic, which is an essential increase occurred at the beginning of time and slow down over time. The pattern indicated that the increase in the regional economy is highly dependent on the production model, which increased production scenario in two ways namely; the extension of planting area and land intensification.

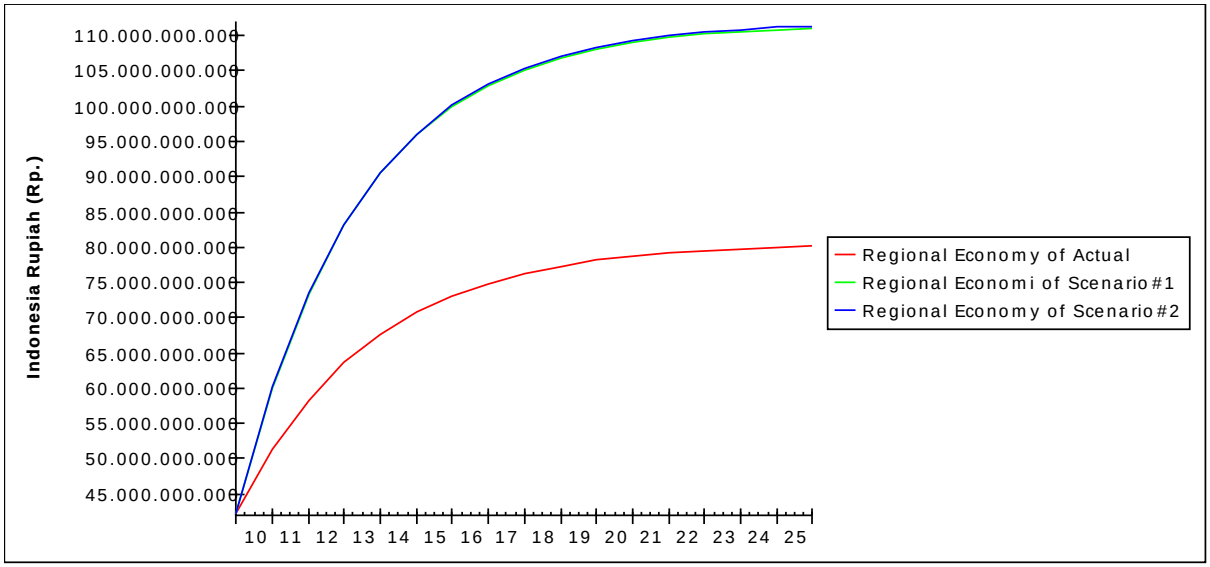

Figure 8: the actual simulation graph, scenario#1 and scenario#2 (regional economy sub-model)

4. Conclusion

Based on the results of analysis and discussion, some conclusions can be obtained as follows:

- The dynamic model of national maize production development to increase the availability of national maize was as an effort to meet the national demand for maize (consumption, feed ingredients and food industry), showed the trend or pattern of exponential growth (exponential growth). The pattern illustrates that an increase in national maize production over time.
- Developed scenarios model with scenario # 1 (extension of planting areas increased from 4% to 8% per year) and scenario # 2 (land intensification with an average of the increase of land productivity was 2.0 tonnes per hectare per year), could answer the national maize availability.
- Availability of national maize that supports the increasing of the national economy, with an increase in production by 7.03 percent in 2015, so that it made an increase of 3.77 percent of the national economy.

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