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# DYNAMIC SIMULATION SYSTEM FOR MAIZE COMMODITIES (CASE STUDY ; TUBAN, EAST JAVA)

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***ABSTRACT***

*Maize is one of four priority and strategic commodities which is still being enhanced to reach food sufficiency. Besides, maize is the main part of livestock feed, maize also has high level of consumption as food. On this basis, simulations is necessary to forecast the conditions of maize supply, especially in the region that has the highest production of maize in Indonesia, that is Tuban Region, East Java.This research aims to create a Dynamic simulation model using Powersim that represents the system of maize commodities. As well as making seven policy scenarios, to see the changes that occur in the simulation model. The results of this study found that the last scenario obtained stable maize supply, and obtained highest level of maize production.*

*Key words: Maize, Tuban, Dynamic System, Powersim, Availability*

## 1. INTRODUCTION

Indonesia is an agricultural country, where agriculture is one of the sector, which has helped the country's foreign exchange earnings. In the Programs and Activities Development of Agriculture in 2015-2019 by the Direktorat Jenderal Tanaman Pangan, From 36 commodities based on Kepmentan No. 511 of 2006, there 4 main commodities, namely rice, maize, soybeans, peanuts, and, cassava. Direktorat Jenderal Tanaman Pangan want to increase corp production by 2.3% per year, so that by 2019 food crop production is expected to reach 22,506,236 tons.

With the policy of the Minister of Agriculture that Indonesia does not import maize in 2015, and based on research results maize by BPS (Central Statistics agency) in 2012 and 2014 occurred the amount of maize harvest has decreased [a]. Not only total national production decline but also in East Java province as the largest maize producer in Indonesia also declined and the same thing with the Tuban district as the district's largest maize producer in East Java.

One approach to determine the influence of factors on the availability of maize is a dynamic system. A dynamic system is a computer-assisted approach to analyzing and solving complex problems with a focus on policy analysis and design [c][h]. The use of dynamic systems are widely used to describe the supply chain such as wafer supply chain[d], Healthcare Supply Chain[e], and the food supply chain[f]. Assisted with analysis of supply chain systems, variables and factors that affect the system can be used as parameters to determine the value of the maize supply.

## 2. RESEARCH METHOD

This is a descriptive study that illustrates the distribution patterns and systems that affect the availability of maize obtained from each supply chain actor maize. Data obtained from this study is divided into primary data and secondary data. The primary data obtained from interviews and data collection every actor supply chain to obtain a clear supply chain system, while secondary data obtained from the data processed by BPS and Department of Agriculture.

### 2.1. System Description

Models created in this study using software Powersim. In the description of the system, each sub-model is built (in this case, the sub-models are production and consumption) is based on interviews with stakeholders involved in the system.

### 2.2. Sub-Model Production

In this system, will be built a system based on peasant production of maize, the influences brought about by traders, retailers, until the distribution system and other factors that influence these entities.

The model described in the causal relationship that led to the availability of maize. The primary variable in determining the farmer's production is rainfall, the production per hectare or productivity, the areal extent of factors, factors stocks among stakeholders, and the price factor farmers.

In building a system for production sub-model, there are limitations such as, rainfall will be united by a factor of productivity due to factors of rainfall vary each month, while the simulation is performed using a vulnerable time of year so it is assumed that rainfall cannot be entered into the system though in fact, maize production is largely determined by factors of rainfall, especially in the rainfed.

Another factor is the inventory level at each level stakeholders. Basically, the inventory in the village collectors or collectors of districts does have an impact on the availability of maize because collectors generally have a specific strategy, which is to halt the sale if the sale price is down and doing massive sales when selling prices are high.

Harvest shrinkage factor was also not included in the model because the definition of depreciation harvest for this era is less well defined remembering harvesting methods, processing soil or seed used is constantly increasing so that it can be removed and is focused on decreasing the number of acreage for conversion factors.

### 2.3. Sub-Model Consumption

In sub model of consumption is influenced by various factors, including public consumption, industrial consumption or seeds, and the livestock feed that had the greatest level of consumption and affect on availability level. Sub model of consumption in this study is divided into two sub-sub-models of the consumption of livestock feed industry and population consumption. Where in the actual system, the livestock feed takes up more than 95% of maize production.

## 3. RESULT AND DISCUSSION

The following simulation results based on the scenarios. Each scenario was simulated to see how the availability of maize in the future. Here are the results of each simulation are made each scenario.

Scenario 1 : Consumption based on X Company data and the rate of increase in consumption (1a)

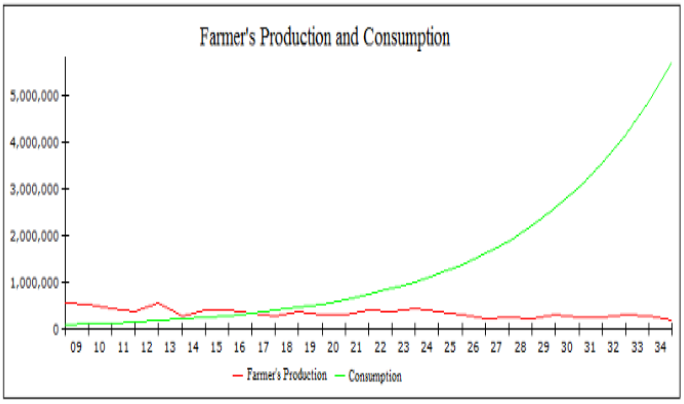


Figure 1. Graph farmers' production and consumption using the data X Company

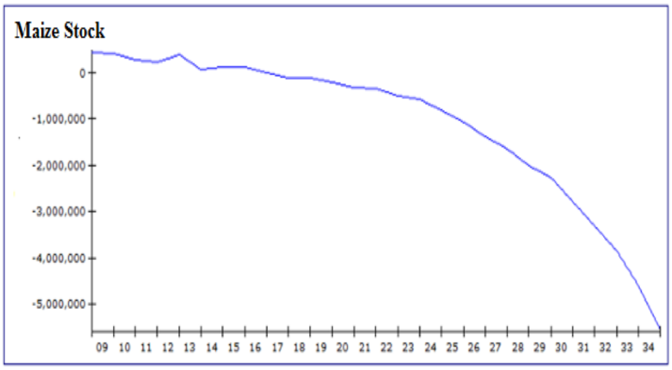


Figure 2. Maize stock chart using the X Company data

This scenario has increased consumption of about 17% per year, which means the accumulation of consumption from year to

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year will increase sharply. By comparing the simulation results of 2009 with 2035 consumption will increase by 5987.0891%. Chart described in Figure 1 shows that there is a meeting point between production and consumption between 2016 and 2017, or in other words, there will be empty on the stock between 2016 and 2017.

Scenario 2: The scenario using randomization X Company data (1b)

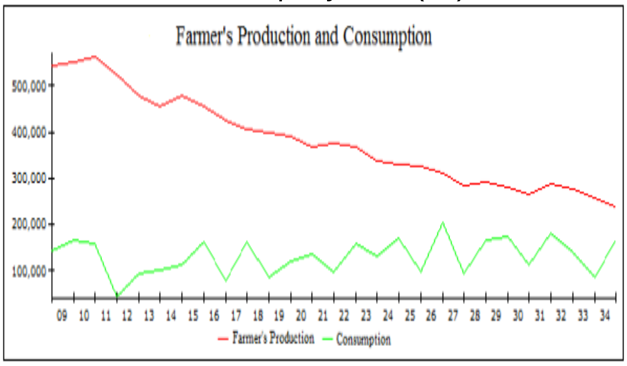


Figure 3. Graph farmers' production and consumption using randomization X Company data

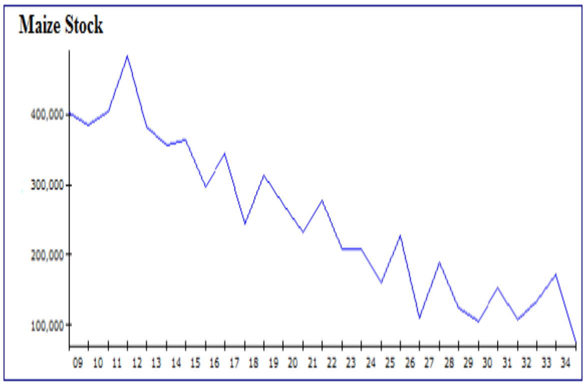


Figure 4. Maize stock chart using randomization X Company data

This scenario is a correction of scenario 1 has increased consumption of about 13.9352% per year. By comparing the simulation results of 2009 with 2035 consumption will increase by 15.8046%. And for the farmers' production will decrease by 56.2420% or 2.1632% per year. Chart described in Figure 4 shows that the maize stock will decrease by 81.5735% in 2035 with an average reduction per year 2.0145% per year.

Scenario 3: Increase maize price (2)

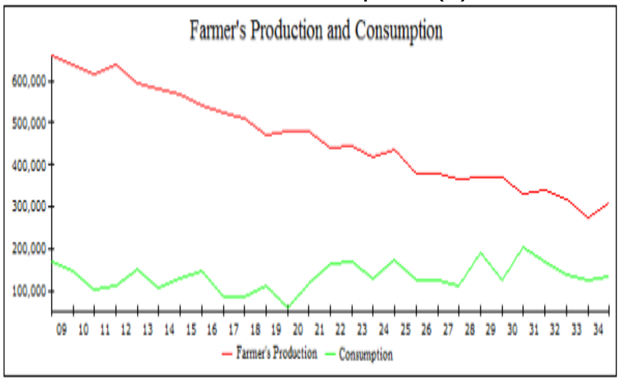


Figure 5. Graph of farmers' production and consumption due to the increase maize price

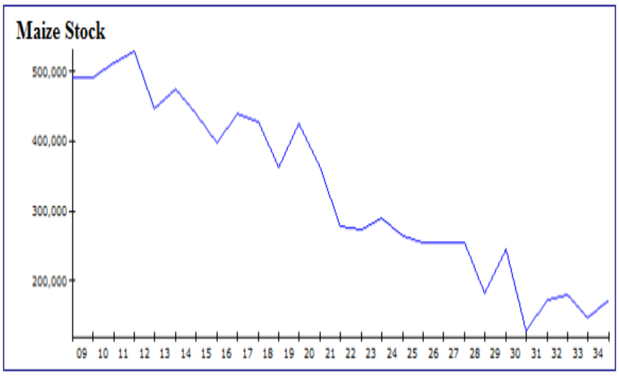


Figure 6. Maize stock chart due to the increase maize price

Increase maize price scenario, by comparing the simulation results of 2009 with 2035 consumption will decrease by 21.996%. And for the farmers' production will decrease by 53.3679% in 2035 or 2.7282% per year. Maize stock was down sharply with a decline of 64.65% with an average annual decline in the range of 2.5%.

Scenario 4: Land conversion is set and held to 2% (3a)

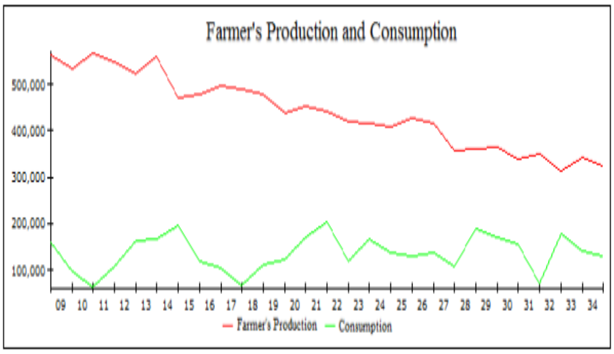


Figure 7. Graph of farmers' production and consumption with 2% land conversion rate

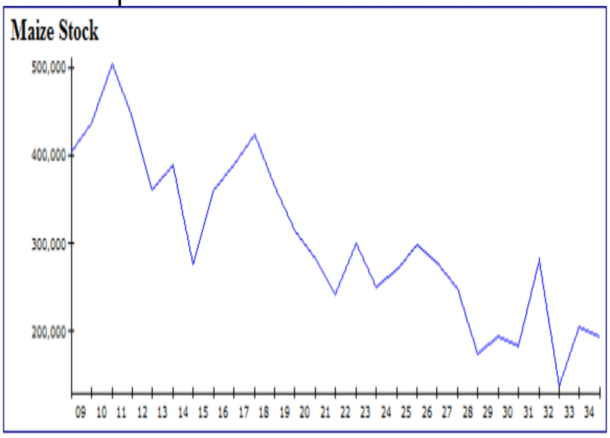


Figure 8. Maize stock chart with 2% land conversion rate

This scenario is a scenario to restrain the rate of change of wetland into industrial zones or residential areas. This scenario simulates when the policy makers made controlling the conversion rate of 2% per year, or about 2,255 hectares per year previously 3:21% per year. This scenario has decreased consumption of about 19.8639%. Changes occur in the amount of production decline by more than 42.6121%. Maize stock decreased by 51.615% with an average annual decline in the range of 1.987%

Comparisons between 2009 to 2035 resulted in a decrease in consumption of 21.6745%, but this could not be used as a foundation for the next simulation with the reduced rate as calculated for this system fluctuates and has a dynamic effect.

Scenario 5: Land conversion is set and held to 1% (3a)

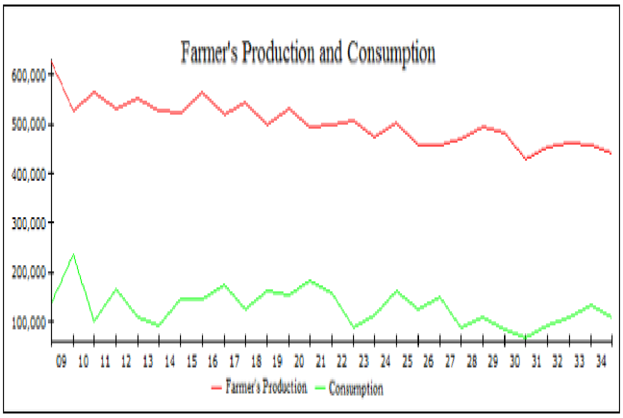


Figure 9. Graph of farmers' production and consumption with 1% land conversion rate

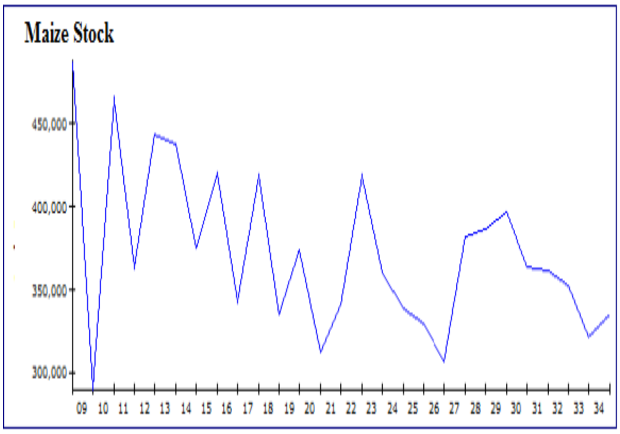


Figure 10. Maize stock chart with 1% land conversion rate

This scenario is a scenario to restrain the rate of change of wetland into industrial zones or residential areas. This scenario simulates when the policy makers made controlling the conversion rate of 1% per year, or about 1,128 hectares per year. Changes occurred in the number of production decline by more than 28.9515%. As for the consumption increased by 21.819%. Maize stock did not decline sharply as the previous scenario with a decrease of 30.9663% with an average annual decline in the range of 2.5%. This difference indicates that the control of land conversion is able to withstand the decline in production from year to year, where the smaller the rate of conversion increases the percentage decrease in production from year to year. This scenario is not focused on improving the existing production, but rather to how to overcome the decline in production and of course with this policy is able to slow the meeting point between production and consumption.

Scenario 6: Stop the land conversion rate or Land conversion is set to 0% (3c)

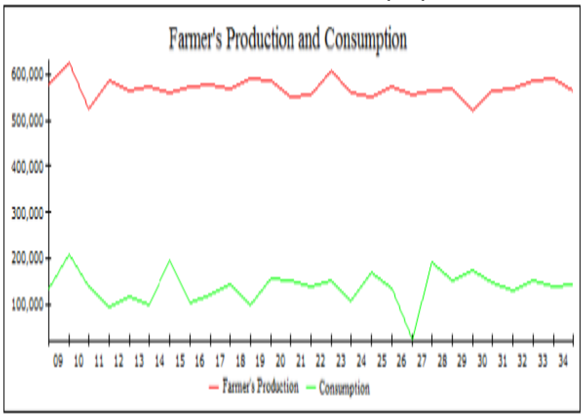


Figure 11. Graph of farmers' production and consumption with 0% land conversion rate

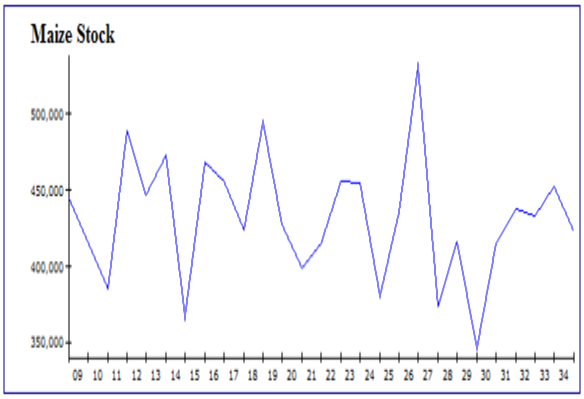


Figure 12. Maize stock chart with 0% land conversion rate

This scenario simulates if policymakers make better control to stop the conversion rate of wetland conversion or conversion into industrial land into residential land. This scenario is difficult to give all the factors of land ownership and entities which influence therein, this scenario shows if an area is focused to overcome the problems of market prices on the stock control maize, then by not allowing the conversion of land may indicate differences and their influence on production maize.

Scenarios with a conversion rate of 2% on production graph in Figure 7, tends to decrease, the scenario with the conversion rate at 1% (in Figure 9) shows a line chart a more stagnant even though the decline was still slightly visible. Scenario conversion rate at 0% (in figure 11), shows a line graph is more stagnant than the scenario with the conversion rate at 1%.

In this scenario, the number of production decreased by 0.375% with an average of 0.0144% per year. While consumption increased by 15.4472%. Maize stock decreased by 4.0913% with an average annual decline in the range of 0.1574%.

Scenario 7: Stop the land conversion rate and increase maize price

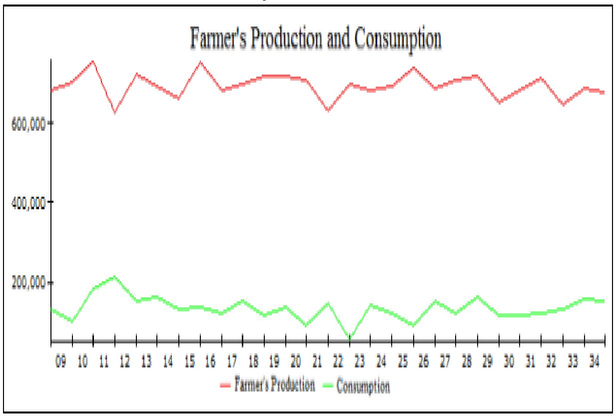


Figure 13. Graph of farmers' production and consumption with 0% land conversion rate and increase maize price

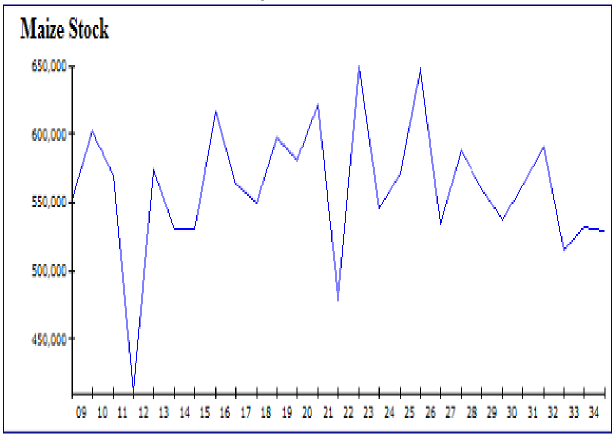


Figure 14. Maize stock chart with 0% land conversion rate and increase maize price

This scenario simulates control by stopping the conversion rate and provide increased price of maize so that in addition to the acreage that does not decrease every year, thereby reducing the variables that affect the decline in production, the acreage also increases because cropping intensity increased caused by the increased enthusiasm of farmers to plant maize.
In the latter scenario results in a decrease in production by 0.375% or 0.0144% per year, which in 2035 is simulated that production in the year will produce 679,154 tons. Values smaller decline compared to the previous scenario. The rate of decline until it reaches below 1% stated that stocks of maize would be maintained until at any time due to changes in stock per year is not so influential.

## 4. CONCLUSION

The results of this study found that the last scenario obtained stable maize supply, and obtained highest level of maize production. Which caused by stopping the conversion rate and provide increased price of maize so that in addition to the acreage that does not decrease every year, thereby reducing the variables that affect the decline in production, the acreage also increases because cropping intensity increased caused by the increased enthusiasm of farmers to plant maize.

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