

## Dynamic System Invention on the Development of Hulled Agro-industry for Supporting Food Autonomy in Papua

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### ABSTRACT

This research intends to invention the dynamics system in developing the regional potency in Merauke Regency as the main central of hulled production for supporting food self-production in Papua. The methodology consists of dynamics system modelling which is supported by the software Powersim Constructor Version 2.51. Result shows that: a) the sub-system consists of addition on irrigated rice area, harvest yield and conversion, and number of population; b) validation of dynamic model with the deviation less than 5% and it can be used in model; c) status of hulled production in Merauke such as the existing condition has ability of hulled surplus as 76,813.63 ton in 2020; d) optimistic scenario that additional irrigated rice area reaches 16.82% every year and the percentage of cropping is 85%, so it is predicted that in 2020 the area number of irrigated rice area will reach 210,372.34 ha with the capacity of hulled production is surplus such as 145,138.26 ton; and e) pessimistic scenario that additional irrigated rice area of 11.21% and the cropping percentage is only 67.4% so it is predicted the area number of irrigated rice area will reach 122,465.58 ha with hulled surplus of 94,953.35 ton.

**KEYWORDS:** system, agroindustry, hulled, self-production, Papua

### INTRODUCTION

Food production is increasing, it is indicated by the increasing of hulled production in the period of 2004-2009 such as from 54.1 million to 63.8 million ton in 2009 or it is increasing of 5.83%. This reaching has made Indonesia as hulled self-production (Ministry of Agriculture, 2010). However, the increasing challenge of food production (mainly hulled) incoming year is still seen to be difficult because some factors as follow: 1) the decreasing on area number of irrigated rice area; 2) the decreasing of area fertility; 3) the decreasing of quality and service area of irrigation system; 4) to be late adoption of farmer technology; 5) the increasing of gloomy farmer; and 6) there is still high on production missing [1][2][3]. In addition, there is global climate change which gives impact on distributing of OPT attach, moving of wet and dry season. Damage of area and vegetation also effects the food production [4].

Hulled is as the strategic food commodity in fulfilling food demand of society mainly in Papua beside the other source of local food. The contribution of food demand in Papua from hulled reaches 98,514 ton which is the 80,177 ton is come from Merauke (81.39%) [5]. Number of population which reaches to 2,097,482 populations, by the assumption on hulled consumption demand in average of 104.9 kg per-year, so the hulled demand in Papua reaches 220,026 ton per-year. By the assumption of hulled randomly on 62%, so number of hulled production in Papua Province reaches 61,078.68 ton, so it can make certainly on 72% of hulled is come from the other province. However, Papua is as rice-barn area mainly hulled has very big potency to be developed as hulled supplier area for Papua region. Therefore, it can be ignored that program of Merauke Integrated Food Energy, and Estate (MIFEE) is as the excellent program to be immediately implemented for accelerating the food self-production mainly hulled in Papua.

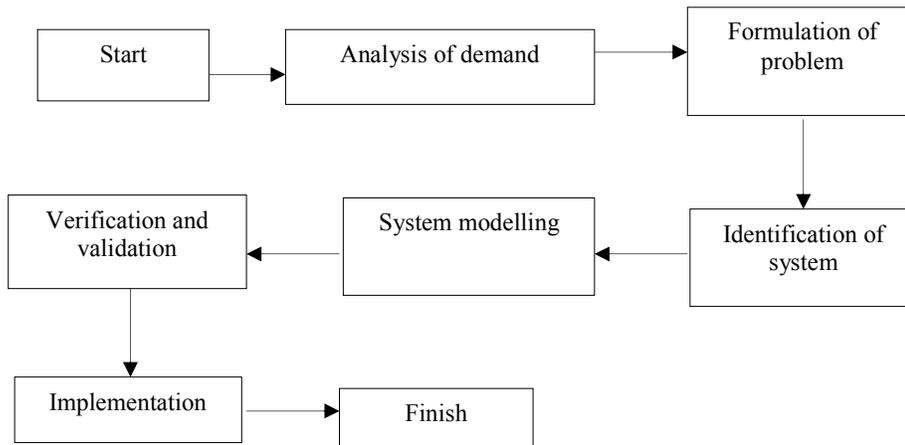
This research intends to invention the dynamic system in developing the regional potency in Merauke Regency as the main central of hulled production for supporting the food self-production in Papua. Remembering that hulled commodity is very strategic to fulfill the society food especially in Papua besides the other source of local food like sago, umbilt, sweet potato, and sweet cassava. There is a question for incoming year: does Papua region have ability to fulfill food demand of hulled as self-production? However, this research is focused for invention the dynamic system due to the development of hulled agroindustry for supporting the food self-production in Papua.

### MATERIALS AND METHODS

Research location is determined by purposive sampling which is carried out due to the natural potency for expanding the new irrigated rice area so it is hoped to be able to reach the food self-production in Papua. The

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methodology consists of dynamic system modeling by system approach. According to Manetsch and Park [6], the steps of system approach is presented as in Figure 1.



**Figure 1 System Approach**

In designing of dynamic system modelling by using the software of Power sim Constructor Version 2.5.1, the validation in this modelling is carried out by comparing the behavior of modelling and real system such as test of Mean Absolute Percentage Error (MAPE). MAPE is one of the relative measures that relates to percentage error. This test can be used to know the suitability between estimation result and actual data. The formulation is as follow:

$$MAPE = \frac{1}{n} \sum \frac{|X_m - X_d|}{X_d} \times 100\% \quad \dots\dots\dots (1)$$

Note:

- X<sub>m</sub>= data of simulation result
- X<sub>d</sub>= actual data
- N = period

The criteria of modelling accuracy with MAPE test [7]:

- MAPE < 5% : very accurate
- 5 < MAPE < 10% : accurate
- MAPE > 10% : not accurate

The criteria of modelling by MAPAE test [8] as above can be described as follow: if MAPE value is close to zero, so the model is not bias or it can be said that the simulation value consistently is not more or less than actual data.

**RESULTS AND DISCUSSION**

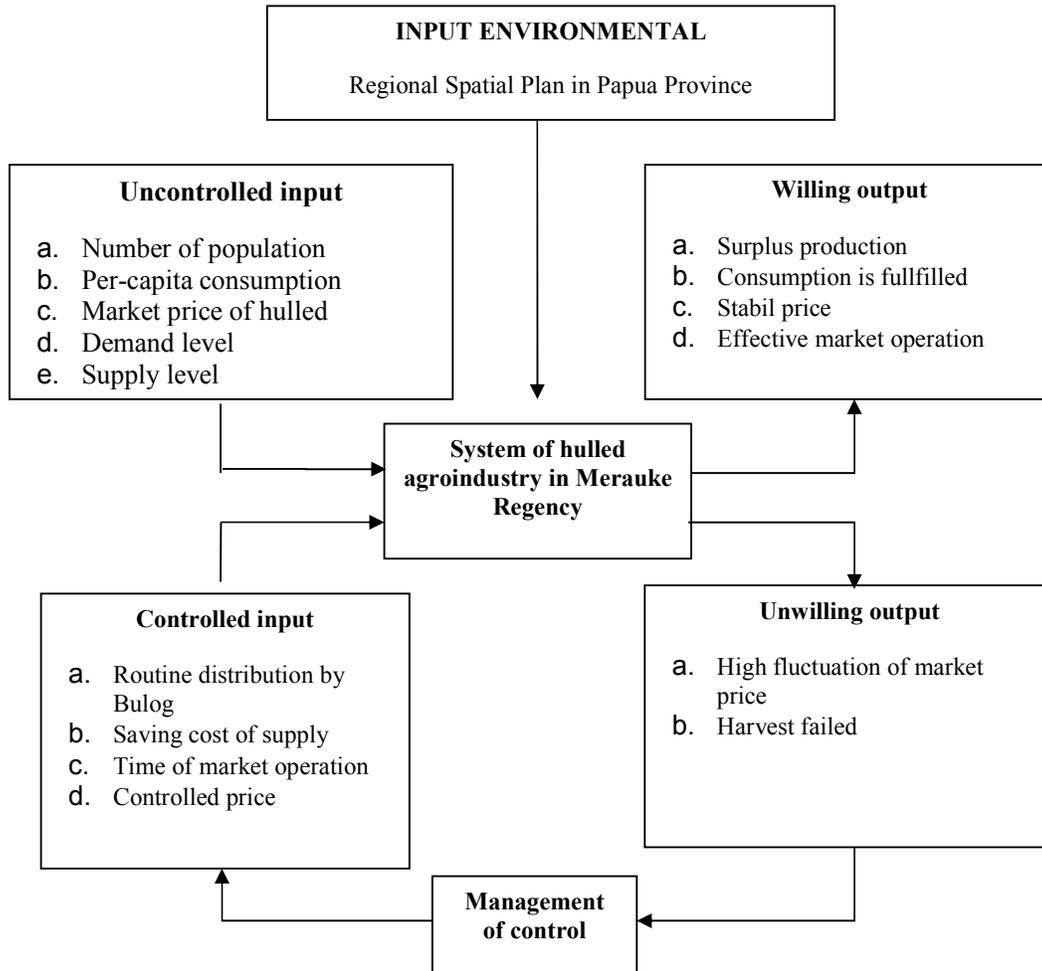
**Construction of causal loop**

In the sub-system of hulled agroindustry system, some variables form the causal loop. Figure 1 presents that there are some elements such as area number and unit base price of paddy is increasing, so it will increase the population of paddy cropping, and then it will increase the productivity of paddy harvest. If the harvest is increasing, there will be happened the increasing of hulled production and then it will increase the consumption of hulled. Therefore, it forms the positive causal loop.

The increasing of manure price and medicine can cause negative effect to the hulled productivity. Therefore, the causal is as negative causal loop. The increasing of water source and excellent seeding will increase the hulled productivity. By the technology development, it will to be able to increase the hulled produktivity and then it will increase the hulled consumption. The increasing of hulled price will give positive effect to the hulled consumption. However, hulls produktivity which is increasing will increase the government function by supporting department (Bulog) ehich intends to monitor and make stability of price and hulled supply in market. The increasing of population, income per-capita, and consumption rate which is increasing will increase the hulled consumption.

**Construction of black box diagram**

Input-output diagram illustrates the relation between the output of production and the input based on the step of demand analysis and problem formulation, Input-output diagram does not describe how the process will be experienced by input to become into willing output as in Figure 2.



**Figure 2. Black box diagram on the development of hulled agroindustry**

In the modelling of hulled demand preparation in Merauke Regency, environmental input is government policy, however, controlled input consists of routine distribution by Bulog, saving cost of supplt, time of market operation, control price, but uncontrolled input consists of number of population, per-capita consumption, market price of hulled, demand level, supply level. Frequently, in happening process, there is appear unwilling output like high fluctuation of market price, more supply level. The unwilling output is needed to be become as the feed back through the management for changing input to reach willing output like suitable production, fullfilling consumption, stabil price, effective market operation, so on the hulled consumption of society in Merauke Regency, the demand can be continuously fullfilled or food self-production.

**Dynamic System Invention of hulled agroindustry**

**a. Validation of model**

Based on the test result on output performance validation of harvest yield variable, number of population, and area number of rice irrigated area, in reality, the deviation level between simulation result and actual data which

is  $MAPE < 5\%$ , the model is categorized very accurate so the developed model can be used as the system dynamics of hulled agroindustry. However, the validation data is as presented in Table 1.

**Table 1. Test result of model validation**

Variable	Simulation result	Actual data	Deviation	Note
Harvest result	116,844,9	115,28,4	1.3312263	in 2011
Number of population	202,375	203,092	0.3542928	
Area number of rice irrigated area	40,175	40,175	0	

**Dynamic Model of hulled agroindustry**

System of hulled agroindustry which is built from some sub systems consists of: a) sub system of population; b) sub system of hulled consumption; c) sub system of area; and d) sub system of hulled production. Each of sub system is interacted to build hulled agroindustry model which is based on the causal loop and black box diagram as above.

**Projection of population number**

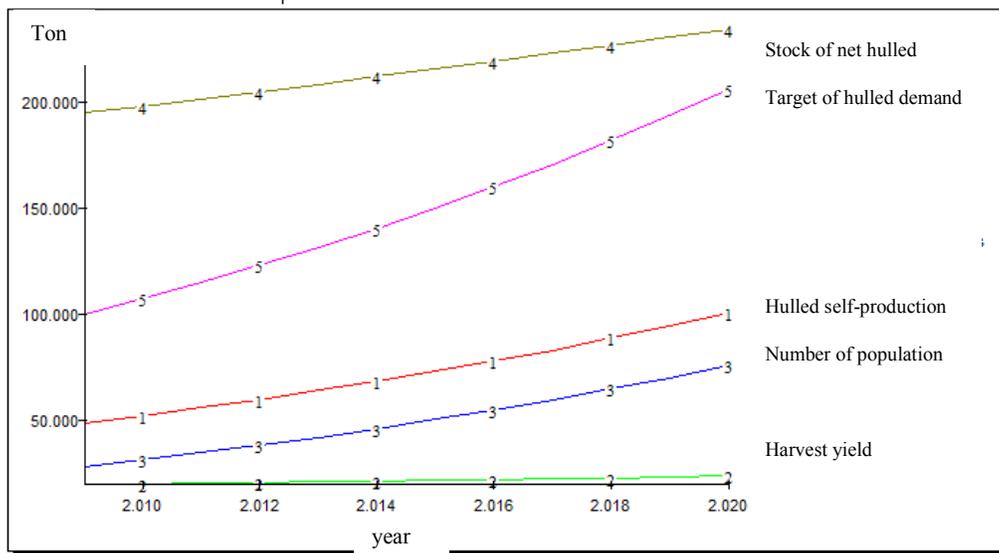
Based on the output of model, it indicates that the increasing of population in Merauke Regency is predicted in 2020 is 235,262 populations with the population growth rate does not change such as 1.69%.

In this discussion, there is carried out the approach of system dynamics scenario test which becomes as the base for setting the policy of hulled agroindustry development that is able to support the hulled demand in Papua.

**Scenario of moderate**

**Projection of area number increasing of irrigated rice area and hulled harvest yield**

Area number of rice irrigated area in Merauke Regency in 2010 is 42,308 ha that is only cropped as 28,406 ha (67%) and the harvest yield of hulled is 108,384 ton or suitable with the productivity of 3.8 ton per-ha. The hulled productivity indicates that the yield is lower and lower is compared with the hulled by farmers in Java that is able for more than 8 ton per-ha every cropping season. The lower harvest productivity is effected by some factors such as a) the quality of soil has acid trend; b) there is limited facility of technic irrigation, so part of them are depended on rainfall so the cropping season only once a year; c) the lower application of plantation technology; d) there is still limited knowledge and skill of farmer in system of intensive plantation. Status of hulled production in Merauke Regency in existing condition (moderate) is able to be hulled surplus of 76,813.63 ton in 2020 as in Figure 3.



**Figure 3. Projection of hulled self-production in Merauke Regency (Scenario of moderate)**

**Scenario of optimistic**

In this scenario, there is projected the rate of irrigated rice area printed reached 16.8% per-year, so it is projected the hulled production will be reached as 145,138.26 ton in 2020 with the area number reaches 210,372.34 ha. This condition is assumed as the other external factor in observation period does not extremely

changed, so it is estimated that in Merauke Regency is really able to supply hulled demand in Papua in 2020 and it can reach minimal of 90% of hulled demand in Papua. It is very possible and though it can be accelerated to be increased the rate of irrigated rice area printed due to the development base of MIFEE. Due to the MIFEE, spatial pattern infestation of area number has been fitted with the policy of Centre Government and Papua Province for the first stage such as 228,022 ha on KSPPI-IV outside the existing development area of farmer on 40,175 ha (to increase from 38,042 ha + 2,133 ha of area opening), APBN and APBD support food cropping in 2011.

#### **Scenario of pessimistic**

Meanwhile in the last scenario which the percentage of area increasing is 11.21% and cropping percentage is only 67.4%, it is predicted that area number of rice irrigated area in 2020 reaches 122,165.58 ha with hulled surplus of 94,853.35 ton. In the condition that Merauke Regency is still on the status of self-production so the strategic position and natural potency is very big so it is very possible to be carried out the effort of farming corporate in wide scheme.

#### **Policy line which is necessary to be develop**

- a. There is needed to be carried out the integrity and similarity of understanding for the whole stakeholder in implementing the MIFEE program
- b. There is needed to be carried out the synchronization activity program by horizontal and vertical crossing of institution mainly for applying the permission and AMDAL
- c. There is needed the continuity and sustainability of agricultural and fishery development program so the willing guidance and target can be reached.
- d. Strengthen on the institution in the form of farming corporate in empowering the belonging resources.
- e. There has to start from now with the activity real example of MIFEE activity which is local society base. The target is the society and that the MIFEE program is really to take them to the increasing the prosperity mainly for the local society.
- f. There is needed the social strengthen (social invention) systematically for going against MIFEE development due to the local society base.

### **CONCLUSION**

Based on the analysis as above, it is concluded as follow:

1. Now Merauke Regency is able to be as hulled self-production and it is projected in 2020 it is able to supply more than 90% of hulled demand for Papua society.
2. Development Projection of Merauke Regency is very potential as the hulled supplier through the acceleration of new rice irrigated area printed due to the target of 282,022 ton on the first stage in MIFEE program
3. There is needed the integration, synchronization, systemic, sustainability in developing the hulled agroindustry due to the local society base.

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