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Model of Sustainable Rural Development Based on Rice Agroindustry Development

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Abstract

Agroindustry is an activity which is able to create other activities that have value added; thus, the development of agroindustry in a rural area is expected to produce various products, from products that are not valuable into products with high economic value. The purpose of this study was to build a model that can describe the existence of rice fields and increase the farmers' income. This research used system approach and method of data analysis applied in this research was system dynamics. A result of simulation shows that the existence of rice fields will be converted to 1.5 percent along with the development of rice agroindustry which later will increase the farmer's income by two-fold from the previous farmer's income.

Keywords: Agroindustry; System Dynamics; Model.

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1. Introduction

In general, national development can be classified into urban and rural development. Urban areas so far have been directed as a center of industry, commerce, and government. Furthermore, rural areas are directed as a center of agricultural production. The process of rural development which is implemented thus far has not succeeded in achieving the goal of improving the welfare of rural communities and has even created new problems of the gap between city and village, namely visible difference in welfare level between rural and urban areas. This is in line with Mubyarto [1] who stated that the gap between the industrial sector and the agricultural sector is visible in the gap between rural and urban. Industrial development which is mostly in the urban area grows rapidly; on the contrary, the development of agricultural sector and its processing industry, which is almost entirely in a rural area, runs very slowly. The failure of development in the rural area has worsened the condition of rural communities in terms of poverty and ignorance. This situation is also stated by Yudhoyono [2] that until now, the rapid growth of development results in poverty and unemployment in the rural area. Therefore, the development approach that has been implemented needs to be rethought. According to Tong Wu [3], one of the development approaches is the implementation of development in rural area. In this case, agroindustry development is an alternative that can be applied in rural development. Agroindustry is an activity that can create other activities which have value added. Development of agroindustry in a rural area is expected to produce various products, from products that are not valuable into products with high economic value. Thus, effort in agroindustry development will raise the growth of agricultural sector while increasing rural economic growth. The development of agroindustry which is in accordance with the characteristics of agriculture and livelihood of rural communities will be a strategic basis for rural development. Therefore, the effort required is about how to design a model of sustainable rural development based on agroindustry development. Agroindustry is adjusted to the available resource potential thus supporting the sustainable rural development. Based on the background and problems, the purpose of this research was to build a model which is able to describe the behavior of agroindustry existence that can increase the income of farmers.

2. Research Method

The research was conducted in Irrigation Area of Cihea, Subdistrict of Bojongpicung, Haurwangi, and Ciranjang, District of Cianjur. The study was conducted from January to April 2016. The research method used was system approach. In research implementation, a method of the soft system was used with expert judgment applied to extract information and knowledge from the expert [4]. Determination of information sources was done purposively, namely stakeholders of 15 people related to the sustainable rural development system based on rice agroindustry development with consideration of the presence, affordability, reputable, and experience in their field. Component of stakeholders included in the sustainable rural development system based on the development of rice agroindustry was farmers, agroindustry actors, cooperative business groups, government, financial institutions and research institutions. Since each stakeholder has its own interests, if the interests are not gathered in a holistic way, conflict of interest may happen. Data and information of survey results were processed in accordance with the design of model building method using system dynamics with a software of powersim studio 10. Analysis of system dynamics started from determining objectives in the system [5], then the determination of system requirement to achieve the objective, and formulation of problems obtained from the results of studies and discussion of experts. The next stage was an identification of system by creating input and output diagrams. Causal Loop Diagram was created to ease in observing the relationship between elements in the system. Technical analysis was done by creating the structure of Stock Flow Diagram so that simulation can be done and the behavior of system formed can be observed. The final step was to validate the model which caused the trend of the behavioral pattern.

a. Requirement Analysis

Requirement analysis was aimed to identify the requirement of each actor involved in sustainable rural development based on the development of rice agroindustry. At this stage, inventory of stakeholder requirements was conducted.

b. Problem Formulation

Stage of problem formulation was made by evaluating the limited resources owned and/or the existence of the conflict of interest among stakeholders to achieve the system objectives. Solutions were undertaken by knowing the problems existed in each stakeholder and the influence of other stakeholder influences.

c. System Identification

System identification is a chain of relationships between the statements of results from the requirement analysis by stating the problem to be solved in order to meet those requirements. The purpose of system identification is to provide an overview of the relationship between interacting factors in relation to the establishment of a system. A relationship between factors is described in the form of causal loop diagram and input output diagram.

d. Model Simulation

Simulation of result of system dynamics modeling is used to observe patterns of model behavior trends. Model simulation results are analyzed and factors causing the pattern of trend are investigated.

e. Model Validation

According to Muhamadi and his colleagues [6], validation of behavioral model can be done by comparing the extent and the characteristics of error, those are: 1) Mean Square Percent Error (MAVE), that is the difference between the average values of simulation result against the actual value and 2) Absolute Variation Error (AVE) which is the deviation of simulation variance value. The acceptable deviation limit is <10%.

3. Result and Discussion

a. System Requirement

System requirement was derived from the identification of the needs of each stakeholder in relation to the development of rice agroindustry. The stakeholders interviewed were the government as the planning and policy maker on the development of rice agroindustry, farmers, cooperative business groups, and rice agroindustry actors who directly manage the rice agroindustry, research institutions that continue to study the development of rice agroindustry, and financial institutions which support the source of capital for farmers. The requirement for a system of rice agroindustry development from each stakeholder that describes the importance of each stakeholder can be seen in Table 1.

Table 1: Matrix of the requirement of rice agroindustry development system

No	Analysis of requirement	Farmer	Business group	Goverment	Financial institutions	Research institutions
1	Fattern of business	☑☑☑	☑	☑	☑☑	☑☑☑
2	Product price warranty	☑☑☑	☑☑☑	☑	☑☑☑	☑
3	Sosialization and training	☑☑	☑	☑☑☑	☑☑	☑☑
4	Market warranty	☑☑	☑☑	☑	☑☑	☑☑☑
5	Continuity of raw material	☑☑	☑☑	☑☑	☑☑	☑☑☑
6	Easy access to reach fund	☑	☑☑	☑	☑	☑
7	Government assistance	☑☑☑	☑☑☑	☑☑	☑	☑
8	Rice agroindustry	☑	☑☑	☑☑☑	☑☑	☑☑☑

Information : ☑=quite important, ☑☑=important, ☑☑☑= very important

b. Problem Formulation

Based on the results of requirement analysis, there were several problems arose which can be seen based on the scarcity of resources and different interests, namely: 1) Benefit of government assistance has not been directly felt by farmers thus potentially causing land conversion. 2) The absence of processing industry of agricultural derivative product thus not yet provided economic value added for farmers and 3) Pattern of groups that currently has not lead to cooperate business activities so that the benefits are still only felt by a certain group of people.

c. System Identification

In system identification, there were 6 (six) groups of variables that can affect the performance of rice agroindustry development system, namely: (1) Output wanted, that is the objective of system studied to see the success of the model built. The wanted objectives in the sustainable rural development model based on the development of rice agroindustry were an increase in farmer income, labor absorption, and controlled land conversion; (2) Controlled input, which is a factor driven in the model to optimize the wanted output. Included in this variable were training, technology, and capital; (3) Uncontrolled input, that is input in the model which greatly affects the performance of the model since it is difficult to be controlled thus should be taken into consideration in policy making as an assumption of the model; (4) Environmental input, as a limitation in the model especially the regulations related to the development of agroindustry; (5) Unwanted output, as output that is not in accordance with expectation such as environmental damage, rapidly growing settlements, and unemployment; (6) Feedback in rural development related to agroindustry development policy.

Relationship between variables in the system of rice agroindustry development can be illustrated in the diagram in Figure 1. Moreover, explanation of the Black Box on the variables that affect the system can be seen in the causal loop diagram in Figure 2.

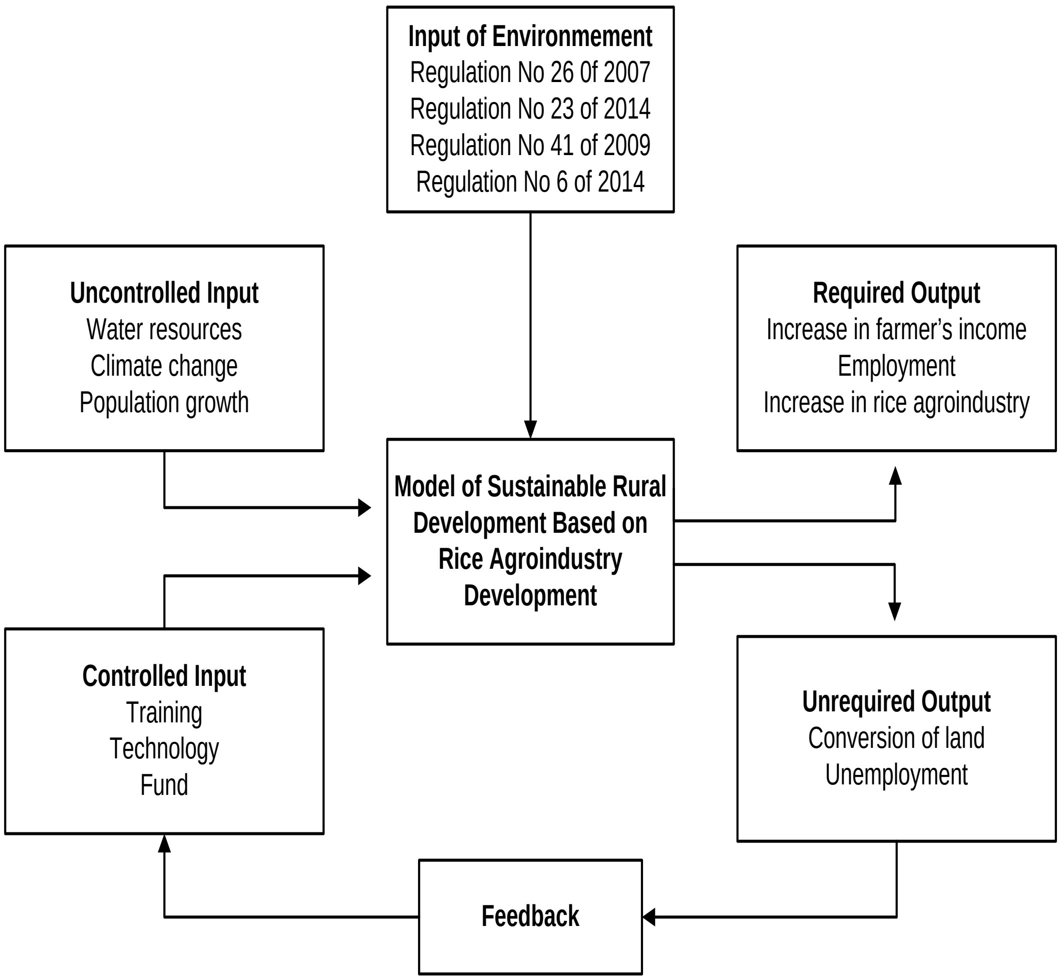

Figure 1: The variables that affect system performance

From the causal loop in Figure 2, it is known that rice agroindustry development system is affected by social, economy, environment, and agroindustry aspects.

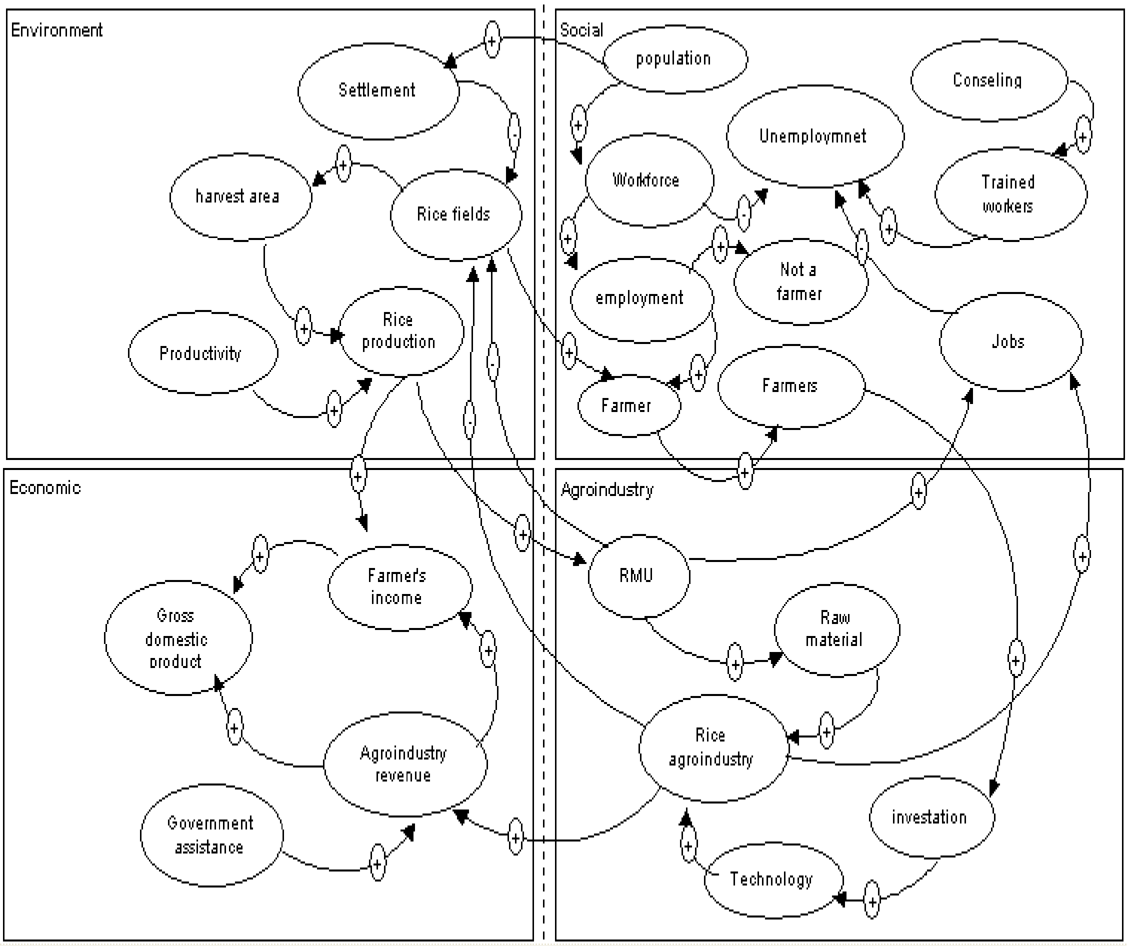

Figure 2: Diagram of Causal Loop

d. Model Validation

Performance validation can be seen from the comparison between simulation result and real data of research location. In the rural development model based on the development of rice agroindustry, the validation of MAVE value for the population was 1.41% and the productivity was 0.07%, while the AVE validation value for population and productivity amounted to 1.21% and 0.07% %, respectively.

e. Simulation and Modeling

1) Social Sub-Model

In social sub-model, the variables used were population growth in Irrigation area of Cihea, the number of farmers, labor, and unemployment. The relationship between variables in social sub-model is depicted on the Stock Flow Diagram (Figure 3).

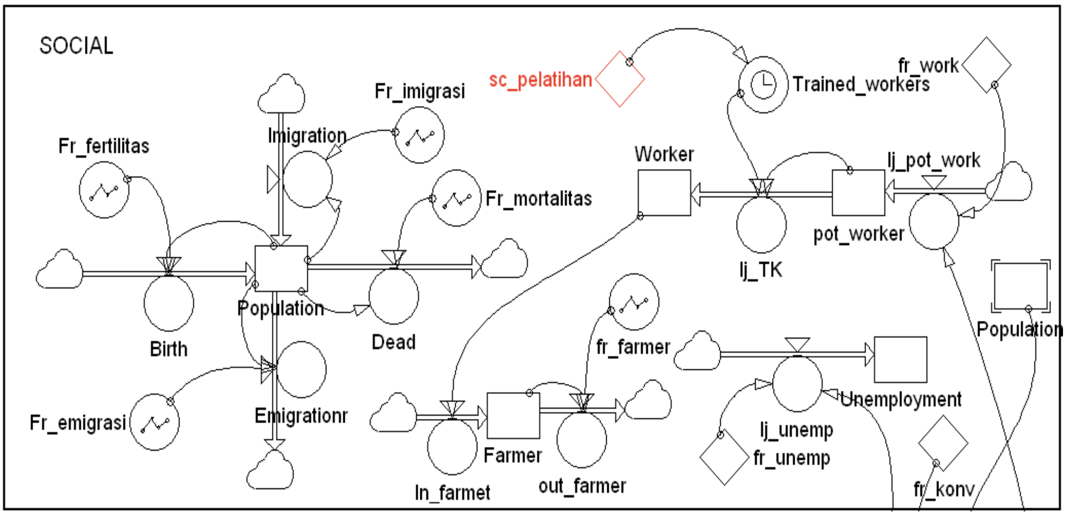

Figure 3: Stock Flow Diagram of Social Sub-Model

The potential of employment amounted to 2,000 people is due to the development of rice agroindustry. Population growth and employment potential of employment absorption are presented in Figure 4.

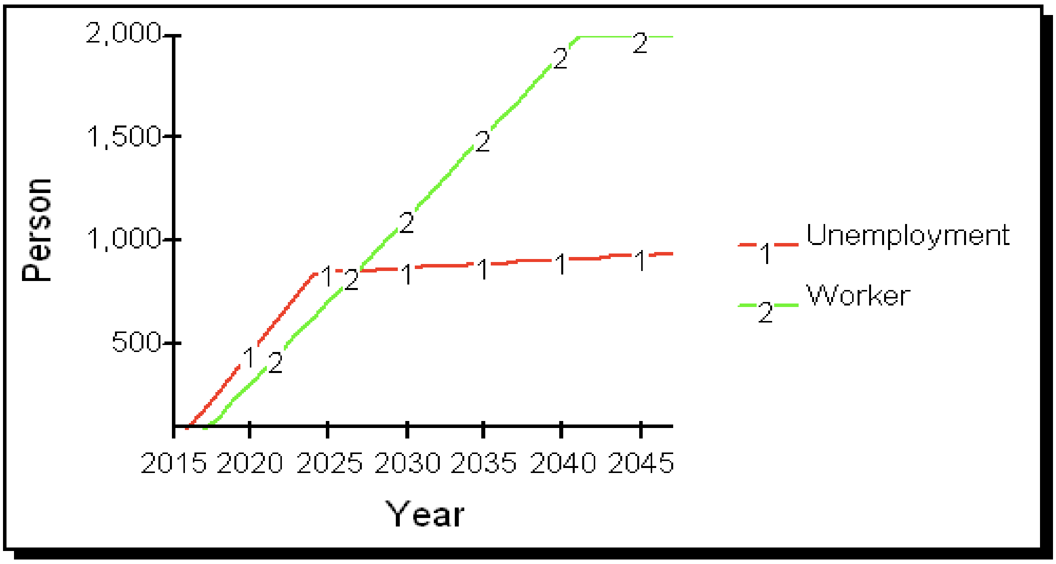

Figure 4: Employment Absorption

2) Economic Sub-Model

The economic subsystem was designed to predict the value added that will be obtained by farmers when conducting the development activities of rice agroindustry. In the economic sub-model, farmers' income from on farm and agroindustry activities was observed. The detail of variable is presented in Stock Flow Diagram (SFD) of economic sub-model (Figure 5).

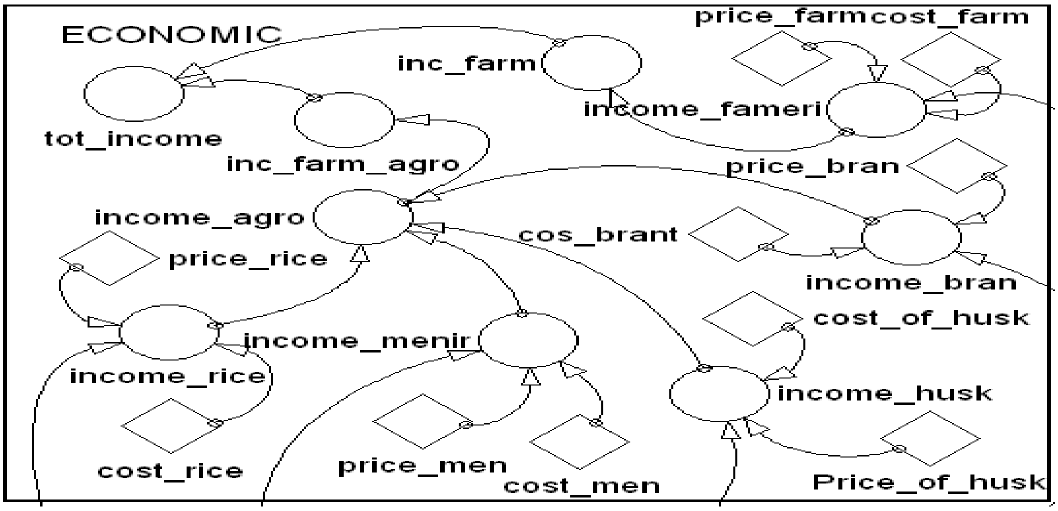

Figure 5: Stock Flow Diagram of Economic Sub-Model

The assumptions on the economic sub-model were constructed using average data of selling price and production cost of each derived product [7]. The simulation results are presented in Figure 6.

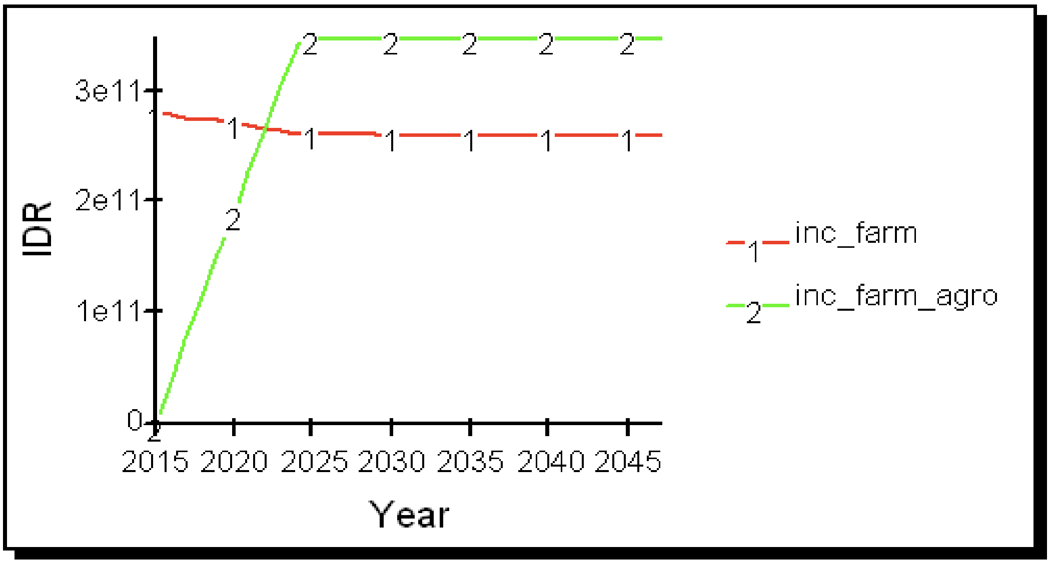

Figure 6: Farmers' Income

Farmers' welfare can be reflected from their income. Farmers' income from farming activity thus far has tended to decline as seen in Figure 7. This is because the farmer's income was only gained from the rice business. After the development of rice agroindustry, an increase in farmer's income continues to exceed the farmer's previous income in the 10th year. This value was obtained from the value added through the processing of derived product of rice production.

3) Environmental Sub-Model

The environmental sub-model is designed to determine the effect of rice agroindustry development on the decrease in rice field area which is converted to non-agricultural land. The variables depicted in the Stock Flow Diagram (SFD) of environmental sub-model are presented in Figure 7. The assumption used in the environmental sub-model is that the minimum area required by one RMU (Rice Milling Unit) business unit is 1 ha per unit. Data of rice field used were data of BPS in 2010 and 2016.

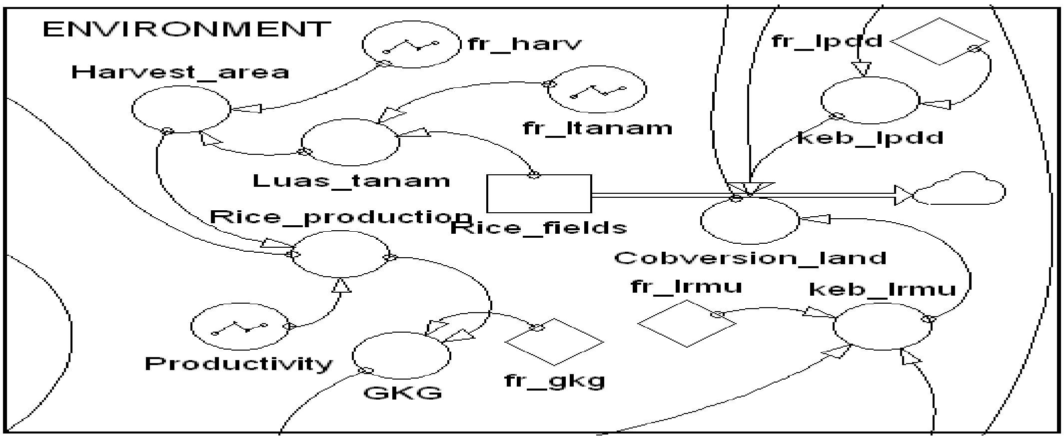

Figure 7: Stock Flow Diagram of Environmental Sub-Model

A result of simulation shows that there will be a conversion of agricultural land into non-agricultural land along with the development of rice agroindustry. It can be seen in Figure 3 where rice fields are under pressure and conversion until the 10th year by 1 percent of the area in 2015. This is due to the development of RMU industry or agricultural processing industry until 2025. The simulation results are presented in Figure 8.

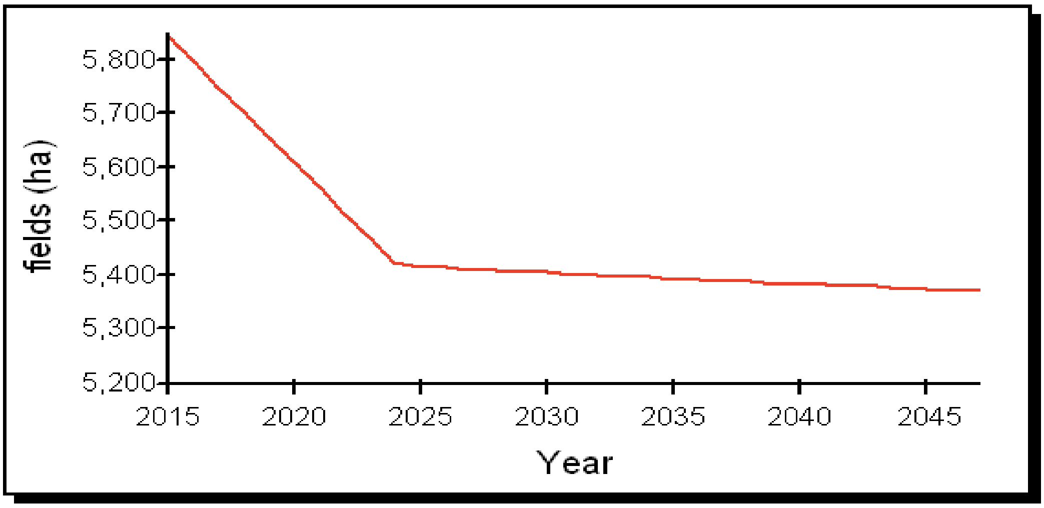

Figure 8: Conversion of Rice Field

4) Agroindustry Sub-Model

Agroindustry sub-model was designed to observe the number of RMU required in accordance with raw material conditions at that location. The variables depicted in the Stock Flow Diagram (SFD) of the agroindustry sub-model are presented in Figure 9. The assumption used in the agroindustry sub-model is that the miller capacity is 250 kg/hour with an assumption of 1 day equals 8 hours and 1 year equals 300 days and the addition of RMU each year is 3 RMU.

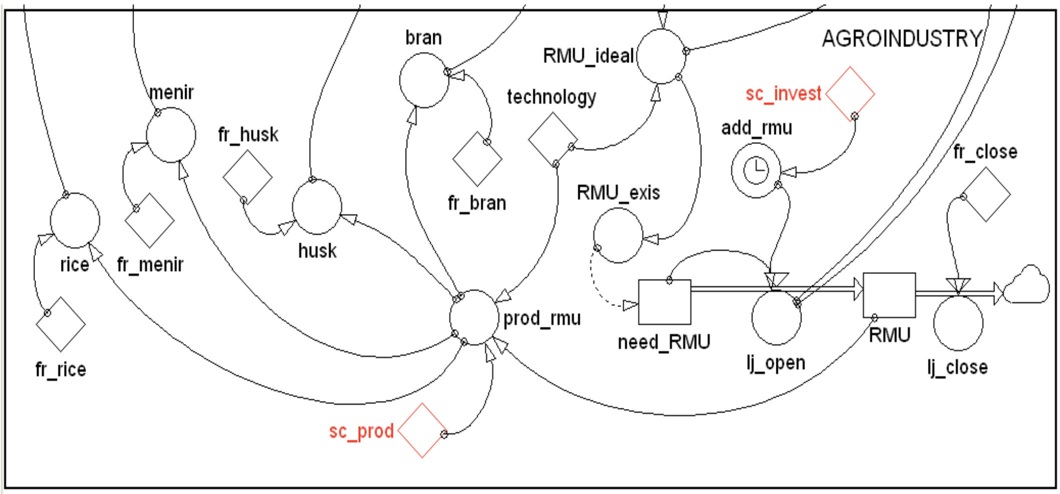

Figure 9: Stock Flow Diagram of Agroindustry Sub-Model

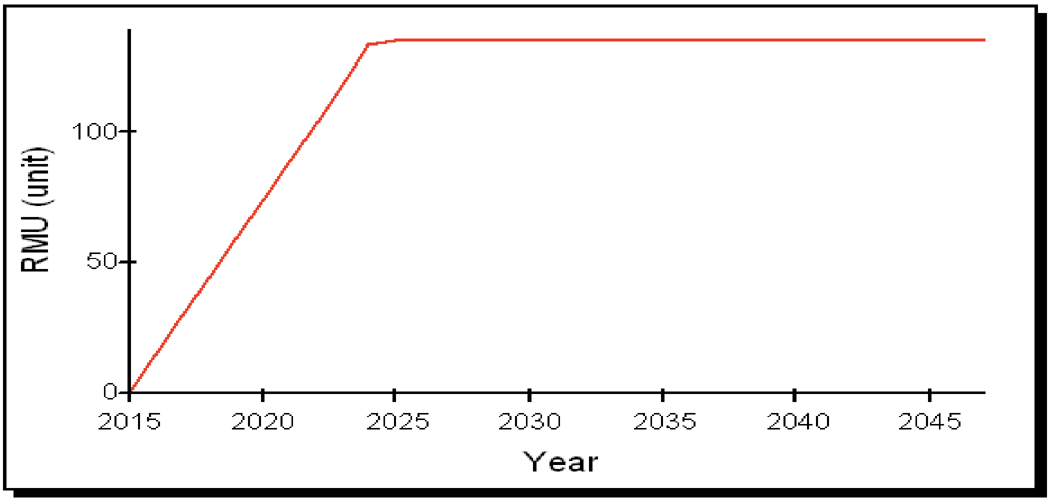

Figure 10: Requirement for RMU

The simulation result shows that the requirement of RMU in Irrigation area of Cihea is 136 units. It can be seen in Figure 10 that the RMU requirement will be fulfilled in the 10th or in 2025 since the investment starts in 2015.

4. Conclusion

The result of simulation of rural development model based on the development of rice agroindustry shows that the conversion of paddy field is relatively small, that is 1 percent for 10 years, whereas with the development of rice agroindustry by processing the derived products from rice processing results in value added for farmer which is twice the farmer' income. An increase in farmer's income is expected to reduce farmers' willingness to sell their fields and can provide an idea to farmers regarding the prospect of rice agroindustry development.

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