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Using System Dynamics Approach in Modeling the Integrated Farming Scenario to Increase Cassava Production in Indonesia

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ABSTRACT

This research was focused on integrated farming system and usage of system dynamic approach. This research was done in Trenggalek District, East Java Province, Indonesia. It used secondary data, and supported by primary one. Modeling and making policy scenario used system dynamics approach. The model fit was examined by Theil test. Modeling with system dynamics approach is effective to create a complex model of IFS, because the model behavior is similar with those of the real-world. The model also could be used to simulate policy scenarios and estimate the future performance of the model. The scenario done was a policy of technology innovation namely optimal production with the environmental awareness. This scenario focuses on using organic fertilizer in cassava-goats integrated farming; it is quite effective and can decrease farming cost as much as 27.75% up to 34.36%. The scenario needs introduction of composting technology and availability of the facilities and infrastructure. Therefore, the implementation needs supports from stakeholder, i.e. government and society, as well as public and private sectors.

General Terms

Modeling, integrated farming system (IFS), agribusiness.

Keywords

System dynamics, modeling, scenario, cassava, agribusiness, organic fertilizer.

1. INTRODUCTION

Cassava is one of important food crops in Indonesia. It is not only easy to grow but also can substitute rice and maize as source of carbohydrate. That is why cassava spread to almost the entire territory of Indonesia. One of the important production center in East Java Province is Trenggalek District.

Cassava is a regionally important crop in Trenggalek District, it is marketed in fresh and processed forms (Ariadi et al, 2014). Processed cassava is marketed in the form of ready food and half-in-processed products. The ready foods are in the form of chips, crackers, biscuit and several traditional snacks, they are marketed more locally. Meanwhile, the half-in-processed products are marketed as dried cassava, chips (raw material of flour), flour and starch. They are marketed widely and some of them are exported.

Cassava agribusiness involves thousands of people in Trenggalek. They are farmers, processors and also marketers. That is why an effective policy in developing cassava agribusiness must be designed comprehensively based on an empirical study.

Some previous studies used system dynamics approach to analyze a complex system. Some of them were applied on agricultural system, such as: dynamic model of farm management (Ariadi et al. 2014); eco-agriculture system (Li et al. 2012); organic farming in Slovenia (Paz & Kljajic 2013); integrated pig production supply chain (Piewthongngam & Vjitrnopparat 2014). System dynamics modeling was also applied on the integrated assessment of sustainable marine cage culture (Château et al. 2015).

Some scientific policy scenario also used system dynamics. The policy scenarios were applied on the sustainable development of ecological agriculture in China (Shi & Gill 2005); eco-agriculture system with policy recommendations (Li et al. 2012); future biodiesel policy designs and consumption patterns in Latvia (Barisa et al. 2015).

Other research on integrated, conventional and sustainable agribusiness used multinomial logit regression (Anim and Mandleni 2011). The result informs that the integrated agribusiness system is the most appropriate system in the developing region that is dominated by less-educated farmers and lower information access. This research developed IFS as a tool in developing cassava agribusiness, but the difference is using dynamics perspective.

Some previous researches have similarities and differences with this research. System dynamics also has been used to analyze food availability in East Java, the result showed that sweet potato and cassava are future prospective commodity that can substitute rice (Rahmatullah et al, 2012). The similarities are cassava as the research objective and the system dynamics approach. The difference, however, this research studied the cassava production in the IFS.

Other research used descriptive approach in developing institutional model to increase production and farmers income, based on integrated livestock and rice crops (Rachman. et al., 2009). This research was focused on cassava crops as the main commodity and used the system dynamics approach as the main analysis.