Structural Equation Modelling of Rice Production for Rural Development At Sumani Watershed, Sumatera Barat, Indonesia
インドネシア西スマトラスマニ流域における地域開発のための構造方程式モデル

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1. Introductions

Sumatera Barat Province contributed approximately 3.2 % of national paddy production (BPS, 2013). Sumani watershed is a primary rice producing region. Total area of the watershed is 57090 ha, and around 30 % is paddy field. Administratively, around 90 % Sumani watershed lies in Solok Regency and the rest in Solok Municipality. Rice is not only the staple food in this area but also influence the economics of the domestic people. Rice is exported to another province and another island. So, sustainability rice production in this region is the crucial factor for food security and people prosperity. The total production increase around 32.74 % from 2004 to 2013 but the average yield growth is lower than average national yield

Fig.1 Sumani Watershed

growth around 0.08 ton/ha (Agricultural Agency of Solok Regency, 2014). Beside the increasing conversion of agricultural land due to the population and economic growth, around 55 % of Solok Regency is protected forest (BPS, 2013). These conditions become the reason for the intensification as the first choice to increase paddy production. The location of study area is Fig.1.

The intensification approach in order to increase land productivity and cropping index will be determined by climatological and hydrological aspect, technology, agricultural input, social/economic, market and agricultural infrastructures. These factors are related with each other and it is difficult to describe how each factor effected rice productions. Therefore Structural Equation Modelling (SEM) was used as a tools for comprehensive evaluation and assessment of the factors that influence rice production. The objectives of this research are to develop structural equation model to evaluate the complex relationship of several factors that determine rice production in Sumani Watershed and to identify the key factors and constraint that influence paddy production in existing condition as a base for future investment.

2. Methodology

Research was conducted by several steps including research location observation, interview with farmers and government officers, collecting secondary data (climatological,

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hydrological, agricultural input, technology and social/economic), hypothesis formulation and model development. To get more information about agriculture sector in research location, interview was conducted with officers from Agricultural Agency of Solok Regency, officer of Public Works and farmers to gather information from different perspective. The data was collected for each Sub Districts of Solok Regency that lies in Sumani Watershed. The period of data is from 2004-2014. Hypothesis was formulated based on result of observation, interview and secondary data collection. Then structural equation model developed by using lavaan (latent variables analysis) within the Comprehensive R Archive Network (CRAN).

3. Result and Discussion

The hypothesis of the model was formulated. (1) The increasing rice production have been done through intensification approach, therefore the increasing yield and cropping index determine the increasing rice production (2) The direct factors that affect rice production are potential plant growth, production technology and irrigation system, while the indirect factors are demand of rice and market/post-harvest facilities.

Applying SEM for above hypothesis, SEM was resulted in Fig.2. The simulation
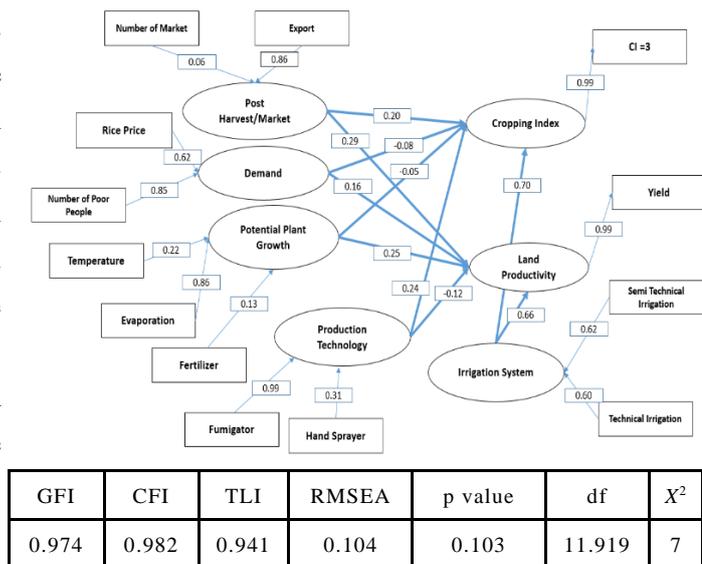
GFI	CFI	TLI	RMSEA	p value	df	X^2
0.974	0.982	0.941	0.104	0.103	11.919	7

Fig.2 Path diagram of structural equation model

result show irrigation system is the most significant factors that effected rice production in Sumani watershed through cropping index and yield. The existing technical and semi technical irrigation system can assure efficient water for rice cultivation in dry season. But in this watershed only 29 % of paddy area are irrigated with technical and semi technical irrigation system.

Production technology application such as fumigator significantly relate with the cropping index, but it caused decrease of the yield. Probably, often the decrease of yield is coming from pest and fumigator should be equipped for each farmer. Model shows that the increasing export and the number of poor family that have significantly related with the increasing yield but have not significantly affected the cropping index. It is means farmers have ability to improve the agricultural input but not enough to increase cropping index due to income limitation.

Structural equation model can possibly explain the real situation in Sumani Watershed. The key factor that affected rice improvement in Sumani watershed is irrigation system through technical irrigation system and semi-technical irrigation. The constraints in rice production in Sumani watershed are the pest issues and farmers poverty. The increasing yield in Sumani watershed respectively low, therefore the investments in all factors that effected the rice production are required. But result shows the improvement irrigation system is a key factor to increase rice production through increasing cropping index and yield.