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Model Increasing Productivity and Sustainability of Lowland Rice Farming in Tanjung Jabung Barat District - Indonesia (With a SEM Partial Least Square Approach)

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Abstract— *This study aims to analyze the structural model of the increase productivity and sustainability of rice farming in West Tanjung Jabung District. The data used are primary data obtained directly from farmers. The sample size used was 90 farmers. Sampling using simple random sampling method. The data analysis used the SEM Partial Least Square structural model. The results of the analysis show that the description of internal factors, external factors of farmers and the adoption of farming technology are in the medium category. The productivity and farming sustainability factors are in a low category. The determinant factor that greatly influences the productivity and sustainability of rice farming is farm income. Farm productivity and sustainability are significantly influenced by farmers 'access to credit, farmers' access to technology, and access to input procurement. The main determinant of productivity is the use of production inputs. The sustainability of farming is mainly determined by economic aspects, especially income. Models for increasing productivity and agricultural sustainability must pay attention to efforts to improve farmers' access to credit, access to technology and access to input procurement. Efforts are needed to handle the input output price for rice so that it can increase farmers' income.*

Keywords— ***Farming, Lowland, Model, Productivity, Sustainability.***

I. INTRODUCTION

The agricultural policy in the food agriculture sub-sector is directed at achieving food self-sufficiency and the realization of food security. For this reason, various programs that have been, are being and will be carried out cannot be separated from; intensification program, extensification, construction and repair of irrigation channels, credit distribution, distribution of subsidized production facilities, more intensive counseling, and assistance to farmers. This program is primarily aimed at increasing farmers' productivity and income. The sustainability of farming will be maintained if the government always strives to increase farmers' productivity and income.

For Jambi Province, the food agriculture sub-sector aims to achieve food self-sufficiency and sustainable agriculture, especially rice production. The rice field area in Jambi Province in 2017 was 140,129 ha, and 29.68% of the land area was a technical irrigation system. Production of 678,128 tons with a productivity of 4.8 tons / ha. In Jambi Province, the center of rice (rice) production is Tanjung Jabung Barat Regency with a harvest area of 9,838 ha, production of 50.396 tons with a productivity of 51.22 kw / ha. . Its contribution to the total land area and lowland rice production of Jambi Province was 7.02% and 7.43%, respectively. For Tanjabbar Regency, Batang Asam District is the second largest rice producer after Pengabuan District.

Lowland rice productivity of 54.61 kw / ha is lower than Indonesia's productivity of 7 tonnes / ha (Hasibuan, 2015). Efforts that can be made are paying attention to and optimizing the use of production inputs, internal and external factors. Internal factors that can affect the productivity of lowland rice farming include age which

can affect the mindset of farmers in managing their rice farming, education which can affect the adoption and innovation of new technologies, farming experience affects the ability to plan farming, and the number of family members who can help. supply of labor for farming.

In addition, external factors for farmers, including access to capital, access to production input procurement, access to technology, irrigation and farming distance affect the productivity of lowland rice farming. Internal factors, external factors, efficient use of production factors are determinants of productivity and sustainability of lowland rice farming.

II. RESEARCH METHODOLOGY

The research focuses were Sri Agung Village and Rawa Medang Village which were drawn purposively. This village was chosen because the main rice producing centers. Primary data were obtained directly from sample farmers through direct interviews with farmers. Secondary data were collected by quoting, copying, and processing data from related agencies, literature studies, journals, and previous research results. The study was conducted from April to July 2020.

Sampling was done by *Simple Random Sampling Method* by using a random table, the number of lowland rice farmers at the research location was Sri Agung Village as many as 404 farmers, RawaMedang Village as many as 375 farmers.

Determination of the sample using the Slovin method with the following formula:

$$n = \frac{N}{1+Ne^2}$$

Where:

n = Number of respondents {KK}

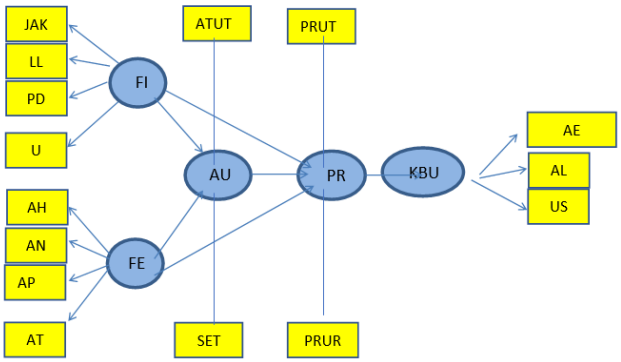
N = farmer population (KK)

e2 = Precision deviation sample size determination (10%)

The sample size obtained was 90 farmers. Sri Agung Village with 46 farmers and RawaMedang Village with 44 farmers.

Data analysis method

. Model estimation using Partial Least Square {PLS} structural model is as follows.



Information:

FI	= Internal factors (exogenous latent variable 1)
JAK	= Number of Family Members (Soul)
LL	= Land area (ha)
PD	= Education (Years)
U	= Age (Years)
TAN	= Income (Rp)
ATU	= Adoption of Farming Technology
ATUT	= Use of Production Inputs as Recommended
SET	= Use of Production Inputs Does Not Appropriate Recommended
PRO	= Farm Productivity
PRUT	= Farm Productivity above the Median
PRUR	= Farm productivity below Median
KBUT	= Rice Farming Sustainability (Score)
FE	= Ex Factorternal (exogenous latent variable 2)
AH	= Price access
AP	= Access to Capital
AI	= Access to Input Procurement
AT	= Access to Technology
AE	= Economic Aspect (Score)
AL	= Environmental Aspects
	= Latent Variable
	= Indicator
	= Coefficient Path

Model Fit Test (Goodness of Fit) consists of

(1) Outer Model is (a) Converegent validity If 0.5 <CV <0.6 is said to be Goodness of Fit Jaya and Sumertajaya, (2008), Latan, H (2012) and Gunarto, M (2018) (b) Discriminant validity Jaya and Sumertajaya (2008) that if DV = AVE> 0.5 it says Goodness of Fit {realistic} DV, (c) Composite reliability If CR> 0.7 is said to be Goodness of Fit {realistic}

$$AVE = \frac{\sum\lambda_i^2}{\sum\lambda_i^2+\sum_i var(\varepsilon_i)} \rho c = \frac{(\sum\lambda_i)^2}{(\sum\lambda_i)^2+\Sigma_{ivar}(\varepsilon_i)},$$

(2) Jaya and Sumertajaya (2008) Latan, H (2012) and Gunarto, M (2018), Inner Model, Goodness of Fit Model seen from Q2 predictive relevance. The magnitude of Q2 shows the predictive relevance value of the structural model. The value of Q square has a value of O <Q square <1. If the value of Q Square is getting closer to one, it means that the structural model has a better predictive relevance model value.

Hypothesis testing

The significance test of the structural model and the reflective variables of internal factors, external factors and the use of production inputs uses probability values. If the p-value <α (0.05), it can be concluded that it has a significant effect. . Jaya and Sumertajaya (2008), that the test results on the inner model have a significant effect, it is said that these variables are classified as determinant variables with exogenous latent variables and endogenous latent variables.

Model of Increasing Productivity and Sustainability of Paddy Rice Farming

The construction of models for increasing productivity and sustainability of lowland rice farming is built from the results of structural model analysis, path diagrams, common path conversions, inner models, outer models and partial hypothesis testing results. The model obtained is a matrix consisting of determinant variables on farm productivity and sustainability.

III. RESULTS AND DISCUSSION

Structural Model Fit Test

Outer model is reviewed from convergent validity, discriminant validity and composite reliability All manifest variables and latent variables are Goodness of fit, except the age of the farmer. The inner model can be seen from the magnitude of R-square (R2) and Q2, it can be seen in Table 1. Table 1 shows that the adoption of farming technology (ATU) can be explained simultaneously by internal factors (FI) and external factors (FE) by 67.0%. Farm productivity (PRU) can be explained simultaneously by internal factors (FI), external factors (FE) and the adoption of farming technology (ATU) by 84.8%

Table 1. Value of R2 Variable InModel of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

	R Squared
ATU	0.670
PRU	0.848
KBUT	0.680
Q Square	0.680

Farming sustainability (KBUT) can be explained simultaneously by internal factors (FI), external factors (FE), technology adoption (ATU) and farm productivity (PRU) by 68.0%.

Goodness of fit structural model can be seen from the value of Q2 as follows: Q2 = 1- (1- R12) (1- R22) (1- R32) = 0.984. The structural model has a very high predictive relevance of 98.4%.

Direct Influence

The direct effect can be seen from the path coefficient value. Figure 1.The direct effect is the effect of the correlation between exogenous variables on exogenous variables, the effect of exogenous variables on endogenous variables can be seen in Table 2.

Table 2. Correlation between Latent Variables in Model of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

Correlation between variables	Path Coefficient	Sample average	Standard Deviation	t-statistics	P Value	Note
FI -> ATU	0.575	0.616	0.180	3,186	0.002	Positive and Significant
FI -> PRU	0.277	0.245	0.184	1,505	0.134	Positive and insignificant
FE -> ATU	0.303	0.263	0.194	1,562	0.119	Positive and insignificant
FE -> PRU	0.497	0.461	0.231	2,149	0.032	Positive and Significant

OR -> PRU	0.238	0.296	0.300	0.791	0.430	Positive and insignificant
PRU -> KBUT	0.825	0.825	0.055	14,932	0,000	Positive and Significant

Table 2 shows that internal factors (FI) directly have a positive and significant effect on the adoption of farming technology (ATU) and have a positive but not significant effect (p-value = 0.134> α = 0.05) on farm productivity (PRU). The internal factor is 10%, there will be a strengthening of farming technology adoption by 5.75% and a strengthening of farm productivity by 2.77%.

External factors directly have a positive but non significant effect (p-value = 0.119> α = 0.05) on the adoption of farming technology, but have a positive and significant effect on farm productivity. If there is a strengthening of external factors by 10%, there will be a strengthening of the adoption of farming technology by 3.03% which is insignificant and a strengthening of farm productivity by 4.97%. Bashir and Koestiono (2018) state that the adoption of farming technology has a positive and significant effect on farm productivity. . Nuryono (2017), Nainggolan FN and Lubis (2019), farm productivity directly has a positive and significant effect on the sustainability of farming.

Indirect Influence

Internal and external factors not only have a direct effect on farm productivity but also indirectly influence through moderation in the adoption of farming technology and farm productivity. The indirect effect of internal and external factors on the sustainability of farming can be seen in Table 3.

Table 3. Indirect Effects Factors in the Model of Increasing Productivity and Sustainability of Rice Farming in the Research Area, 2020

Correlation between variables	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics	P-Value
FI-> ATU -> PRU-> KBUT	0.113	0.145	0.149	0.754	0.451
FI-> ATU-> PRU	0.136	0.177	0.186	0.736	0.462
FI-> PRU-> KBUT	0.228	0.201	0.150	1,517	0.130
FE-> ATU -> PRU-> KBUT	0.059	0.083	0.125	0.475	0.635
FE-> ATU-> PRU	0.072	0.100	0.147	0.489	0.625
FE-> PRU-> KBUT	0.410	0.383	0.200	2,054	0.041
OR-> PRU -> KBUT	0.196	0.244	0.248	0.790	0.430
Total Indirect Effect					
FI-> PRU	0.136	0.177	0.186	0.736	0.462
FI-> KBUT	0.341	0.346	0.136	2,501	0.013
FE-> PRU	0.072	0.100	0.147	0.489	0.625
FE-> KBUT	0.470	0.466	0.146	3,218	0.001
OR-> KBUT	0.196	0.244	0.248	0.790	0.430

Table 3 shows that internal factors indirectly influence the sustainability variable by moderating technology adoption and farm productivity by 0.113 but not significant (p-value = 0.451> α = 0.05), through moderation technology adoption increases farm productivity by 1.36. % but not significant (p-value = 0.462> α = 0.05), and through moderation of farm productivity there will be a strengthening of farming sustainability by 2.28% but not significant (p-value = 0.130> α = 0.05).

Strengthening external factors by 10% through moderating the adoption of farming technology and farm productivity, there will be a strengthening of farming sustainability by 0.59% but not significant (p-value = 0.635> α = 0.05), through moderation the adoption of farming technology will increase farm productivity. equal to 0.72% but not significant (p-value = 0.625> α = 0.05). Tuwo, MA (2011) and Nainggolan et.al (2011) stated that external factors through moderation of farm productivity on farming sustainability have a positive and significant

effect. Strengthening external factors with moderation of farm productivity will result in a significant strengthening of farming sustainability. Adoption of farming technology with moderation of farm productivity on farming sustainability has a positive but not significant effect.

The total coefficient of the indirect effect of internal factors on farm productivity has a positive but non significant effect. It can be interpreted that indirectly every time there is a strengthening of internal factors by 10%, there will be a strengthening of farm productivity by 1.36% but not significant (p-value = 0.462> α = 0.05). The total coefficient of the indirect effect of internal factors on the sustainability of farming has a positive and significant effect. It can be interpreted that indirectly every 10% strengthening of the internal factor will result in the strengthening of the farming sustainability variable by 3.41%. Nuryana, M (2017) The total coefficient of the indirect effect of external factors on farm productivity has a positive but not significant effect.

Total Effect

The total effect is generated from the sum of the direct and indirect effects. The total effect of the two latent variables is the same as the direct effect can be seen in Table 4.

Table 4. Effect of total factors in Model of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

Correlation between variables	Path Coefficient	*Sample average*	*Standard Deviation*	t-statistics	*P Value*
FI -> ATU	0.575	0.616	0.180	3,186	0.002
FI -> PRU	0.413	0.422	0.168	2,459	0.014
FI -> KBUT	0.341	0.346	0.136	2,501	0.013
FE -> ATU	0.303	0.263	0.194	1,562	0.119
FE -> PRU	0.569	0.561	0.160	3,568	0,000
FE -> KBUT	0.470	0.466	0.146	3,218	0.001
OR -> PRU	0.238	0.296	0.300	0.791	0.430
ATU -> KBUT	0.196	0.244	0.248	0.790	0.430
PRU -> KBUT	0.825	0.825	0.055	14,932	0,000

Table 4 shows that the coefficient resulting from the total effect is a total internal factor that has a positive and significant effect (*p-value = 0.002 <0.050)* on the adoption of farming technology, internal factors have a positive and significant effect (*p-value = 0.014 <0.050)* on farm productivity, internal factors have a positive and significant effect (*p-value = 0.013 <0.050)*on the sustainability of farming. Rozandhy et.al (2013) P.he strength of internal factors will significantly increase technology adoption, increase productivity and farm sustainability.

External factors have a positive but not significant effect (*p-value = 0.119> 0.050)* on the adoption of farming technology, external factors have a positive and significant effect (*p-value = 0.000 <0.050)* on farm productivity, external factors have a positive and significant effect (*p-value = 0.001 <0.050)*on the sustainability of farming. Zuriani (2013) Strengthening external factors will significantly increase the adoption of farming technology, increase productivity and farm sustainability.

Adoption of farming technology has a positive but not significant effect (*p-value = 0.430> 0.050)* on farm productivity, the adoption of farming technology has a positive but insignificant effect (*p-value = 0.430> 0.050)*. Bananiek and Abidin (2013) and Wongkaret.al (2016) Increasing the adoption of farming technology will significantly increase the productivity and sustainability of farming.

Conversion of the Similarity Path Diagram

The conversion of path diagrams and PLS measurements into structural equations aims to express the causality correlation between various constructs whose values can be found in the PLS software from the PLS algorithm menu. Internal and external factor variable indicator path diagram factors that influence the sustainability of lowland rice farming generated through the PLS algorithm can be seen in Figure 3

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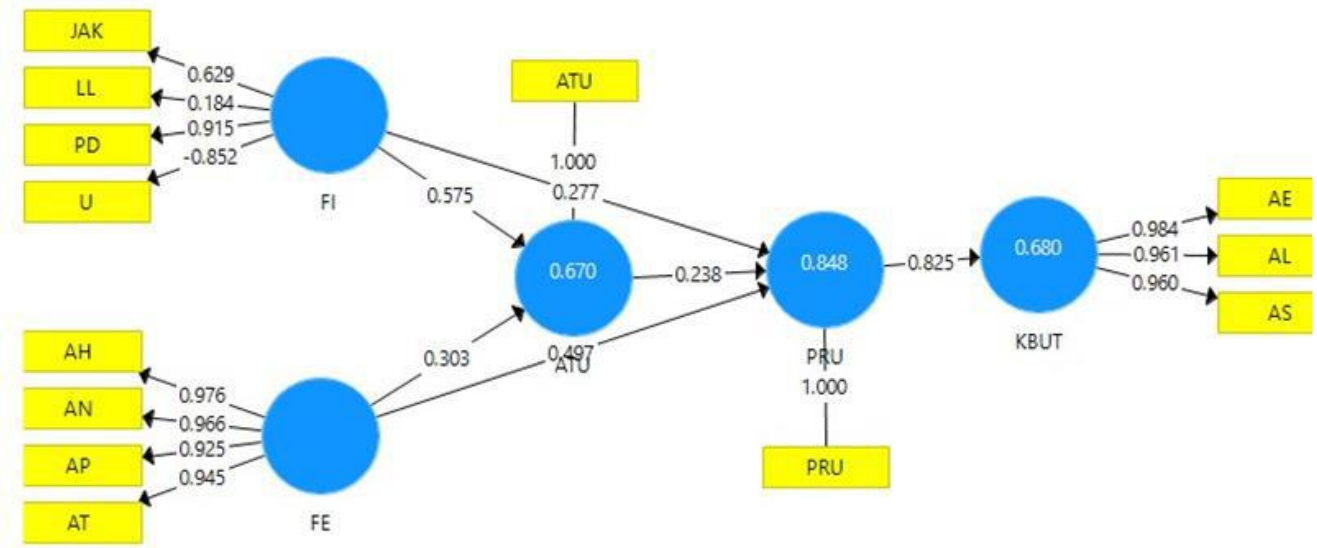

Fig.3. Path diagram of the variable indicator in Model of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

Analysis of the Correlation Coefficient Between Latent Variables

Analysis of the correlation coefficient on latent variables aims to see the rela between latent variables. The results of the correlation estimation between latent variables can be seen in Table 5.

Table 5. Correlation Between Latent Variables in Model of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

	FI	FE	ATU	PRU	KBUT
FI	1,000	0.711	0.790	0.818	0.709
FE	0.711	1,000	0.712	0.863	0.941
ATU	0.790	0.712	1,000	0.810	0.719
PRU	0.818	0.863	0.810	1,000	0.825
KBUT	0.709	0.941	0.719	0.825	1,000

Table 5: Internal factors (FI) have a relationship with external variables (FE), technology adoption (ATU), productivity (PRU) and farming sustainability (KBUT) respectively 71,1%; 79,0%; 81,8%; and 70,9% external factors (FE) have a relationship with ATU, PRU, and KBUT respectively 71,2%; 86,3%; and 94,1% technology adoption (ATU) has a relationship with PRU and KBUT of 81.0 percent and 71.9. percent. Analysis of the Influence of Indicators on Latent Variables
The effect of indicators on the latent variables is seen in Table6.

Table 6. Effect of Indicators on Inner Latent Variables Model of Increasing Productivity and Sustainability of Paddy Rice Farming in the Research Area, 2020

Correlation	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (O / STDE)	*P-Value*
JAK <- FI	0.629	0.581	0.239	2,635	0.009
LL <- FI	0.184	0.181	0.310	0.594	0.553
PD <- FI	0.915	0.913	0.029	31,247	0,000
U <- FI	-0.852	-0,840	0.078	10,973	0,000
AH <- FE	0.976	0.978	0.007	141,603	0,000
AN <- FE	0.966	0.966	0.011	85,432	0,000
AP <- FE	0.925	0.932	0.032	28,490	0,000

AT <- FE	0.945	0.949	0.019	50,996	0,000
ATU <- ATU	1,000	1,000	0,000		
PRU <- PRU	1,000	1,000	0,000		
AE <-BUT	0.984	0.984	0.006	168,536	0,000
AL <- KBUT	0.961	0.962	0.012	77,042	0,000
AS <- KBUT	0.960	0.959	0.015	66,122	0,000

Source: Smart PLS Data Processing Results, 2020

Table 6 shows that the effect of manifest on the latent variable. All manifest variables on latent variables have a p-value = 0.000 <0.010) which means that they have a very real effect. ***First***, the number of family members, land area, education and age jointly able to measure and explain the latent variable is an internal factor, except for age where it has a negative coefficient. . Strengthening the manifest number of family members, land area, education and age by 10%, then the internal factor variables will be strengthened respectively by 6.26%, 1.84%, 9.15% and -0.852.***Second***, access to prices, market access, access to counseling and access to technology are simultaneously able to explain the variables of external factors. . Strengthening the manifest variables of price access, market access, extension access and technology access by 10% will result in strengthening of external variables by 9.76%, 9.66%, 9.25% and 9.45%. ***Third***, economic aspects, environmental aspects and social aspects together explain the variable of farming sustainability. The coefficient of each of the manifestations of farming sustainability is an economic aspect of 0.984, an environmental aspect of 0.961 and a social aspect of 0.960. Hoar and Yosefina (2017) that the strengthening of economic aspects, environmental aspects and social aspects has a significant effect on sustainability.

Model of Increasing Productivity and Sustainability of Rice Farming

The factors of farm productivity and sustainability are determined by internal factors and external factors. The internal factor that greatly influences productivity and sustainability is the income factor. The income factor is a key factor as a major economic aspect in the sustainability of farming. External factors that become determinants of productivity and farming sustainability are access to credit, access to inputs, access to technology and irrigation. This determinant factor is a key factor in the use of production and production inputs. This in turn is a key factor in productivity and sustainability. The model for increasing productivity and sustainability of rice farming based on the determinant factors can be seen in the following chart.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

Description of internal factors, farmer external factors and the use of production inputs are in the medium category. The categories of productivity and sustainability of rice farming are in the low category. The internal factor which becomes the determinant factor of productivity and sustainability of rice farming is the variable of farm income. External factors that become determinants of productivity and farming sustainability are access to credit, access to technology, access to inputs and irrigation. The use of production inputs which is a determinant factor for the productivity and sustainability of rice farming is the area of land and the use of fertilizers. In order to increase productivity and sustainability, there is a need for guidance and counseling for farmers to overcome problems that come from internal factors. Increasing farmers' access to credit and access to technology of farming. . Guidance on the use of production inputs and guidance on economic and environmental aspects of farming sustainability. Increasing productivity and sustainability of rice farming needs to pay attention to the determinant factors in production and the determinants of the sustainability of farming.

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