

# The effect of wetland management and Agricultural Productivity on Environmental Sustainability in South Sumatra

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## ABSTRACT

Indonesia's population in 2020 is around 271 million, so it requires 30.24 million tons of rice for consumption. Rice produced from the agricultural culture on dry land and swamps. Swamplands consist of wetland and tidal lowlands. This study aims to examine the effect of wetland swamp management and agricultural productivity on environmental sustainability. The research method used is quantitative to know the influence between variables using statistical analysis. The results showed that the average score of wetland management was 3.33 and the Respondent Achievement Level (RAL) was 83.39% at the interval (80-<90), it was well categorized. The productivity of agricultural products an average score of 3.27 and the Respondent Achievement Level (RAL) of 81.79% good category. The average score for environmental sustainability is 3.29 and the Respondent Achievement Level (RAL) 82.21%, including the good of criteria categories. Wetland management and agricultural productivity partially and simultaneously effect on environmental sustainability. The influence is 36.2%, the remaining 63.8% do not influence the other variables outside the regression equation of this study. This influence of level interpreted by the correlation coefficient, is in the interval 0.20-0.399, meaning that the independent variable has a low effect on the dependent variable. Wetland management and agricultural productivity are not the main factors that affect the environmental sustainability of the swamp. The other factors are not included, in the variables of this study.

*Key words:* Agricultural production, Wetland swamp, Environmental sustainability

## Introduction

Rice is the staple food of more than half of the world's population. The need for rice globally is produced and consumed by the Asian population, is around 90% of the population needs rice as a primary need (Bandumula, 2018). Indonesian people consume an average of 154 kg of rice for one person by the year. The Indonesian people's rice consumption needs 154 per capita by the year, while China is

only 90 kg, India 74 kg, Thailand 100 kg and the Philippines 100 kg 89 kg (Febriaty, 2016). Agriculture in Indonesia country utilizes swampland to increase agricultural production by optimizing lowland swamp farming (Ak *et al.*, 2021).

The area of agricultural land including swamps in 2019 is 10.68 million hectares, and rice production of 54.60 million tons of milled dry unhulled rice, when converted to rice for consumption, 31.3 million tons of rice will be produced (BPS, 2020). The

harvested area for rice in 2020 was 10.79 million hectares, an increase of 108.93 thousand hectares or 1.02 per cent compared to the harvest area in 2019 of 10.68 million hectares. Rice production in 2020 amounted to 55.16 million tons, an increase of 556.51 thousand tons or 1.02 per cent compared to production in 2019 just amounted to 54.60 million tons. Rice production in 2020 converted into rice for food consumption for the population, rice production in 2020 is estimated at 31.6 million tons, an increase of 314.10 thousand tons or one per cent compared to 2019 which amounted to 31.3 million tons of rice (BPS, 2020).

In 2020 Indonesia's population people estimated to reach 271 million people. The average rice consumption is 111.58 kg for a person by the year, so the amount of rice needed is 30.24 million tons (<https://www.pertanian.go.id>, n.d.). The amount of rice production in 2020, if we compare it to the people's consumption needs, there will still be 1.1 million tons remaining as national rice reserves. Regulation of the Minister of Agriculture number 11 of 2018, National Rice Reserves (NRR) is 20% of the total national rice demand (Sulaiman *et al.*, 2018). The rice reserve requirement for 2020 is 6.05 million tonnes. Total the national to consumption needs are reduced by a rice reserve of 1.1 million tons, then the rice consumption needs will still experience a deficit of 4.95 million tons. Therefore, Indonesia must import an average of 1.3 million tons of rice a year.

Data from the Central Statistics Agency (CSA) of South Sumatra Province, the harvest area where 2019 is 539.32 thousand hectares, with a productions level is 2.603,40 thousand tons of Milled Dried Unhulled (MDU). The production rate to converted into rice is 1.49 million tons. The harvest area for the 2020 planting season is 551.24 thousand hectares, with a production rate of 2.696,88 thousand tons of Milled Dried Unhulled (MDU), so that when converted to rice it becomes 1.54 million tons (Central Bureau of Statistic of South, 2020). The population of South Sumatra in 2020 is 8.6 million people. If converted to the average rice requirement of 111.58 kg per capita per year, then 959,59 kg thousand rice is needed for one year's consumption. The demand for rice, agricultural cultivation is carried out from dry land and swamps.

Swamplands found on the islands of Sumatra, Kalimantan, Sulawesi and Papua. Indonesia has around 34.12 million hectares of swamps, of which 14.18 million hectares or 41% has the potential for

agricultural land. The area of wetland swamp used for agricultural land is around 6.77 million hectares. The swampland managed by the government is 3.77 million hectares. The remaining 3 million hectares are done independently by the community (Sulaiman *et al.*, 2018). Lowland swamp hydroecology also a wetland, lowland, peatland, inland, and deepwater land are wet areas throughout the year with rainfall of 2000 mm per year, they have 5-7 months of wet months (Haryono, Muhammad Noor, Haris Syahbuddin, 2013).

Swampland has divided into two typologies, namely tidal swamps and swamps. The tidal swampland has located in lowland areas, so that periodic overflow and puddle of water (Ar-Riza, 2008). The tidal swampland period of inundation can be predicted clearly, namely at the time of the new moon or when the full moon (Arsyad *et al.*, 2013). Tidal land is a lowland agroecosystem used for agricultural cultivation (Purba *et al.*, 2020). The growing season for riparian rice in swamps begins at the end of the rainy season before flood puddle recede completely (Ramadhani *et al.*, 2018). The intensity of agricultural activities on swamps is very low, mainly due to two extreme impish conditions, namely flooding during the rainy season and drought during the dry season (Lakitan *et al.*, 2018). Apart from natural factors, soil fertility is also a major problem for swamp farming in Indonesia (Kartika *et al.*, 2018).

Swampland is the largest rice producer in South Sumatra. Swamplands have scattered in Banyuasin, Ogan Ilir, Ogan Komering Ilir, Palembang and Musi Rawas. The area of swamps in South Sumatra is 483.000 hectares. Lowland swamps are around 240.000 hectares, which the remaining 772.000 hectares are dry land (Permana, 2020). Ogan Ilir Regency has 266.607 hectares a land area, consisting of 16 sub-districts, 14 sub-districts and 227 villages (Muhammad Kurniawan, Emil El Faisal, 2019). The sub-districts that have the most extensive swamplands are central Pemulutan and west Pemulutan. The land area of the two sub-districts are 12,292 hectares, has consisting of 14.475 hectares of lowland swamps, and the remaining 2.183 hectares are lowland and river areas (Desinta, 2019). Soil fertility also affects environmental sustainability (Fan, 2020). Degraded agricultural land and reduced soil fertility cause unsustainable agriculture. Soil fertilities of wetland can be increased by utilizing plants that grow in swamps such as; *Polygonum*

barbatum, *Neptunia prostrata*, *Phragmites karka*, *Ludwigia adscendens* and *Phragmites communis*, which can be used as a source of compost, all plants adaptable and grows well in acid soils (Bernas *et al.*, 2015).

The original inhabitants of Pemulutan are the Ogan tribe consisting of 3 sub-tribes, namely; *Pegagan Ulu* tribe, *Penesak* tribe, and *Pegagan Ilir* tribe. They live in lowland areas and along the banks of the Ogan river. The occupations are swamp farming, trade, labour and other businesses. The Ogan ethnic has to do swamp farming for generations using a floating nursery system. Floating rice nursery techniques are local wisdom adapting to nature for environmental sustainability. This agricultural technique can conserve lowland swamp ecosystems so that the environment as a provider of resources for human life can maintain its carrying capacity (Rahmi *et al.*, 2017). The floating rice nursery method has been using since the traditionalist generation (Sakir *et al.*, 2020). Research on rice production in tidal swamps and lowlands has more widely conducted. However, there is not much research on swamp management, agricultural productivity and environmental sustainability. Environmental sustainability can be realizing which environment as a provider of resourcing for human life can maintain its carrying capacity in ecological, economic and social aspects (Juniah *et al.*, 2018)(Juniah, 2018). Therefore this research has to know the important determine the partial and simultaneous effect of lowland swamp management, agricultural productivity and environmental sustainability.

**Methodology**

**Research Method**

The research location has conducted in Pemulutan district, Ogan Ilir Regency, South Sumatra, Indonesia. There are several reasons for choosing Pemulutan District to be the research location:

1. The research location has the most extensive swamplands in Ogan Ilir Regency, South Sumatra.
2. The characteristics of lowland swamps are very varied, namely shallow, middle, and deep.
3. The swamp farming system in Pemulutan is distinctive compared to other regions in Indonesia.
4. The research methodology used is quantitative with research design, testing and measurement

procedures using statistical analysis (Marvasti, 2018):

**Data Processing Method**

The population of this research are the farmers which members of the Farmer Group Association (FGA). The number of these groups was 221 with 5,632 members. They are spreading over 25 villages in Pemulutan District, Ogan Ilir Regency, South Sumatra. The determination of the number of samples using a probability sampling method with a proportional random sampling technique (Yusuf, 2019). The determinate of the number of sampling in this study using the theory developed by Isaac and Michael, of the significance level of 5 per cent (Sugiyono, 2019).

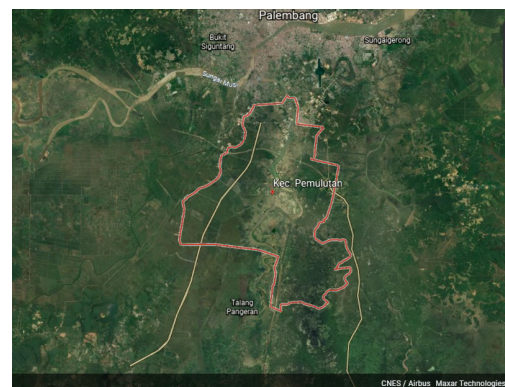
$$S = \frac{\lambda^2 \cdot N \cdot P \cdot Q}{d^2(N-1) + \lambda^2 \cdot N \cdot P \cdot Q}$$

where:  
 $\lambda^2$  = Chi-squared with  
 DK = 1, the 5% error rate is 3,841  
 S = number of samples  
 P = Q = 0.5; d = 0.05  
 N = Total population (5,632)

Using the Isaac and Michael formula with an error tolerance limit of 5% (0.05), the accuracy rate is 95%, and the sample size is 338 respondents. The variables in this study consisted of 3 variables, namely; wetland swamp management (X1) (Waluyo and Suparwoto, 2008); (Tafarini and Yazid, 2018). Agricultural productivity (X2) (Siaga *et al.*, 2018); (Lakitan *et al.*, 2018), and environmental sustainability (Y) (Juniah *et al.*, 2018).

**Measurement Scale**

The Likert scale has used to measure attitudes, re-



**Fig. 1.** Research of sites, Pemulutan District, South Sumatra, Indonesia

spondents' opinions about social phenomena (Imron, 2019). Exogenous and endogenous variables are translating into variable indicators, then these indicators serve as a guide for compiling questionnaires and alternative answers. The determination of the respondent's answer score is; strongly agree = 4, agree = 3, disagree = , and strongly disagree = 1. Furthermore, testing the validity and reliability of the Pearson Bivariate (Pearson Moment Product) and Item-Total Correlation Correction.

The classical assumption test to carried out to determine whether the Ordinary Least Square (OLS) linear regression model has a classic assumption problem. The classical assumption collinearity, heteroscedasticity and autocorrelation (Priyastama, 2020). In this study has used three variables, namely; Lowland swamp management and agricultural productivity (independent), and environmental sustainability (dependent). Control uses two or more predictors to research can use multiple regression analysis (Yusuf, 2019).

**Multiple regression equation :**

$$Y = b_0 + b_1X_1 + b_2X_2$$

where:

Y = Environmental sustainability

X1 = Wetland management

X2 = Agricultural productivity

b0 = Constant

b1,2 = Regression coefficient

The wetland management (X<sub>1</sub>) and Agricultural productivity (X<sub>2</sub>) variables individually affect environmental sustainability, so the t-test is carried out with the conclusion; If the significance value <0.05 or t count> t table, then there is a partial effect of X<sub>1</sub>, X<sub>2</sub> on Y. Conversely, if the significance value> 0.05 or t count <t table, there is no partial effect of the variables X1, X2 on Y. Variable X jointly affects variable Y is done by using simultaneous F test with the provisions; If the significance value <0.05 or F count> F table, then there is an effect of variable X simultaneously on Y. Conversely, if the significance value> 0.05 or F count <F table, then there is no effect of variable x simultaneously on variable Y.

**The coefficient of determination (R Square)**

The coefficient of determination in multiple linear regression which carried out how much the ability of the independent variable to explain the dependent variable (I Made Yuliara, 2016). The Achieve-

ment Level (RAL) of several variables X on the fluctuation variation of Y is expressed in percentage using the formula:

where :

RAL : Respondent Achievement Level

MSR : Mean Score Responden

MLV : Maximum Likert Value

Respondent Achievement Level (RAL) with an interval of 90% -<100%, very good criteria, 80% -<90% good criteria, 65%-<80% interval, good enough category, 55% - <65% interval, poor category, and the 0% - <55% interval is in the bad category. Frequency distribution and calculation of the average value of the Respondent Achievement Level (RAL). Furthermore, testing the validity and reliability of each question item according to the indicators of each variable.

**Results and Discussion**

**Respondent Characteristics**

Respondents in this study were the Association of Farmer Groups (AFG). The totalling 338 people for spread over 25 villages in Pemulutan district, Ogan Ilir Regency, South Sumatra. The sampling technique used was proportional random sampling. The obtain of distribution samples for each farmer group.

Figure 2. shows the percentage of respondents' age, namely; farmers with age or 18%, age 41-50 years as many as 95 people or 28%, aged 51-60 years 23-30 years as many as 30 people or 9%, aged 31-40 years as many as 60 people or 18%, and age e" 61 years as many as 66 people or 19%. The average swamp farmers in Pemulutan are still productive for work.

**Characteristics of agricultural land**

Wetland swamps are dividing into three types,

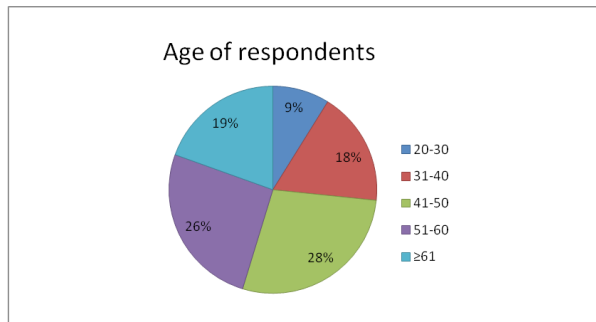


Fig. 2. Respondent age interval



namely; 1) shallow swamp, 2) medium swamp, and 3) deep swamp. Shallow swamps or bunds, areas that have inundation height between 25-50 cm. The inundation period is at least three months a year. Middle fields areas have inundation height between 50-100 cm, inundation period 3-6 months in a year. The lower topography than shallow groves and is the area between shallow and deep grooves. Deep swamp, which an area that has an inundation height > 100 cm with inundation time > 6 months in a year (Muhammad Alwi, 2006).

Figure 5. is a typology of swamp inundation in Pemulutan District, Ogan Ilir Regency, South Sumatra as follows:

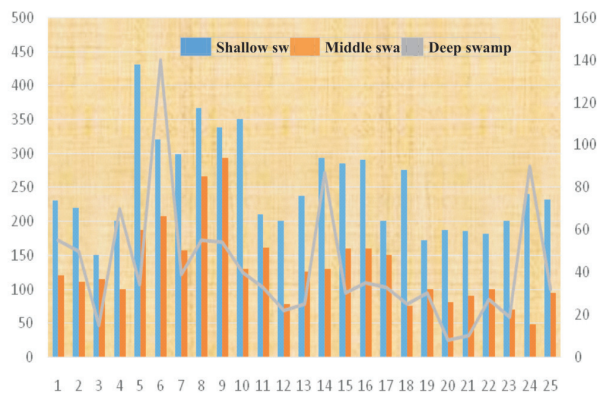


Fig.3. Data from the Agricultural Extension Center, types of swamps in Pemulutan (2018-2020) were shallow swamp, middle swamp and deep swamp.

**Classic assumption test**

The normality test is using to see whether the residual value generated from the regression has normally distributed or not normally distributed. The standardized residual regression plot is normally distributing if the data spread around the diagonal line. And do not normally distribute if the data spreads far from the diagonal line, or does not follow the diagonal line. The results normality test can be concluded that the data is declared normally distributed because all data spread along the diagonal line.

The multicollinearity test results aim to determine the perfect correlation or approaching perfection between the independent variables (X) in the regression model. Multicollinearity is declared non-existent if the tolerance value is > 0.1 and the Variable Inflation Factor value is VIF < 5. Based on collinearity statistics, the tolerance value is 0.717, and

the VIF value is 1.394. Because the tolerance value is > 0.1 and the VIF value < 5, it can be concluded that there is no multicollinearity.

Heteroscedasticity is the unequal variance of the residuals from one observation to another. The decision of whether or not heteroscedasticity exists is by looking at the scatterplot graph between standardized predicted value (ZPRED) and studentized residual (SRESID). There is a certain pattern such as dots forming a certain and regular pattern, then heteroscedasticity occurs. Conversely, if there is no clear pattern on the Y axis, there will be no heteroscedasticity. Based on the results of the scatterplot, it can be concluded that heteroscedasticity does not occur because there is no similarity in variance from the residuals of one observation to another.

The autocorrelation test aims to test whether in the linear regression model. There is a correlation between confounding error in period t (year of observation) and confounding error in period t-1 (previous year). The basis for decision making is; a)  $DU < DW < 4-DU$ , then the decision is accepting, and there is no autocorrelation.

b)  $DW < DL$  or  $DW > 4-DL$ , the conclusion is rejected, meaning there is autocorrelation. c)  $DL < DW < DU$  or  $4-DU < DW < 4-DL$  means there is no definite conclusion.

Where:

$$DU < DW < 4-DU$$

$$1.833 < 1.841 < 2.167$$

$$N = 338$$

$$K = 2$$

$$DL = 1.810$$

$$DU = 1.833$$

$$DW = 1.841$$

The following displays the data according to the decision basis as follows:

Based on the output model summary, the Durbin Watson value is 1.841, located between  $DU < DW < 4-DU$  ( $1.833 < 1.841 < 2.167$ ), the decision is accepted and there is no autocorrelation.

This linearity test needs to be done, to find out which model is proven is a linear model or not. The decision is linearity or nonlinear, it must meet the following criteria: a) If the value is sig linearity > than 0.05, there is a linearity relationship between the independent variable (X) and the dependent (Y). b) If the value is sig linearity < than 0.05, so there is no linearity relationship between the independent variable (X) and the dependent (Y).

### Respondent Achievement Level (RAL)

Wetland swamp management variable (X1) has 11 questions, agricultural productivity variable (X2) has 12 questions, and environmental sustainability (Y) has 14 questions. The Respondent Achievement Level (RAL) for the distribution of the questionnaires carried out. Its' can be explained in table 1 to table 3. Ordinal data from the results of respondents' answers using a likert scale, namely; Strongly Agree (SA), Agree (A), Disagree (DA) and Strongly Disagree (SDA), can be presented in the following table:

Wetland swamp management as an independent variable (X1) in table 1, can be explained about the level of achievement of the respondents for each question as follows:

Question X1-1 about floating rice nursery techniques practised by farmers in Pemulutan. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 63%, the Agree criteria (A) 28.1%, 6.5% Disagree (DA), and 2.4% Strongly Disagree (SDA) criteria. The average score was 3.52, with the respondent's achievement level of 87.94%. The percentage of respondents' answers for the level of achievement is in the interval (80% - <90%), in a good category.

Question X1-2 regarding floating rice nursery techniques is an effective for planting because the material and media were easy to find out. The largest percentage of all instrument answer choices is in the criteria of Strongly Agree (SA) as much as 55.9%, Agree (A) 34.6.1%, Disagree (DA) 7.7%, and

Strongly Disagree (SDA) as much as 1.8%. The results of the distribution of the questionnaires showed an average score of 3.45, with the respondent's achievement level of 86.16%. The average score and achievement level score are in the interval (80% - <90%) or good category.

Questions X1-3, the *Berondong* and *Reamun* grass are easy to find for floating rice nurseries. The results of distributing questionnaires an average score of 3.28 with the respondent's achievement level of 82.10%. The average score and the risk level score indicate a good. The *Berondong* grass and *Reamun* as a medium for making floating rice nurseries easy to obtain. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 51.8%, 30.2% agreeing criteria, 12.7% Disagree (DA) and Strongly Disagree (SDA) as much as 5.3%.

Question X1-4, the floating rice nurseries has been carried out by the farming community in Pemulutan from generation to generation (hereditary). The distribution of the questionnaire an average score of 3.56. The level of respondent achievement of 90.31%. The average score and the risk level score indicated a very good, meaning that the floating rice nursery has been carried out by the farming community in Pemulutan and from generation to generation (hereditary). The floating rice nursery is the local wisdom of the Pemulutan community, which as the manager of wetland swamp farming. The greatest of the percentage all instrument answer choices is in the Strongly Agree (SA) criteria, namely 66.3%. The Agree (A) 28.7%, and none of the respon-

**Tabel. 1.** Respondent Achievement Level (RAL) Wetland Swamp Management (X1)

N	Question	Respondents' answers								Average	RAL (%)	Category
		SA		A		DA		SDA				
		f	%	f	%	f	%	f	%			
1	X1-1	213	63	95	28,1	22	6,5	8	2,4	3,52	87,94	Good
2	X1-2	189	55,9	117	34,6	26	7,7	6	1,8	3,45	86,16	Good
3	X1-3	175	51,8	102	30,2	43	12,7	18	5,3	3,28	82,10	Good
4	X1-4	224	66,3	97	28,7	17	5	0	0	3,56	90,31	Very good
5	X1-5	170	50,3	119	35,2	28	8,3	21	6,2	3,30	82,39	Good
6	X1-6	132	39,1	156	46,2	46	13,6	4	1,2	3,23	80,76	Good
7	X1-7	82	24,3	134	39,6	108	32	14	4,1	2,84	71,00	Good enough
8	X1-8	152	45	123	36,4	60	17,8	3	0,9	3,25	81,36	Good
9	X1-9	169	50	117	34,6	52	15,4	0	0	3,35	83,65	Good
10	X1-10	207	61,2	120	35,5	4	1,2	7	2,1	3,55	88,97	Good
11	X1-11	172	50,9	111	32,8	41	12,1	14	4,1	3,30	82,61	Good
Score total										3,33	83,39	Good

dents answered Disagree (DA), and Strongly Disagree (SDA).

Question X1-5, regarding the inheritance of the floating rice nursery. The results of distributing questionnaires showed an average score of 3.30 with a respondent's level of achievement of 82.39%. The average score and achievement level figures show a good, meaning that the farming community in Pemulutan will pass on floating rice nurseries to the next generation. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 50.3%, on Agree criteria (A) 35.2%, Disagree (DA) 8.3% and Strongly Disagree (SDA) criteria as much as 6.2 %.

Question X1-6 regarding the period of inundation of agricultural land in Pemulutan for less than three months. The results of the distribution of the questionnaires showed an average score of 3.23, the respondent's achievement level of 87.76%. The average score and achievement level figures indicate a good. The largest percentage of all instrument answer choices is in the criteria of Agree (A) as much as 46.2%, Strongly Agree (SA) 39.1%, Disagree (DA) 13.6%, and respondents who answered Strongly Disagree (SDA) 1, 2%.

Question X1-7 regarding the period of inundation of agricultural land in Pemulutan for 3-6 months. The distributing questionnaires showed an average score of 2.84. The respondent's achievement level of 71%. The average score and achievement level figures indicate enough category. The largest percentage of all instrument answer choices is in the Agree criteria (A), namely 39.6%, Disagree criteria (DA) 32%, Strongly Agree (SA) criteria 24.3%, and

Strongly Disagree (SDA) criteria as much as 4.1 %.

Question X1-8 regarding the regular planting season 1 April, May, June and July. The results of the distribution of the questionnaires showed an average score of 3.25. The respondent's achievement level of 81.36%. The average score and achievement level figures indicate a good. The largest percentage of all instrument answer choices are in the Strongly Agree (SA) 45%, on Agree category (A) 36.4%, Disagree (DA) 17.8% and respondents who answered Strongly Disagree (SDA) by 9%.

Questions X1-9 regarding planting season 2 for *IP 200* were conducting in August, September and October. The results of distributing questionnaires showed an average score of 3.35 with a respondent's achievement level of 83.65%. The average score and achievement level figures indicate a good. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 50%, Agree (A) 34.6%, Disagree (DA) 15.4%, and none of the respondents answered Strongly Disagree (SDA).

Questions X1-10, about farming communities in Pemulutan, get information about the low swamp agricultural management system. The results of the distribution of the questionnaire showed an average score of 3.55, with the respondent's achievement level of 88.97%. The average score and achievement level figures indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria as much as 61.2%, on Agree to category (A) 35.5%, Disagree (DA) 1.2% and respondents who answered Strongly Disagree (SDA) as many as 2,1%.

Question X1-11, regarding the management of

**Tabel. 2.** Respondent Achievement Level (RAL) Agricultural productivity (X2)

N	Question	Respondents' answers								Average	RAL (%)	Category
		SA		A		DA		SDA				
		f	%	f	%	f	%	f	%			
1	X2-1	107	31,7	130	38,5	71	21	30	8,9	2,92	73,22	Good enough
2	X2-2	178	52,7	134	39,6	26	7,7	0	0	3,44	86,24	Good
3	X2-3	226	66,9	98	29	10	3	4	1,2	3,61	90,38	Very good
4	X2-4	165	48,8	116	34,3	53	15,7	4	1,2	3,30	82,69	Good
5	X2-5	197	58,3	120	35,5	15	4,4	6	1,8	3,50	87,57	Good
6	X2-6	124	36,7	164	48,5	36	10,7	14	4,1	3,17	79,43	Good enough
7	X2-7	158	46,7	140	41,4	21	6,2	19	5,6	3,29	82,32	Good
8	X2-8	166	49,1	134	39,6	22	6,5	16	4,7	3,33	83,28	Good
9	X2-9	181	53,6	119	35,2	19	5,6	19	5,6	3,36	84,17	Good
10	X2-10	178	52,7	126	37,3	23	6,8	11	3,3	3,39	84,83	Good
11	X2-11	90	26,6	183	54,1	43	12,7	22	6,5	3,00	75,22	Good enough
12	X2-12	125	37,0	95	28,1	71	21,0	47	13,9	2,88	72,04	Good enough
Score total										3,27	81,79	Good



wetland swamps as suboptimal land received special attention from the government. The results of distributing questionnaires showed an average score of 3.30 with a respondent's level of achievement of 82.61%. The average score and achievement level figures indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria namely, 50.9%, on Agree to category (A) 32.8%, Disagree (DA) 12.1% and respondents who answered very Strongly Disagree (SDA) by 4.1%.

Lowland swamp management variable (X1) has a total value of 12,402, with categories; Very good in questions X1-4, good categories are in questions X1-1, X1-2, X1-3, X1-5, X1-6, X1-8, X1-9, X1-10, X1-11, enough category is found in questions X1-7. The average score is 3.33 and the Respondent Achievement Level (RAL) was 83.39%. The concluded that the independent variable (X1) is in good to category.

Wetland swamp management for agricultural land is supporting by abundant water availability. Products of living natural resources and other ecosystems can be used directly by farmers in Pemulutan. Wetlands are highly productive natural ecosystems that maintain and provide high biodiversity of a wide variety of environmental services (Katerås et al., 2013). Wetland swamps provide benefits for ethnicity in Pemulutan. In addition to agricultural cultivation, an average of once a year. Wetland also can be used for fisheries and livestock. The relatively long period of inundation makes farmers have to do the nursery using floating techniques. The media used were "bonding" grass and "reamon" algae as a medium for floating nurseries. Traditional agricultural land management by utilizing natural resources around agricultural, for the local wisdom of Ogan's wetland swamp areas.

Table 2, the variable productivity of agricultural products (X2), was asked 12 questions to the respondents. The results answers about the category of the respondent's level of achievement are presenting for each question.

Question (X2-1) regarding the preparation and processing of community agricultural land in Pemulutan to done traditionally. The results of distributing questionnaires showed an average score of 2.92 with a respondent's level of achievement of 73.22%. The average score and achievement level figures indicate an enough to category. The largest percentage of all instrument answer choices is in the Agree (A) criteria, namely 38.5%, Strongly Agree

(SA) 31.7%, Disagree (DA) 21% and respondents who answered Strongly Disagree (SDA) by 8, 9%.

Question (X2-2) about the agricultural land processing system carried out by Pemulutan community using a hand tractor. The results of the distribution of the questionnaires showed an average score of 3.44, with the respondent's achievement level of 86.24%. The average score and achievement level figures indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 52.7%, on Agree category (A) 39.6%, Disagree (DA) 7.7%, and none of the respondents answered Strongly Disagree (SDA).

Question (X2-3) regarding the selection of superior seeds/varieties can increase agricultural yields of Pemulutan community. The results of distributing questionnaires showed an average score of 3.61 with a respondent's level of achievement of 90.38%. This average score and achievement level score indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 66.9%, on Agree category (A) 29%, Disagree (DA) 3%, and Strongly Disagree (SDA) 1.2%.

Questions (X2-4) regarding the availability of seeds and varieties needed by the community are easy to find. Based on questions about the selection of superior seeds/varieties can increase agricultural yields of Pemulutan community. The results of distributing questionnaires showed an average score of 3.30 with a respondent's level of achievement of 82.69%. The average score and achievement level figures indicate a good to category. The largest percentage of all instrument answer choices are in the Strongly Agree (SA) criteria as much as 48.8%, on Agree category (A) 34.3%, Disagree (DA) 15.7%, and Strongly Disagree (SDA) 1.2%.

Questions (X2-5) about varieties that are often to used are IR.42 and Ciherang. Based on questions about the selection of superior can increase agricultural yields of Pemulutan community. The results of the distribution of the questionnaires showed an average score of 3.50, with the respondent's achievement level of 87.57%. The average score and achievement level figures indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 58.3%, on Agree to category (A) 35.5%, Disagree (DA) 4.4%, and Strongly Disagree (SDA) 1.8 %.



Questions (X2-6) the varieties grown in wetland swamps, such as Inpara and *Inari* varieties. The results of distributing questionnaires showed an average score of 3.17 with a respondent's level of achievement of 79.43%. The average score and the level of achievement of these respondents indicate an enough to category. The largest percentage of all instrument answer choices is in the Agree (A) criteria, namely 48.5%, on Agree to category (A) 36.7%, Disagree (DA) 10.7%, and Strongly Disagree to(SDA) 4.1%.

Questions (X2-7) the farming used by the spacing the community in Pemulutan, when cultivating lowland swamp rice. The results of distributing questionnaires showed an average score of 3.29 with a respondent's level of achievement of 82.32%. The average score and the level of achievement of these respondents indicate a good to category. The largest percentage of all instrument answer choices is in the criteria of Strongly Agree (SA) as much as 46.7%, on Agree to category (A) 41.4%, Disagree (DA) 6.2% and Strongly Disagree (SDA) 5.6%.

Questions (X2-8) regarding spacing affect rice production in lowland swamps. The results of the distribution of the questionnaires showed an average score of 3.33, with the respondent's achievement level of 83.28%. The average score and the level of achievement of these respondents indicate a good to category. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria as much as 49.1%, on Agree to category (A) 39.6%, Disagree (DA) 6.5%, and Strongly Disagree (SDA) 4.7%.

Questions (X2-9) regarding fertilization by farming communities using organic materials can increase rice production. Based on the results of distributing questionnaires, the average score was 3.36, with the respondent's achievement level of 84.17%. The average score and the level of achievement of these respondents indicate a good to category. The largest percentage of all instrument answer choices is in the criteria of Strongly Agree (SA) as much as 53.6%, on Agree category (A) 35.2%, Disagree (DA), and Strongly Disagree (SDA) 5.6%.

Questions (X2-10) regarding the control of plant pests are carrying so that agricultural yields can increase. The results of the distribution of the questionnaires showed an average score of 3.39, with the respondent's achievement level of 84.83%. The average score and the level of achievement of these respondents indicate a good to category. The largest percentage of all instrument answer choices are in the Strongly Agree (SA) criteria as much as 52.7%, on Agree to category (A) 37.3%, Disagree (DA) 6.8%, and Strongly Disagree (SDA) 3.3%.

Questions (X2-11) are questions about the production rate of harvested dry grain ranging from 4-7 tonnes/ha. The results of distributing questionnaires showed an average score of 3.0 with a respondent's level of achievement of 75.22%. The average score and the level of achievement of these respondents indicate an enough to category. The largest percentage of all instrument answer choices is in the Agree criteria (A), namely 54.1%, Strongly Agree (SA) 26.6%, Disagree (DA) 12.7%, and Strongly Disagree (SDA) 6.5 %.

**Tabel. 3.** Respondent Achievement Level (RAL) Environmental sustainability (Y)

N	Question	Respondents' answers								Average	RAL (%)	Category
		SA		A		DA		SDA				
		f	%	f	%	f	%	f	%			
1	Y-1	146	43,2	137	40,5	55	16,3	0	0	3,27	81,73	Good
2	Y-2	148	43,8	120	35,5	31	9,2	39	11,5	3,11	77,88	Good enough
3	Y-3	132	39,1	178	52,7	20	5,9	8	2,4	3,28	82,10	Good
4	Y-4	147	43,5	139	41,1	22	6,5	30	8,9	3,19	79,81	Good enough
5	Y-5	184	54,4	132	39,1	15	4,4	7	2,1	3,46	86,46	Good
6	Y-6	193	57,1	115	34	30	8,9	0	0	3,48	87,06	Good
7	Y-7	159	47	146	43,2	29	8,6	4	1,2	3,36	84,02	Good
8	Y-8	98	29	165	48,8	36	10,7	39	11,5	2,95	73,82	Good enough
9	Y-9	161	47,6	134	39,6	43	12,7	0	0	3,35	83,73	Good
10	Y-10	181	53,6	119	35,2	38	11,2	0	0	3,42	85,58	Good
11	Y-11	175	51,8	137	40,5	12	3,6	14	4,1	3,40	84,98	Good
12	Y-12	163	48,2	150	44,4	13	3,8	12	3,6	3,37	84,32	Good
13	Y-13	126	37,3	168	49,7	15	4,4	29	8,6	3,16	78,92	Good enough
14	Y-14	144	42,6	133	39,3	53	15,7	8	2,4	3,22	80,55	Good
Score total										3,29	82,21	Good

Question (X2-12) The production of dry unhulled rice is above 7 tons per hectare. Based on data from the results of distributing questionnaires about the level of dry unhulled rice production above 7 tonnes per hectare, it shows an average score of 2.88, with the respondent's achievement level of 72.04%. The average score and the level of achievement of these respondents indicate an enough to category. The largest percentage of all instrument answer choices is in the criteria of Strongly Agree (SA) as much as 37%, on Agree category (A) 28.1%, Disagree (DA) 21%, and Strongly Disagree (SDA) 13.9%.

The variable productivity of agricultural products (X2) has a total value of 13,269, with each category; Very good in questions X2-3, on good are in questions X2-2, X2-4, X2-5, X2-7 to X2-10, enough are founding in questions X2-1, X2-6, X2- 11 and X2-12. The average score is 3.27 and the Respondent Achievement Level (RAL) 81.79%, so it can be concluding that the independent variable (X2) on good to category.

The agricultural output is obtaining by various factors, such as water management, soil acidity, Al and Fe poisoning, pests and diseases, thick peat. Therefore, not all swamplands are suitable for food crop farming (Wildayana and Armanto, 2018). Farmers in Pemulutan have no other choice to maintain their survival. They always carry out one to twofold agricultural cultivation. Dependence on nature is the factor inhibiting swamp farming systems.

Environmental sustainability (Y) or the dependent variable has 14 questions. The indicators are Economic factors, interaction indicators and ecology presenting based on the respondents.

The results of distributing questionnaires, with questions (Y-1) whether Pemulutan people have enjoyed the equitable development carried out by the government. The largest percentage of all respondents' answer choices are in the criteria of Strongly Agree (SA) of 43.2%, Agree (A) 40.5%, Disagree (DA) 16.3%, and none of the respondents answered Strongly Disagree (SDA). The average is 3.27, with the respondent's achievement level of 81.73%. The percentage of respondents' answers for the level of achievement is in the interval (80% - <90%) or good category.

Based on the data from the distribution of questionnaires with questions (Y-2) whether the use of "berondong" and "reamon" for floating rice nurseries can protect the environmental ecosystem. The larg-

est percentage of all the answer choices are in the criteria of Strongly Agree (SA) of 43.8%, Agree (A) 35.5%, Strongly Disagree (SDA) 11.5% and Disagree (DA) 9.2%. Average score 3.11 with the achievement level of 77.88%. The percentage of answers for the achievement level is in the interval (65% - <80%), or the category good enough.

Questions (Y-3) whether Pemulutan community meet their basic (primary) needs while maintaining the swamp ecosystem. To find out about the adequacy to needed of farmers while maintaining the wetland swamp ecosystem, based on the largest percentage of all answer choices are in the Agree (A) criterion of 52.7%, Strongly Agree (SA) 39.1%, Disagree (DA) 5,9%, Strongly Disagree criteria (SDA) as much as 2.4%. The average score is 3.28, with an achievement level of 82.10%. The percentage of respondents' answers for the level of achievement is in the interval (80% - <90%) or good category.

Question (Y-4) does the swamp farming system provide assurance and quality of life for Pemulutan farmers. The distributing that the largest percentage of all respondents' answer choices are in the criteria of Strongly Agree (SA) of 43.5%, Agree (A) 41.1%, Strongly Disagree (SDA) 8.9%, category Disagree (DA) as many as 6.5%. The average score is 3.19, with the respondent's achievement level of 79.81%. The percentage of respondents' answers for the level of achievement is in the interval (65% - <80%) or the category good enough.

Question (Y-5) whether the swamp farming system can improve the welfare of the people who work in this sector. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 54.4%, 39.1% agreeing criteria, 4.4% Disagree (DA) and Strongly Disagree (SDA) as much as 2.1%. The average is 3.46, with the respondent's achievement level of 86.46%. The percentage of answers for the achievement level is in the interval (80% - <90%), on good category.

Question (Y-6) whether the farming communities in Pemulutan influence each other in maintaining the lowland swamp ecosystem. The largest percentage of all respondents' choice of answers is in the Strongly Agree (SA) criteria, namely 57.1%, 34% agree on category, Disagree (DA) 8.9%, and none of the respondents answered Strongly Disagree (SDA). 3.48 average with the respondent's achievement level of 87.06%. The percentage of answers for the achievement level is in the interval (80% - <90%) or in the good with a category.

Question (Y-7) whether the farming communities in Pemulutan need each other and dependence between farmer groups. The largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 47%, 43.2% agree to a category, Disagree (DA) 8.6% and Strongly Disagree (SDA) as much as 1.2%. Average score 3.36 with the respondent's achievement level of 84.02%. The percentage of answers for the achievement level is in the interval (80% - <90%), on good category.

Question (Y-8) the construction of rafts for floating nurseries an adaptation to the environment of wetland swamp rice fields. The distributing result of questionnaires that the largest percentage of all respondents' answer choices are in the Agree (A) criteria of 48.8%, Strongly Agree (SA) 29 %, Strongly Disagree (SDA) 11.5%, category for Disagree (DA) as many as 10,7%. The average score is 2.95, with the respondent's achievement level of 73.82%. The percentage of respondents' answers for the level of achievement is in the interval (65% - <80%) or the category is quite good.

Question (Y-9) whether Pemulutan society has a system of norms, culture and customs in interacting with members of farmer groups. Based on the questionnaire result distribution, the largest percentage of all instrument answer choices is in the Strongly Agree (SA) criterion, namely 47.6%, Agree on the category (A) 39.6%, not as much as agree (TS) 12.7% and no None of the respondents answered Strongly Disagree (SDA) as much. The average score of 3.35 with the respondent's achievement level of 84.73%. The percentage of respondents' answers to the level of achievement was in the interval (80% - <90%) or good category.

Question (Y-10) whether the Pemulutan farming community can adapt to the lowland swamp environment. Based on the percentage of respondents' answers were obtained as follows: Strongly Agree (SA) criteria, namely 53.6%, criteria agreeing 35.2 %, Disagree (DA) 11.2% and none of the respondents answered Strongly Disagree (SDA). The average score is 3.42 with the respondent's achievement level of 85.58%. The percentage of respondents' answers to the level of achievement is in the interval (80%) - <90%) or good category.

Question (Y-11) whether the floating rice nursery system implemented by Pemulutan community is the existence of lowland swamp management. The results of distributing questionnaires show; The percentage of all instrument answer choices is in the

Strongly Agree (SA) criteria, namely 51.8%, the Agree criteria (A) as much as 40.5%, Strongly Disagree (SDA) as much as 4.1%, and Disagree (DA) 3.6 %. The average score is 3.40, with the respondent's achievement level of 84.98%. The percentage of respondents' answers for the level of achievement is in the interval (80% - <90%) or good category.

Question (Y-12) the utilization weather of local resources in the wetland swamp farming system can maintain the swamp ecosystem. The results of the distribution of the questionnaires showed that the largest percentage of all instrument answer choices was in the Strongly Agree (SA) criteria, namely 48.2.8%, the Agree criteria (A) as much as 44.4%, Disagree (DA) 3.8% and Strongly Disagree (SDA) as much as 3.6%. The average score is 3.37, with the respondent's achievement level of 84.32%. The percentage of respondents' answers to the level of achievement is in the interval (80% - <90%) in a good on category.

The question (Y-13) is whether the Pemulutan community will maintain the swamp farming system as a form of human and environmental interaction. The distributing of questionnaires results that the largest percentage of all respondents' answer choices are in the Agree (A) criteria of 49.78%, Strongly Agree (SA) 37.3 %%, Strongly Disagree (SDA) 8.6%, Disagree criteria (DA) as much as 4.4%. The average score is 3.16, with the respondent's achievement level of 78.92%. The percentage of respondents' answers for the level of achievement is in the interval (65% - <80%) or the category is quite good.

Question (Y-14) whether respondents agree that the natural, ecological and social environment is an ecosystem that affects and is interdependent. Based on these questions, that the largest percentage of all instrument answer choices is in the Strongly Agree (SA) criteria, namely 42.6%, 39.3% agreeing criteria, Disagree (DA) 15.7% and Strongly Disagree (SDA) as much as 2.4%. The average score is 3.22, with the respondent's achievement level of 80.55%. The percentage of respondents' answers for the level of achievement is in the interval (80% - <90%) or good category.

The environmental sustainability variable (Y), with a total value of 15,561. Respondent Achievement Level (RAL)) in the good category (80% - <90%) is in the question; Y-1, Y-3, Y-5, Y-6, Y-7, Y-9, Y-10, Y-11, Y-12 and Y-14. Fairly good categories (65% - <80%) are founding in items Y-2, Y-8, and Y-

13. The average score is 3.29, and the Respondent Achievement Level (RAL) is 82.21%, so concluded that these variables are in a Good category.

The Ogan ethnic community in Pemulutan manages agricultural land traditionally. They use local resources as a medium for agricultural cultivation. Wetland swamp farming system is local wisdom to keep the ecosystem well maintained. Environmental sustainability is influencing by economic, ecological and social factors. The sustainability of crop production in the tidal lowlands supporting the achievement of the SDGs, namely eliminating hunger, achieving food security with good nutrition, and increasing sustainable agriculture (Purba & Yazid, 2018).

### Multiple Linear Regression Test

Multiple linear regression analysis aims to measure the influence between two independent variables (X) on one dependent variable (Y). Multiple linear regression for known determine 1) the mathematical equation (Model) multiple regression. 2) the coefficient sign of the independent variable (X). 3) the relationship between each independent variable (X) to the dependent variable (Y) or t-test partial, 4) testing all independent variables (X) on the dependent variable (Y) or simultaneous F test, and 5) measuring the value of the coefficient of determination (R squares) which shows the value of all independent variables contributing to the dependent variable.

### Partial t-test

The t-test is a hypothesis test on multiple linear regression analysis to determine whether the independent variable (X). Namely; Agricultural system policies, communication media, community participation individually (partially) affect the dependent variable (Y), namely environmental sustainability. The following is a table of partial t-test results, to compare the significance value between t value and t table value.

The hypothesis of the partial t-test research is that:

- a) If the significance value  $<0.05$  or t value  $> t$  table value, there is a partial influence of the variable lowland swamp management, agricultural productivity towards environmental sustainability.
- b) If the significance value  $> 0.05$  or t value  $> t$  table value, then there is no partial influence of the wetland swamp management variable, agricultural productivity on environmental sustainability.

Table 4 partial t-test for each variable, get the following results:

- 1) Lowland swamp management (X1) obtained sig. X1 to Y is  $0.014 < 0.05$  and the t value is  $2.458 > t$  table value 1.961, concluded that there is a partial influence of wetland swamp management variables on environmental sustainability.
- 2) Productivity of agricultural products (X2) obtained sig value.  $0.00 < 0.05$  and t value  $10,188 > t$  table value 1.961, it can be concluded that there is a partial effect of agricultural productivity variables on environmental sustainability.

### Simultaneous F-test

The F test using to see whether there is a significant relationship between all independent variables (X) and the dependent variable (Y). The basis for the decision making for the simultaneous F test research hypothesis is as follows:

- a) If the significance value  $< 0.05$  or F value  $> F$  table value, then there is an effect of variable X automatically simultaneously against Y.
- b) If the significance value  $> 0.05$  or F value  $> F$  table value then there is no effect of variable X simultaneously on variable Y.

Table 5 Anova  $df-1 = 3$  and  $df-2 = 334$ , then the F table value is 2,631 and the F value is 95,157, with sig. 0.00, it can be concluded as follows:

1. There is an effect of wetland swamp management (X1), agricultural productivity (X2) on environmental sustainability.
2. The value of sig.  $0.00 < 0.05$  and F value  $95.157 > F$  table value 2.631, it can be concluded that there is a simultaneous effect of the independent variable on the dependent variable.

### The coefficient of determination (R Square)

The value of R square is 0.362. The value of the coefficient of determination is 36.2%. The reflected value concludes that wetland swamp management (X1), agricultural productivity (X2) simultaneously affect environmental sustainability (Y). The amount of this influence is 36.2%, the remaining 63.8% influenced by other variables outside the regression equation of this study. This influence level, when interpreted by the correlation coefficient. The interval of 0.20 to 0.399, meaning that the independent variables (X1, X2) and dependent variable (Y), the influenced is low. The regression equation for the two independent variables on the dependent variable is:



$$Y = 6.860 + 0.186 \times X_1 + 0.825 \times X_2$$

## Conclusion

Wetland swamp management variable (X1) has a total value of 12.402, with categories; very good in questions X1-4, questions X1-1, X1-2, X1-3, X1-5, X1-6, X1-8, X1-9, X1-10, X1-11 is good category, good enough to category is founding in questions X1-7. The average score is 3.33 and the Respondent Achievement Level (RAL) is 83.39%, in the interval (80- <90), concluded that the independent variable (X1) is a good category.

The agricultural productivity variable (X2) has a total value of 13.269, with categories; very good in questions X2-3, the questions X2-2, X2-4, X2-5, X2-7 to X2-10 is a good, good enough category are founding in questions X2-1, X2-6, X2- 11 and X2-12. The average score is 3.27 and the Respondent Achievement Level (RAL) is 81.79% in the interval (80- <90), so it can be concluded that the independent variable (X2) is in good to category.

The environmental sustainability variable (Y), with a total value of 15.561, with categories; on good are questions Y-1, Y- 3, Y-5 to Y-7, Y-9 to Y-12 and Y-14. Good enough are founding in questions Y2, Y-4, Y-8, and Y-13. The average score is 3.29, and the Respondent Achievement Level (RAL) is 82.21% in the interval (80- <90), concluded that the dependent variable (Y) is in good to category.

Wetland swamp management (X1) obtained sig value.  $X_1$  to Y is  $0.014 < 0.05$  and the t value is  $2.458 > t$  table value 1.961, concluded that there is a partial influence of wetland swamp management variables on environmental sustainability. The productivity of agricultural products (X2) with sig.  $0.00 < 0.05$  and t value  $10.188 > t$  table value 1.961, it can be concluded that there is a partial effect of agricultural productivity variables on environmental sustainability.

The effect of wetland swamp management (X1), agricultural productivity (X2) on environmental sustainability. Sig value.  $0.00 < 0.05$  and F value  $95.157 > F$  table value 2.631, it can be concluded that there is a simultaneous effect of the independent variable on the dependent variable.

The value of R Square is 0.362, concluded that wetland swamp management (X1), agricultural productivity (X2) simultaneously affect environmental sustainability (Y). The amount of this influence is 36.2%, the remaining 63.8% influenced by other variables outside the regression equation of this

study. The correlation coefficient is in the interval of 0.20 - 0.399, concluded that the independent variable (X1, X2) and dependent variable (Y), the influence is low/weak. The dependent variable (X1 and X2) has a low leak on the dependent variable (Y). Wetland swamp management and agricultural productivity are not the main factors affecting environmental sustainability. Others are factors not included in the variables of this study.

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