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The Influence of Operation and Maintenance Activities on Water Management of Tinondo Swamps Irrigation Area at East Kolaka Regency, Southeast Sulawesi Province, Indonesia

The Influence of Operation and Maintenance Activities on Water Management of Tinondo Swamps Irrigation Area at East Kolaka Regency, Southeast Sulawesi Province, Indonesia

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Abstract. This research was intended to know how far the influence of operation and maintenance activities on the water system in Tinondo SwampsIrrigation Area, and what factors between those two activities have significant influence to the water system in the Rawa Tinondo Irrigation Area. In this research, the method used linear regression analysis, with questionnaires distributed to farmers with independent variables (operation and maintenance) and the dependent variable (Water Flow Distribution). The result showed that Operation and Maintenance activities have significant influence to Water Flow Distribution activities, it can be seen from equation Y = 6,279 + 0,661 X1 + 0,025 X2, where activities of Operation has significant effect. The dominant parameter that influenced the significance level of the operation activities was the planting plan. The positive influence of the activities can be seen from the increase of average rice production from the previous average of 2.5 tons / year to 4-5 tons / ha / year. However, from the results of questionnaires, 77,88% of respondents get an average production of 4-5 tons/ha/year or can be said enough / standard for the swamp production, in addition to the previous planting period can be implemented one time, was able to be implemented into twice.

Keywords: water management, irrigation, swamp, Kolaka, Sulawesi

1. Introduction

Tinondo Swamps Irrigation Area is one of the mainstay areas in East Kolaka Regency of Southeast Sulawesi Province. The potential area of Tinondo Swamps Irrigation Area is 5,267,64 Ha, with functional area of 3,123.4 Ha. For wetland rice field use 2,806,82 Ha or 53.28% from total area of potential area [3]. Tinondo Swamps Irrigation Area is an area not affected by sea tides, The region was relatively high rainfall and evenly distributed throughout the year and fertile for agriculture. Therefore, field observations indicate that the land that has been used as agriculture crops still produces low productivity with an average production of 2.5 tons / year [4]. Since 2010, operation and Maintenance activities have been carried out in the swamp irrigation area, after the operation and maintenance activities are expected to have water system in Tinondo Swamps Irrigation Area is getting better, resulting in more optimal swamp conditions that will increase crop productivity. To know the relation of operation and maintenance activities to the water system, it is necessary to study how to observe the effect of operation and maintenance activities on the water system as well as the operation and maintenance performance so that it can be used as the basis for improvement for operation and maintenance activities in Tinondo Swamps Irrigation Area.

The research on Farmer Participation Assessment in Operation and Maintenance of Irrigation Network in Sasak District Irrigation Area, Bogor [6]. Data are determined in independent variable (socioeconomic and institutional) and dependent variable (operation and maintenance) data processing using path analysis followed by correlation and regression analysis. From the research results obtained that there is a strong correlation between each independent variable to the dependent variable. The existence of strong regression between independent variable (X_1 and X_2) to dependent variable (Y) following linear equation $Y = 24{,}133 + 0{,}408\ X_1 + 0{,}416\ X_2$, so that the increase of operational and maintenance variable value can be predicted from the increase of social economic and institutional variable value. Other research on P3A Performance Study in Improving Operation and Maintenance of Irrigation Nokan Rama Agung, North Bengkulu regency, Indonesia [7] aims to determine the extent of P3A's ability and impact to run operation and maintenance activities on their agricultural activities. The results showed that organizational, funding, operation and maintenance variables significantly affect the performance of P3A organization.

Using multiple linear regression method in the research "Influence of Operation and Maintenance Activities on Tinondo Swamps Irrigation Area ", aims to find out how much the influence of operations and maintenance activities on the distribution of water flow, the performance of operations and maintenance activities and what activities are most dominant in operation and maintenance in Tinondo Swamps Irrigation Area

2. Method

2.1. The Study Area

The research location is located in Rawa Tinondo Irrigation Area, East Kolaka Regency, Southeast Sulawesi Province with total area of 3,123.4 Ha. The geographical location of the research location is located in the western part of Southeast Sulawesi Province, Indonesia The research location is located in 2 (two) districts. Tinondo sub-district and Lalolae sub-district covering 6 residential areas (Transmigration) namely: Tinondo Village, Lamunde Village, Lalosingi

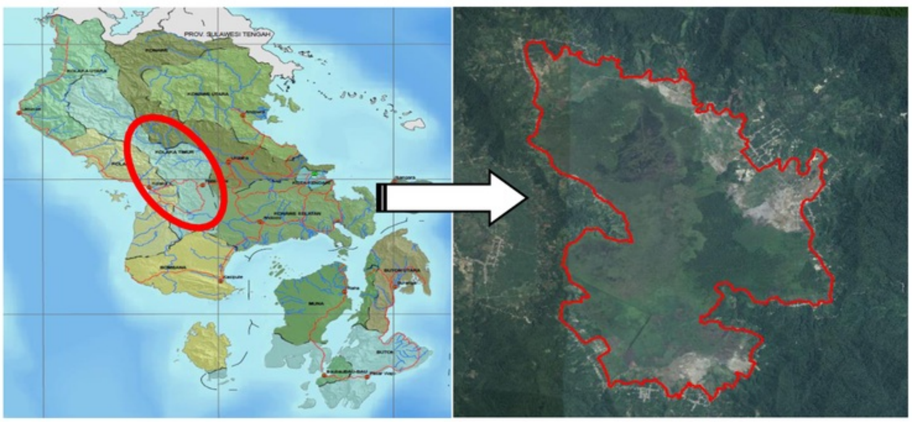

Figure 1. Tinondo Swamps Irrigation Area

2.2. Study Methods

Evaluation used the questionnaire which was distributed by using the Likert Scale, and for the purposes of quantitative analysis, each answer was given a score. To get a score of each respondent's answer, each question has four alternate answers sequential and tiered from the best answer to the lowest [1]. The number of respondents in this study amounted to 480 farmers, namely members of farmers groups in Tinondo Swamps Irrigation Area, which has got the operation and maintenance activities.

This study used multiple linear regression analysis method by doing classical assumption test (normality test, heterokedastic test and multicollinearity test) first [5]. To make it easier to analyze using SPSS 20 program, this research uses 95% confidence level, which means the possibility of error to reject the correct hypothesis of 5% [8]. The variables in this study consisted of independent variables X1 (operation activities), independent variables X2 (maintenance activities) and the dependent variable Y (water flow distribution). To see how far the influence of independent variable to bound, F test and t test to the hypothesis made. For F test the hypotheses used are as follows:

H_1 = Operation and maintenance activities together have to influence to the distribution of water flow

H_o = Operation and maintenance activities together have no influence to the distribution of water flow

While the hypothesis used for t test as follows:

H_1:b1 $\neq 0$ = Means that Operation activities has influence to water flow distribution
H_o:b1 $= 0$ = Means that Operation activities has no influence to water flow distribution
Ha:b2 $\neq 0$ = Means that Maintenance has influence to water flow distribution
H_o:b2 $= 0$ = Means that Maintenance activities has no influence to water flow distribution

3. Result and Discussion

3.1 Multiple Linear Regression Test Results

From the result of classic assumption test consist of normality test, heteroskedastic test and multicolinearity test indicated that regression model was feasible to be used in this study, because there was no correlation between each independent variable (operation variable and maintenance variable).

The result of multiple linear regression test toward Operation Variable (X_1), maintenance variable (X_2) and dependent variable (Y), test result can be seen in Table 1.

Table 1. Results of Multiple Linear Regression Testing

Model	Unstandardized Coefficients		Stand Coeff	t	Sig.
	B	std. Error	beta		
(Constant)	6.279	1.720		3.651	.000
Operation	.661	.087	.593	7.569	.000
Maintenance	.025	.052	.038	.489	.626

Based on the table 1 above can be formulated a regression equation for the water flow distribution as follows:

$$\mathbf{Y = 6{,}279 + 0{,}661\, X_1 + 0{,}025\, X_2}$$

Information:

Y1 = Water Flow Distribution
7,711 = Constants
X1 = Operation
X2 = Maintenance

Constant value of 6,279 meant that if there was no increase of value from Operation variable (X_1) and Maintenance Variable (X_2) then the value of Water Flow Distribution (Y) was 6,279. Double regression coefficients of 0,661 and 0,025 indicated that each addition (+ sign) a score or value of operation and maintenance provided increased score of 0,661 and 0,025.

3.2 Hypothesis Testing

In this research used test instrument to see how big influence of free variable (X1 and X2) to dependent variable (Y). The test equipment used is as follows:

3.2.1 Test Variables X_1, X_2 Together to Variable Y (Test F). Test F or regression coefficient test, is used to test the significance effect of Operation Variable (X_1) and Maintenance Variable (X_2) together to Variable Water Distribution (Y). test result can be seen in Table 2.

Table 2. The Result of F Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	151.334	2	75.667	30.038	.000b
Residual	269.539	107	2.519		
Total	420.873	109			

From table 2 above obtained the value of F arithmetic of 30.038, with a probability / significance level of 0.000. For the value of F table can be searched on the statistical table with the significance of 0.05 df1 = k-1 or 3-1 = 2 and df2 = n-k or 110-3 = 107; (where k is the number of variables). F value the table obtained is 3,081.

Based on the above values, it is shown that F count (30,038)> F table (3.081), so Hypothesis Zero (H_0) is rejected and H_1 is accepted. It indicates that the independent variable (Operation and Maintenance) influences simultaneously to the dependent variable (Distribution Flow Water). This statement is also supported by a probability significance level value of 0.000<0.05.

3.2.2 Test Variables X1 and X2 Partially to Variable Y (Test t). The t test is used to test the effect of Operation Variables (X1) and Maintenance Variables (X2) partially to the Water Distribution Variable (Y), and to see which of the two independent variables has the most significant influence on the dependent variable. test result can be seen in Table 3.

Table 3. The Result of t Test

Model	Unstandardized Coefficients		Stand Coeff	t	Sig.
	B	std. Error	beta		
(Constant)	6.279	1.720		3.651	.000
Operation	.661	.087	.593	7.569	.000
Maintenance	.025	.052	.038	.489	.626

From table 3 above obtained t value for Operating activities of 7.569, with a significance level of 0.000. For table t values can be searched on statistical tables with significance at siginificancy 0,05 / 2 = 0,025 with df = n-k-1 or 110-2-1 = 107 (k is the number of independent variables). The value of t obtained Table is 1.983. While the value of t arithmetic for Maintenance activities obtained by 0.489 with a significance level of 0.626. For t table equal to 1,983.

From the above data can be concluded for Operation activities t arithmetic (7,569)> t table (1,983), significance level 0,000 < α = 0,05. So, Hypothesis Zero (H_0) is rejected and H_1 accepted. This indicates that Operation activities are proven to have an effect on Water Distribution. For the value of the positive t count coefficient so that Operation activities have a positive effect on Water Distribution. As for the activities Maintenance t arithmetic (0.489) <t table (1.983), significance level 0.626> (α = 0.05). So, Hypothesis Zero (H_0) is accepted and H1 is rejected. This indicates that Maintenance activities proved to have no effect on the Water Flow Distribution.

From the result of 2 (two) hypothesis test in this study can be explained as follows:

a. Obtained that F count (30,038) > F table (3,081), so Hypothesis Zero (H_0) was rejected, it showed that independent variable (Operation and Maintenance) effect simultaneously to dependent variable (Water Flow Distribution).
b. For Operation activities obtained t value count was 7,569 > t table (1,983), so Hypothesis Zero (H_0) was rejected, it showed that Operation activities influence to dependent variable (Water Flow Distribution).
c. For Maintenance activities, the value of t arithmetic was 0.489 > t table (1,983) so the null hypothesis (H_0) was accepted, it showed that Maintenance activities has no influence on the dependent variable (Water Flow Distribution).

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Based on the above explanation it was known that Operation and Maintenance Activities have an influence on Water Flow Distribution activities in this case to the Tinondo Swamps Irrigation Area water management. However, from both activities (Operation and Maintenance), only Operation activities have a significant influence. Operations activities aimed at managing water level targets, water distribution to land, and excess water drain have been shown to have a positive impact on agricultural activities in Tinondo Swamps Irrigation Area.

In addition to see the effect of overall operation and maintenance on the water flow distribution, the questionnaire results can also be used to see the performance of the operation and maintenance activities and what were the most dominant parameters of the operation and maintenance activities, in particular the operations that have the most significant influence on the flow distribution water. It can be used as a basis for improving the performance of future operation and maintenance.

The results of the percentage assessment of the parameters of operation and maintenance activities are presented in the following Table 4:

Table 4. Recapitulation of Parameters in OP Activities

X Variable	Parameter Description	Assessment Criteria (%)			
		Very Good	Good	Bad	Very Bad
Operation Activities	1. Planting Plan	21.82	65.45	12.73	0.00
	2. Arrangement of Water Distribution	24.55	49.09	26.36	0.00
	3. Arrangement of Water Disposal	20.91	51.82	27.27	0.00
	4. Performance of Officer OP (Watergates Officer)	8.18	56.36	34.55	0.91
Average		**18.87**	**55.68**	**25.23**	**0.23**
Maintenance Activities	1. Cleaning Garbage/Waterplants	19.09	43.64	33.64	3.64
	2. Maintenance/Replacement Waterworks	17.73	42.27	39.09	0.91
	3. Grass Clearing	16.82	59.55	23.18	0.45
	4. Mud Dreding	23.64	42.73	33.64	0.00
	4. Repair Road Inspection	14.55	55.45	30.00	0.00
Average		**18.37**	**48.73**	**31.91**	**1.00**

From the table above can be seen that the most dominant parameter in operation activities was the planting plan. The planting plan was very important in irrigation activities, as it become the basis for determining the water management plan. If the planting plan was coordinated, both in the data collection in the field, the arrangement of the planting pattern up to the implementation, the increased efficiency of water use, the optimization of the door plan and even the intensity of planting area can be achieved. From table 4,17 can be seen that the performance of planting plan in the research area of 87,27% was good / very good, with the condition of planting plan also affect the accuracy in the division and disposal of water. Although there were still some farmers who complain about the lack of water distribution in their land because the location of land that was away from the primary / secondary channels.

Due to the positive influence of Operation activities on the water system in Tinondo Swamps Irrigation Area, thus causing increased production. Previous rice production at Tinondo Swamps Irrigation Area (in 2010) only range from 2,5-3 tons/ha/year. However, from the results of questionnaires, 77,88% of respondents get an average production of 4-5 tons/ha/year or can be said enough / standard for the swamp production, in addition to the previous planting period can be implemented one time, was able to be implemented into twice. The results achieved in the last 5 (five) years can be more significant if Maintenance activities can run more effectively. Because of the results of hypothesis testing on the distributed questionnaire, it was found that maintenance activities have not been able to optimally / significantly affect to the pattern of water flow distribution in Tinondo Swamps Irrigation Area Kolaka Regency of Southeast Sulawesi. Whereas maintenance activities undertaken in Tinondo Swamps Irrigation Area, such as deforestation, mud dredging, garbage disposal have been carried out according to maintenance standards [3] The problems in the field that influenced less optimal maintenance activities carried out in Tinondo Swamps Irrigation Area East Kolaka regency at Southeast Sulawesi province, among others, as follows:

1) The unstructured institutional / water user organization in Tinondo Swamps Irrigation Area, because the existing organization was still in the form of farmer groups, which causes the active role and participation of its members to be less, resulting in less optimal maintenance that was the authority of water user farmers (tertiary network).
2) Due to the lack of optimal maintenance activities in tertiary channels, so the government has participated in maintenance activities in the channel. This affects the budget of Maintenance activities of the central Government which should only cover primary and secondary networks, but the reality in the field still finance activities in the tertiary network.
3) Inadequate facilities and infrastructure (absence of water gates) so that the capacity in the primary channel was still not optimal.
4) The absence of mud pockets in secondary channels, thus causing large amounts of sedimentation deposit along the secondary and tertiary canals. This caused the distribution of water flow to be less than optimal.
5) Due to the large amount of sedimentation in the secondary and primary channels, the dredging of mud that should be budgeted with manual power was not optimal anymore so it needs the heavy equipment (Excavator).

Improvement and upgrading of Operation and Maintenance activities on Tinondo Swamps Irrigation Area East Kolaka regency Southeast Sulawesi province can be done with several things as follows:

a. Operation Aspect:
   (1) The need to improve the ability of farmers to be self-sufficient management to Tinondo Swamps Irrigation Area at the tertiary level which was the responsibility and authority of the farmers.
   (2) Implement effective and efficient irrigation systems and the use water efficiently.
b. Aspects of Maintenance
   (1) Encourage farmers' ability to maintain good Tinondo Swamps Irrigation Area.
   (2) Growing awareness and ownership of farmers to keep, secure and maintain all irrigation assets in Tinondo Swamps Irrigation Area, so that irrigation system can be used continuously, so that can be utilized maximally for the welfare of society.

In order to increase the participation of farmers, the efforts should be made to improve coordination and cooperation among farmer groups so to facilitate the achievement of common goals by intensifying the meetings between farmer groups and can be done with mentoring activities, motivation, technical guidance, education, training and granting facilities by the government.

4. Conclusions and Suggestions

Based on the results and discussion it can be summarized as follows: first operation and maintenance activities proved to affect the water system in Tinondo Swamps Irrigation Area, it can be seen from the test results that was the value of F arithmetic (30,038) > F table (3,081), it showed that the independent variables (Operation and Maintenance) effect simultaneously on the dependent variable (Water Flow Distribution). Both operations have a significant influence on Water Management, while Maintenance activities there was no influence on the water system. It was seen from the test result that t count value was 7,569 > t table (1,983), it showed that the activities of Operation influence to the dependent variable (Distribution of Water Flow), The three dominant parameters that influenced the level of significance of the Operation activities was the planting plan.

Based on the conclusion, it was suggested that the first thing to do the improvement / development of facilities and infrastructure in Tinondo Swamps Irrigation Area, among others, a water gate that serves to regulate the amount of water entering and exiting, so that the water can accommodate the water needs of farmers, canals to minimize the amount of sediment deposits that exist, so that existing maintenance funds can be more optimal. The two solutions can optimize existing farmer groups, so that the function and maintenance role in the tertiary channel can run optimally. Third the need for guidance and empowerment of farmers community in order to improve the capability and skills of farmers, done in the appropriate way by looking at the educational background, age and farmer's economy.

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