Article

Application of Asset Management in the Management of Irrigation Areas in the Salaman Technical Implementation Unit

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Abstract: One of the main factors for supporting development in the agricultural sector is the irrigation infrastructure management. Infrastructure is essential because it is a basic prerequisite for development and growth and requires very large costs. Therefore, the infrastructure must be managed properly according to Asset Management principles. This study aims to implement asset management in the management of Irrigation Area in the Salaman Technical Implementation Unit (UPT). The irrigation assets in question are the physical infrastructure of irrigation networks. This study requires an inventory of data on irrigation network which is used as input in analyzing the performance appraisal of irrigation assets. The assessment of the Irrigation Area Performance index is carried out through the weighting of each component according to the technical instructions set by the government. While the evaluation is carried out by determining priorities and types of handling irrigation areas through ranking and classification of aset condition index value. The evaluation show that 3 (three) Irrigation Areas get a condition index value of ≤ 60 (poor). The three irrigation areas are MA Depok, DI Pakem I, and MA Mudal. MA Depok is an irrigation area that is the first priority for treatment in the form of rehabilitation.

Keywords: *asset management, asset performance, performance index, irrigation area*

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1. Introduction

In order to fulfill the national food needs, the Government of Indonesia has carried out a series of continuously dotted businesses that are focused on the agricultural sector, which is supported by one of them with management in the field of irrigation infrastructure to support food security. Infrastructure is very important because it is a basic prerequisite for development and growth and is not a simple object, as well as requiring enormous costs. Therefore, the infrastructure must be managed properly according to the principles of Infrastructure Asset Management [1].

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Irrigation assets management is a structured management process for planning the operation and maintenance of irrigation networks in order to achieve an optimal level of service. Irrigation assets management is needed as management for the operation and maintenance of irrigation assets so that they can continue to maintain the condition and function of these assets. Management of irrigation assets can be realized by asset management implementation. Asset management for irrigation is carried out for maintain the function of the irrigation network, including inventory, (ii) determination of the value of the condition and function of assets, (iii) determination of priority ranking, (iv) information system, and (v) asset strategy plan [2]. The scope is a stage in determining the program maintenance of irrigation networks.

Based on the Regulation of the Minister of Public Works and Public Housing Number 23 Year 2015 (Kementerian PUPR No. 23/2015) concerning Management of Irrigation Assets, the management of irrigation assets is carried out through the activities of inventory of irrigation assets, implementing irrigation asset management, evaluating the implementation of irrigation management, and updating the results of the inventory of irrigation assets [3].

Irrigation and drainage will experience a decrease in ability and performance [4]. This is due to low operating and maintenance performance. Performance appraisal as a form of monitoring and evaluation activities serves to obtain program preparation data [5]. As per the Regulation of the Minister of Public Works and Public Housing Number 12 Year 2015 (Kementerian PUPR No. 12/2015) that in order to prepare an operating and maintenance budget for an irrigation area, a system performance evaluation must first be carried out [6]. Irrigation system performance assessment should be carried out every year in order to know the value of the irrigation system performance of each irrigation area. The values obtained are used to develop follow-up programs such as heavy repairs, rehabilitation, as well as operation and maintenance of irrigation networks that are more targeted and effective [7].

Magelang Regency has 993 Irrigation Areas spread over 6 Technical Implementation Units (UPT) of the Public Works and Spatial Planning Office (DPUPR). The area of irrigated rice fields in the entire irrigation area is 35,662 hectares. This condition is confirmed in the Regulation of the Minister of Public Works and Public Housing Number 14 Year 2015 (Kementerian PUPR No. 14/2015) concerning Criteria and Determination of the Status of Irrigation Areas [8]. One of the Technical Implementing Units of the Public Works and Spatial Planning Office that needs to be improved in the management of irrigation areas is the UPT Salaman. The UPT Salaman includes several irrigation areas spread over 4 (four) Districts with a total service area of 229.22 hectares.

The irrigation area of the UPT Salaman according to its history has an average age of over 50 years. This means that the age of buildings in the irrigation area has exceeded the age for planning. So that by taking into account the age of the building and the network system in it, it is necessary to evaluate the management of the irrigation area.

The evaluation in question is the evaluation of the management of the irrigation area which is carried out through the assessment of the irrigation system performance index. The assessment of the irrigation system performance index is used to determine the condition of the irrigation system performance in the irrigation area including a). Physical infrastructure; b). Plant productivity; c). Supporting facilities; d). Personnel organization; e). Documentation and f). Institutional condition of the Water User Farmers Association [6]. Evaluation of irrigation area management is carried out by referring to the concept of

asset management. Based on irrigation management, the concept of management Irrigation assets in this study are limited as follows:

a. conduct an inventory of irrigation assets;
b. irrigation assets referred to as physical infrastructure of irrigation networks;
c. assessing the condition and function of irrigation assets through weighting to determine the condition index of irrigation area assets; and
d. evaluating the management of irrigation assets.

The purpose of writing this study is intended to:

a. record the condition of irrigation assets in the irrigation area of the UPT Salaman;
e. conduct an inventory of irrigation assets in the irrigation area of the UPT Salaman;
f. assess the condition of irrigation assets in the irrigation area of the UPT Salaman; and
g. evaluate the management of Irrigation Assets based on the asset condition index in the irrigation area of the UPT Salaman.

2. Literature

2.1. Asset Management

Asset management is a systematic process that aims to maintain, renew and operate assets economically through the acquisition, creation, operation, maintenance, rehabilitation and disposal of assets so that the objectives can be achieved effectively and efficiently. Asset management is needed to decide what is needed to achieve business goals, and then to acquire and retain assets over the life of those assets until disposal [9].

While what is meant by irrigation asset management is the management of irrigation assets through a structured management process for planning maintenance and funding of irrigation systems in order to achieve a defined and sustainable level of service for irrigation water users and irrigation network users by financing the management of irrigation assets as efficiently as possible [10].

The scope of asset management includes inventory, determining the value of the condition and function of assets, ranking priorities, information systems, and asset strategy plans. Whereas The scope of irrigation asset management is a stage in determine the maintenance program. The stages of irrigation asset management according to the Regulation of the Minister of Public Works and Public Housing Number 23 Year 2015 (Kementerian PUPR 23/2015) concerning Management of Irrigation Assets include inventory, management planning, management implementation, and evaluation of the implementation of irrigation asset management, as well as updating the results of the irrigation asset inventory [3].

2.2. Irrigation Network Management

Management of irrigation networks includes various things such as operation, maintenance, and rehabilitation of irrigation networks in irrigation areas [10]. Meanwhile, according to the Ministry of Public Works Year 2007 (Kementerian PU, 2007), rehabilitation activities are included in the implementation of maintenance as stipulated in the Guidelines for Maintenance of Irrigation Networks issued by the government. Therefore, irrigation management includes the operation and maintenance of irrigation networks in irrigation areas [11].

2.3. Irrigation Network Operation

Irrigation network operation is an effort to regulate irrigation water and its disposal including activities to open and close irrigation building doors, draw up a planting plan, develop a class system, draw up a water distribution plan, carry outdoor/building calibration, collect data, monitor, and evaluate [6].

2.4. Irrigation Network Maintenance

Maintenance of irrigation networks is an effort to maintain and secure irrigation networks so that they can always function properly in order to facilitate the implementation of operations and maintain their sustainability [11]. The scope of the maintenance includes an inventory of irrigation network conditions, planning, implementation, monitoring, and evaluation. The types of maintenance of irrigation networks consist of securing irrigation networks, routine maintenance, periodic maintenance, and emergency repairs. Meanwhile, the classification of the physical condition of the irrigation network includes good condition with a level of damage 10%, slightly damaged condition with a level of damage of 11-20%, moderate damage condition with a level of damage of condition 21-40%, and heavily damaged conditions > 40% [3].

2.5. Irrigation Asset Inventory

According to the Ministry of Public Works and Public Housing (2015) the inventory is carried out by collecting data on irrigation assets. This activity aims to obtain data on the number, type, condition, function, asset value and damage to irrigation networks that occur in each irrigation area in the context of the sustainability of the irrigation system in each irrigation area [3].

2.6. Assessment of Irrigation Area Asset Condition

Assessment of the condition of irrigation assets is part of the irrigation system performance assessment. The Ministry of Public Works and Public Housing (2015) states that to determine the condition of irrigation system performance, there are six aspects that need to be evaluated including the condition of physical infrastructure, crop productivity, supporting facilities, personnel organization, documentation, and institutional conditions of the Water User Farmers Association. To evaluate the condition of the irrigation system performance, it can be done using the Criteria and Weights of the Irrigation Performance Assessment of the Ministry of Public Works and Public Housing Year 2015. The assessment of the condition of irrigation assets is carried out to determine the level of damage and the functioning of the physical infrastructure of the irrigation network [3].

3. Methods

3.1. Research sites

The research location is in the UPT Salaman area, Magelang Regency including 12 irrigation areas with a service area of 229.22 hectares

3.2. Research Stages

3.2.1. Data Inventory

Data Inventory is to identify irrigation assets which are components of the irrigation system's performance index, including physical infrastructure, plant

productivity, supporting facilities, personnel organization, documentation and institutional conditions of the Water User Farmers Association (P3A). The evaluation component of the irrigation system's performance index is shown in the figure below.

Figure 1. Components of the Assessment Based on the Ministry of Public Works and Public Housing No. 12/2015

In this study, the data inventory that will be identified is the condition of irrigation assets in the form of physical infrastructure in each irrigation area.

3.2.2. Assessment of Irrigation Asset Condition

Evaluation The performance of the irrigation system is carried out through the criteria and weighting of each component according to the technical implementation guidelines issued by the Directorate of Operations and Maintenance Year 2016 (Direktorat Bina OP, 2016) [12]. One of the components of the irrigation system performance assessment is the condition of the physical infrastructure as shown in the figure below.

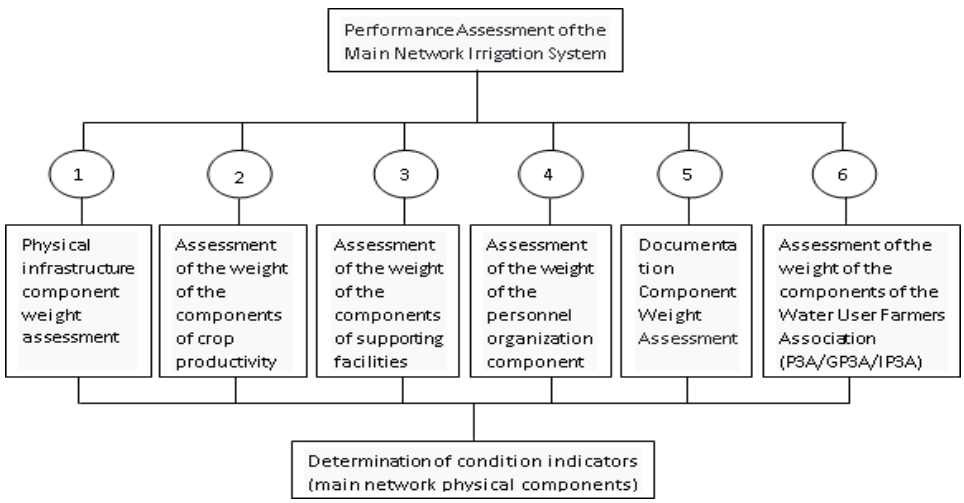

Figure 2. Irrigation System Performance Assessment

The weighting of each component as shown above is shown in the table below.

Table 1. Rating Weight of Each Component

No	**Component**	**Weight**
1	Physical Infrastructure	45%
2	Plant productivity	15%
3	Supporting facilities	10%
4	Personnel organization	15%
5	Documentation	5%
6	Institutional	10%

3.2.3. Evaluation of Irrigation Area Management

Evaluation of Irrigation Area Management is carried out annually by determining priorities and types of asset handling in irrigation areas. The priority of irrigation asset management is determined by determining the ranking of the results of the assessment of the physical infrastructure condition of the irrigation network by sorting from the smallest value to the condition. Meanwhile, the determination of the type of handling is carried out through a maintenance classification based on the applicable provisions, namely [3]:

a. Irrigation Network Condition Index > 90%: Very Good, routine maintenance carried out
b. Irrigation Network Condition Index 80-90%: Good, periodic maintenance is carried out
c. Irrigation Network Condition Index 60-80%: Moderate, periodic maintenance is carried out for repairs; and
d. Irrigation Network Condition Index 60%: poor, irrigation rehabilitation needs to be done.

4. Results

4.1. Irrigation Asset Inventory

The UPT Salaman consists of 12 (twelve) irrigation areas spread over 4 (four) districts (kecamatan), namely Kecamatan Kajoran, Kecamatan Salaman, Kecamatan Borobudur and Kecamatan Tempuran. The list of the Irrigation Areas is as follows.

Table 2. List of Irrigation Areas in UPT Salaman

No.	**Irrigation Area**	**Location (Village)**	**districts**	**Area (Ha)**
1.	DI. Nongko I	Ds. Sidowangi	Kecamatan Kajoran	11.50
2.	DI. Sepet II	Ds. Bangsri	Kecamatan Kajoran	23.68
3.	DI. Tengah	Ds. Sidorejo	Kecamatan Kajoran	21.00
4.	DI. Tlahap	Ds. Sidosari	Kecamatan Salaman	22.60
5.	M.A Mudal	Ds. Paripurno	Kecamatan Salaman	20.00
6.	DI. Warung	Ds. Sidowangi	Kecamatan Kajoran	24.00
7.	DI. Watu Ketuk	Ds. Ngargoretno	Kecamatan Salaman	40.00
8.	DI. Parakan Bengkong	Ds. Sriwedari	Kecamatan Salaman	13.44
9.	DI. Pakem I	Ds. Giritengah	Kecamatan Borobudur	6.98
10.	MA. Depok	Ds. Kalisari	Kecamatan Tempuran	17.60
11.	DI. Kopeng II	Ds. Sutopati	Kecamatan. Kajoran	8.42

12.	DI. Gendol	Ds. Kajoran	Kecamatan Kajoran	20.00

Some data on the condition of physical infrastructure presented in this study, namely:

a The main building includes weirs, weir doors and gears, as well as mud bags and hardening doors;
b The carrier channel includes the channel capacity, and the channel embankment;
c the carrier channel building includes the building for regulating and measuring instrument for water discharge.
d Sewers and structures;
e Entrance / inspection; and
f Offices, housing and warehouses.

4.2. Assessment of Irrigation Asset Condition

The results of the assessment on the components of the physical infrastructure condition of the irrigation network in each irrigation area are as shown in the following table.

Table 3. Results of the Assessment of Physical Infrastructure Conditions for Irrigation Networks in Irrigation Areas at the UPT Salaman

Irrigation Area	Main Dam	Carrier Channel	Carrier Channel Building	Sewer and Structures	Entrance / Inspection	Office, Housing and Warehouse	Index of Physical Infrastructure Condition
DI. Nongko I	10.88	1.35	7.5	4	2	4	29.73
DI. Sepet II	11.1	0.6	7.88	4	2	4	29.58
DI. Tengah	11.55	1.5	7.88	4	2	4	30.93
DI. Tlahap	10.65	1.5	7.88	4	2	4	30.03
M.A Mudal	8	1.2	7.88	4	2	4	27.08
DI. Warung	11.01	1.8	7.88	4	2	4	30.69
DI. Watu Ketuk	11.63	0.75	7.88	4	2	4	30.25
DI. Parakan Bengkong	10.63	1.5	7.88	4	2	4	30.00
DI. Pakem I	10.38	0.6	7.69	2.5	1.15	4	26.31
MA. Depok	6.2	0.6	7.88	4	2	4	24.68
DI. Kopeng II	11.63	0.3	7.88	4	2	4	29.80
DI. Gendol	11.63	1.5	7.88	4	2	4	31.00

4.3. Evaluation of Irrigation Asset Management in Irrigation Areas

4.3.1. Determine Treatment Priorities

Based on the index of physical infrastructure condition produced, a ranking is carried out to determine the priority of handling irrigation assets in each irrigation area. The ranking results are shown in the table below.

Table 4. Priority for Handling Irrigation Assets in the Irrigation Area of the UPT Salaman

Irrigation Area	Main Dam	Carrier Channel	Carrier Channel Building	Sewer and Structure	Entrance / Inspection	Office, Housing and Warehouse	Index of Physical Infrastructure Condition
MA. Depok	6.2	0.6	7.88	4	2	4	24.68
DI. Pakem I	10.38	0.6	7.69	2.5	1.15	4	26.31
M.A Mudal	8	1.2	7.88	4	2	4	27.08
DI. Sepet II	11.1	0.6	7.88	4	2	4	29.58
DI. Nongko I	10.88	1.35	7.5	4	2	4	29.73
DI. Kopeng II	11.63	0.3	7.88	4	2	4	29.80
DI. Parakan Bengkong	10.63	1.5	7.88	4	2	4	30.00
DI. Tlahap	10.65	1.5	7.88	4	2	4	30.03
DI. Watu Ketuk	11.63	0.75	7.88	4	2	4	30.25
DI. Warung	11.01	1.8	7.88	4	2	4	30.69
DI. Tengah	11.55	1.5	7.88	4	2	4	30.93
DI. Gendol	11.63	1.5	7.88	4	2	4	31.00

The ranking results show that of the 12 irrigation areas, the irrigation area that received the first priority treatment is MA Depok which has the lowest rating index, followed by DI Pakem I and MA Mudal.

4.3.2. Determination of Handling Type

Determination of the type of treatment is carried out by grouping the physical infrastructure conditions based on the results of the comparison between the physical infrastructure condition index in the field (existing) and the maximum physical infrastructure condition index set by the Ministry of Public Works and Public Housing (2015). The classification results are shown in the following table.

Table 5. Classification of Physical Infrastructure Conditions and Types of Handling Irrigation Assets in the Irrigation Area of the UPT Salaman

Irrigation Area	Asset Condition Index			Condition Classification	Handling Type
	Existing	Maximum	Existing versus Maximum		
MA. Depok	24.68	45.00	54.83	Poor	rehabilitation
DI. Pakem I	26.31	45.00	58,47	Poor	rehabilitation
M.A Mudal	27.08	45.00	60.17	Poor	rehabilitation
DI. Sepet II	29.58	45.00	65.72	Moderate	RPM
DI. Nongko I	29.73	45.00	66.06	Moderate	RPM
DI. Kopeng II	29.80	45.00	66.22	Moderate	RPM
DI. Parakan Bengkong	30.00	45.00	66.67	Moderate	RPM

Irrigation Area	Asset Condition Index			Condition Classification	Handling Type
	Existing	Maximum	Existing versus Maximum		
DI. Tlahap	30.03	45.00	66.72	Moderate	RPM
DI. Watu Ketuk	30.25	45.00	67.22	Moderate	RPM
DI. Warung	30.69	45.00	68,19	Moderate	RPM
DI. Tengah	30.93	45.00	68.72	Moderate	RPM
DI. Gendol	31.00	45.00	68.89	Moderate	RPM

Note: RPM (repair periodic maintenance)

5. Conclusion and Recommendations

Evaluation Performance is very important to be carried out in order to determine the real need for maintenance operations. Maintenance operations are carried out to ensure the sustainability or extend the useful life of an irrigation network system. Based on the evaluation results, there are 3 Irrigation Areas in UPT Salaman that have poor physical infrastructure conditions and require immediate treatment. The three irrigation areas are: MA Depok, DI Pakem I, MA. Mudal. While the remaining irrigation area (9 irrigation area) is in moderate condition.

The next step that must be taken in order to improve the performance of the irrigation area is to formulate the actual need for maintenance operations and implement it. MA. Depok is an irrigation area that gets priority treatment first in the form of rehabilitation, followed by DI Pakem and MA Mudal.

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