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Performance Study of Irrigation Network in Renggung Irrigung Area, Lombok Central Regency

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ABSTRACT

The impact of the decline in irrigation performance is direct and indirect. The direct impact is a decrease in productivity, a decrease in cropping intensity and an increase in farming risk. The indirect impact is the weakening of the farmer's commitment to maintaining the paddy field ecosystem because the poor performance of irrigation makes the land less conducive for farming, especially rice crops. In order to obtain an overview of the condition of the irrigation areas being managed, it is necessary to conduct a study of the irrigation areas, to determine the conditions of irrigation performance and to determine priorities for handling the rehabilitation of irrigation networks and to make policies. DI performance appraisal evaluation results. Renggung is 75.8% where the performance condition of Irrigation Area of Renggung Irrigation is Good Performance.
***Keywords**: Planting Productivity, Performance, Irrigation*

Introduction

Irrigation is an effort made by humans to irrigate agricultural land. The effort is to utilize surface water (Surface Irrigation). Surface irrigation is an irrigation system that taps water directly into the river through a weir building or through a free intake building, then irrigation water is channeled by gravity through canals to agricultural land. Types of channels commonly known as Irrigation Networks consist of primary, secondary and tertiary channels. The definition of Irrigation Area (DI) is a unitary area or expanse of land that gets water from an irrigation network [1].

More than 80% of rice production in Indonesia comes from irrigated land with a technical network system. Therefore the performance degradation of irrigation networks is a real threat to the future of national food supply. The impact of the decline in irrigation performance is direct and indirect [2].. The direct impact is a decrease in productivity, a decrease in cropping intensity and an increase in farming risk. The indirect impact is the weakening of the farmer's commitment to maintaining the paddy field ecosystem because the poor performance of irrigation makes the land less conducive for farming, especially rice crops [3]..

In order to obtain an overview of the condition of the irrigation areas being managed, it is necessary to conduct a study of the irrigation areas, to determine the conditions of irrigation performance and to determine priorities for handling the rehabilitation of irrigation networks and to make policies. Administratively, the location for the Performance Study of the Renggung Irrigation Area in Central Lombok Regency is in the Kopang District Area, Central Lombok Regency, West Nusa Tenggara Province [s4]..

The rivers that are the mainstay of water sources for the development of the irrigation areas mentioned above are: the Renggung River which is in the Renggung-Perempung Watershed with DAS Number 107, with an area of catchment area (CA) of 9.21 km2 and a length of the main river of 8.91 km [5].

Conditions that affect the climate of an area are: temperature, humidity, wind direction and weather conditions. The climatological condition of the project area was taken from the nearest station, namely the Kopang Climatology Station (Coordinates 116º21'20" East Longitude & 8º37'20" South Latitude).

Table 1. Average Climatological Data Sta. Kopang

Data	Month											
	Jan		Feb		March		April		May		June	
	I	II	I	II	I	II	I	II	I	II	I	II
Relative Humidity (%)	92.80	96.80	93.57	95.70	97.40	97.39	98.17	97.45	97.36	96.02	97.57	97.44
temperature (C^0)	25.94	26.85	25.84	26.37	26.71	26.99	27.41	27.00	27.10	26.55	26.59	25.93
Wind Speed (m/sec)	0.50	0.63	0.86	0.79	0.55	0.38	0.37	0.40	0.38	0.35	0.39	0.44
Solar Illumination (%)	41.05	35.28	38.69	41.00	39.76	47.14	51.52	62.68	54.97	54.97	48.09	47.31
Data	Month											
	July		Aug		Sept.		Oct.		Nov.		Dec.	
	I	II	I	II	I	II	I	II	I	II	I	II
Relative Humidity (%)	97.51	97.53	97.50	97.52	97.60	98.25	97.58	97.55	96.60	96.58	96.59	96.43
temperature (C^0)	25.66	25.61	25.49	25.69	26.29	26.58	27.01	27.33	27.55	27.57	27.10	26.94
Wind Speed (m/sec)	0.45	0.46	0.56	0.50	0.57	0.53	0.54	0.48	0.41	0.37	0.58	0.73
Solar Illumination (%)	53.63	60.68	60.88	64.65	63.94	61.84	58.61	58.42	50.51	45.16	42.64	39.35

Source: Regional Infrastructure Information Center for Prov. NTB

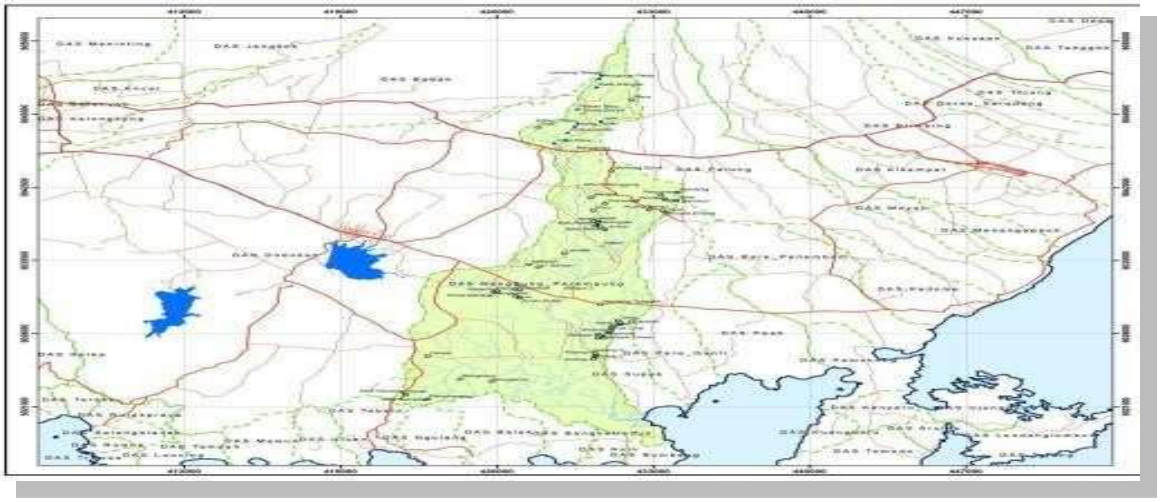

Figure 2. Distribution Map of Natural Resources Infrastructure in the Renggung Watershed

Based on the analysis of the Thiessen Polygon Map, the influential rain stations for the Renggung watershed are the Lingkok Lime, Pengadang and Rembitan Rain Stations (ARR) for the last 30 years [6]. Summary of Rainfall Data for the last 33 years, Half Monthly Average of Lingkok Lime and Perian Rain Stations (mm). The average annual rainfall is 2065 mm/year or 5.74 mm/day.

Table 2. Average Rain in Renggung Watershed

No.	Month												
	Jan		Feb		March		April		May		June		
	I	II	I	II	I	II	I	II	I	II	I	II	
Means	157.0	155.1	137.3	131.7	157.1	126.4	112.0	74.6	55.8	57.7	27.9	40.9	
R 80%	57.3	87.7	58.7	56.8	67.7	47.3	22.3	12.8	3.0	0.0	0.0	0.0	
R 5%	137.7	150.6	128.4	126.2	165.3	134.0	103.9	44.1	27.8	15.1	4.0	15.3	
No.	Month												Total (mm)
	July		Aug		Sept.		Oct		Nov.		Dec.		
	I	II	I	II	I	II	I	II	I	II	I	II	
Means	24.4	24.7	13.5	20.8	37.4	37.3	64.7	73.9	131.3	149.3	164.0	110.4	2085.2
R 80%	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	27.4	67.1	79.1	45.2	632.6
R 5%	2.9	8.9	4.6	3.4	7.2	14.4	26.1	59.8	117.0	140.9	152.0	89.4	1678.9

Source: The calculation results

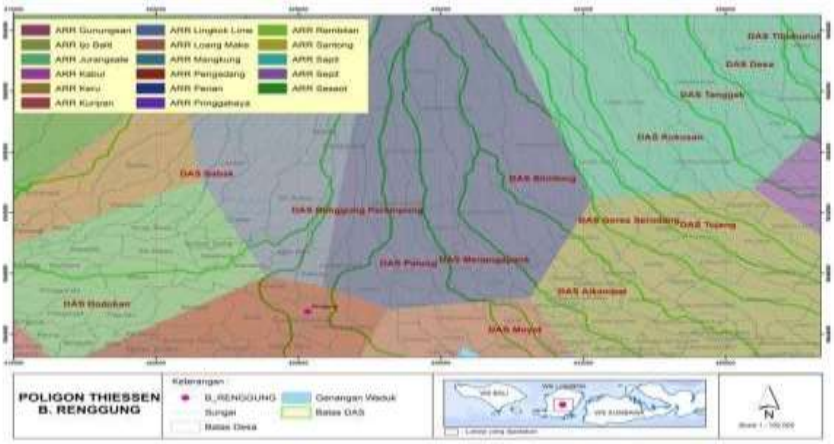

Figure 3. Map of the Renggung River Basin Thiessen Polygon

The water source for supplying the Renggung Irrigation Area comes from the Renggung River which gets water supply from the Babak – Renggung – Rutus HLD through the Otak Desa Supplement Building which flows into the Otak Desa weir [7]. Then the flow of water from the river was caught by the Renggung Weir. The Renggung weir has a flush door and intake gate to the right of the weir and flows to the main canal and 3 (three) secondary canals positioned to the right of the Renggung River to irrigate 1177 ha of rice fields. From the DI water shift schedule. Renggung I is on the 2nd – 5th and 18th – 19th of every month. While the 1st of each month is used for draining [8]. Drainage of the supplementary irrigation network every month for 1 (one) day and the remaining days and remaining days in each month ± 20 (twenty) days for water flow to Central Lombok Regency, from the 20 days above it is further divided into 5 - 6 days for areas East Pray.

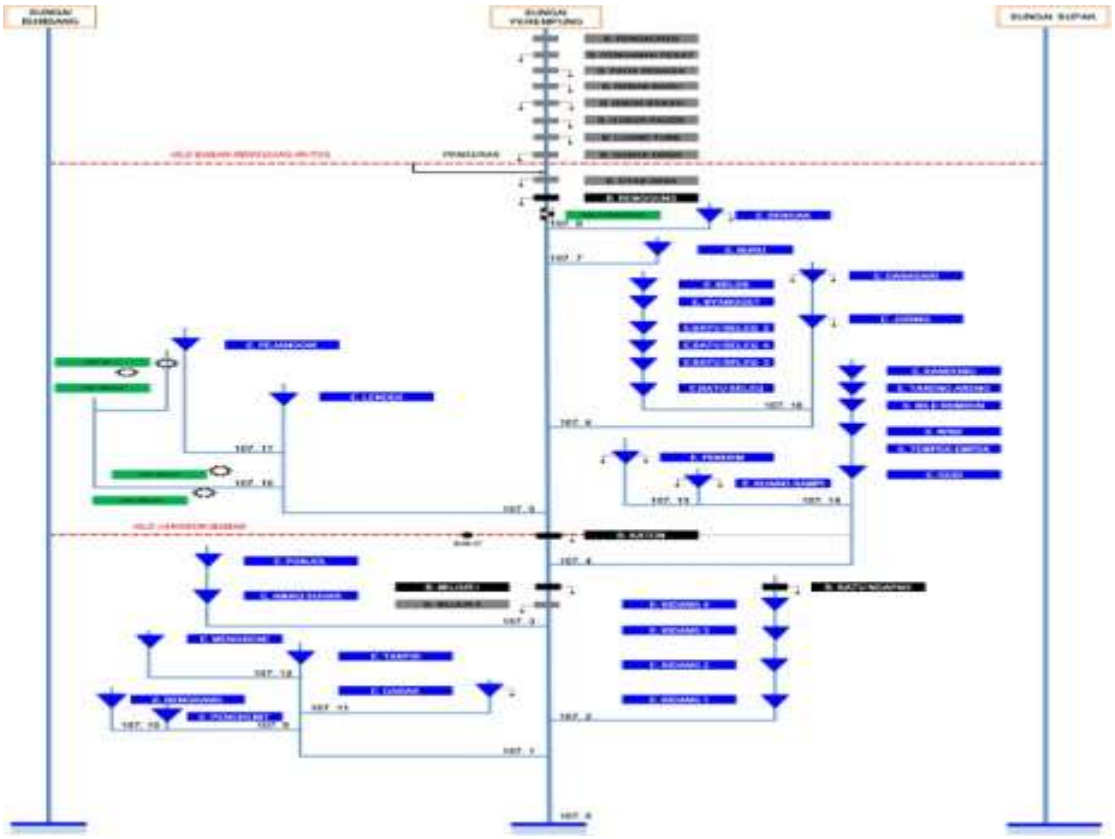

Figure 4. Bendung Renggung River Scheme

On the DI Irrigation Network. Renggung has 1 (one) fixed weir equipped with a rinsing door and intake gate to the right of the weir, 1 (one) main canal, 1 (one) supply canal and 3 (three) secondary canals with a position to the left of the Renggung River to irrigate raw rice fields covering an area of ± 1177 ha. IN. Renggung includes Technical Irrigation where there is a lot of damage to buildings and irrigation canals. Region D.I. Renggung has 1 (one) fixed weir, 1 (one) main canal with a length of ± 3761 m, 1 (one) Iwan supply canal with a length of ± 1655 m and 5 (five) secondary canals consisting of Sal.

Secondary Bakan = ± 950 m; sal. Secondary Renggung = ±2802 m; sal. BRG 13 secondary = ±1500 m; sal. Secondary Iwan I = ±1500 m; sal. Secondary Iwan II = ±1053 m.

Table 3. DI Irrigation Network Inventory. Rendang

No.	Irrigation Building	Unit	Amount	DI. Renggung		
				Good	Lightly damaged	Heavily Damaged
1	Fixed Weir	(Fruit)	1	1	0	0
2	The Inta Door to the Fixed Weir	(Fruit)	2	2	0	0
3	Mud Bag	(Fruit)	0	0	0	0
4	Building for tapping	(Fruit)	2	2	0	0
5	Building door for tapping	(Fruit)	3	2	0	0
6	Tapping building	(Fruit)	16	14	2	0
7	Building doors	(Fruit)	24	18	3	3
8	Measurement Building For Sal. Parent	(Fruit)	3	2	1	0

9	Measurement Building For Sal. Secondary	(Fruit)	3	2	1	0
10	Gutter Building	(Fruit)	0	0	0	0
11	Siphon building	(Fruit)	0	0	0	0
12	Bridge Building	(Fruit)	8	4	2	2
13	Culvert building	(Fruit)	9	7	2	0
14	Falls Building	(Fruit)	11	9	2	0
15	Leaning Got Building	(Fruit)	1	1	0	0
16	Overflow Building	(Fruit)	2	2	0	0
17	Washing Building	(Fruit)	1	1	0	0
18	Drain Iniet	(Fruit)	2	0	2	0
	Supplement Iwan I and II					
1	Supplementary Building	(Fruit)	2	2	0	0
2	Building for Tapping	(Fruit)	2	1	0	1
3	Building Doors for Tapping	(Fruit)	2	1	0	1
4	Tap Building	(Fruit)	6	4	1	1
5	Tapping Building Door	(Fruit)	7	5	1	1
6	Drain Iniet	(Fruit)	2	1	1	0
7	Bridge Building	(Fruit)	4	2	1	1
8	Culvert building	(Fruit)	5	3	1	1
9	Falls Building	(Fruit)	5	4	1	0
10	Leaning Got Building	(Fruit)	2	1	1	0

Research Methods

The implementation approach and methodology takes into account several things, including: i) technical aspects in accordance with the scope of the TOR and Planning Criteria, ii) implementation time aspects, and iii) manpower aspects.

The technical aspect is the top priority to be achieved. Besides still referring to the KAK, the consultant will also work based on currently valid standards/provisions, including:

1. Regulation of the Minister of Public Works Number 12/PRT/M/2015 concerning Guidelines for Exploitation and Planning of Irrigation Networks.
2. Government Regulation of the Republic of Indonesia Number 20 of 2006, concerning Irrigation.
3. Irrigation Planning Standards, Directorate General of Irrigation-Department of Public Works.

Field survey

Field activities were carried out to prepare supporting data for evaluating the performance of irrigation networks, including: irrigation network physical infrastructure (inventory survey), planting productivity data collection survey, irrigation O & P supporting facilities survey, O & P personnel organization survey and data collection, book survey DI data, maps and drawings (documentation), survey related to P3A [9].

Data analysis

Data analysis, including: analysis of hydrology and water balance, analysis of measured data, analysis of irrigation network survey results and analysis of network condition index determination [10].

According to the Appendix to Regulation of the Minister of Public Works Number 12/PRT/M/2015 concerning Guidelines for Exploitation and Planning of Irrigation Networks, there are 6 components that need to be assessed in connection with Network System Performance Assessment, namely:

a. Physical Infrastructure

The physical infrastructure component has a maximum condition index value of 45%, divided into 6 sub-components, namely:

Main Building : 13 %
Carrier Channel : 10 %
Building on carrier channel : 9 %
Sewer and Building : 4 %
Driveway / Inspection : 4 %

Office, Housing and Warehouse : 5 %

b. Planting Productivity

The planting productivity component has a maximum condition index value of 15%, divided into 3 sub-components as follows:

Fulfillment of Water Needs : 9%
Realization of planting area : 4%
Rice productivity : 2%

c. Supporting facilities

The supporting facilities component has a maximum condition index value of 10%, divided into 4 sub-components as follows:

O&M Equipment : 4 %
Transportation : 2 %
O&M implementing office equipment : 2 %
Communication tools : 2 %

d. Personnel Organization

The personnel organization component has a maximum condition index value of 15%, divided into 2 sub-components as follows:

O&M organization has been prepared with : 5 %
Clear boundaries of responsibilities and duties
Personnel : 10 %

e. Documentation

The documentation component has a maximum condition index value of 5%, divided into 2 sub-components as follows:

DI Data Book : 2 %
Map and pictures :
- Wall data in the office : 1 %
- Executor Image : 1 %
- Network Scheme : 1 %

f. Association of Farmers Using Water

The components of farmer associations using water have a maximum condition index value of 10%, divided into 7 sub-components as follows:

GP3A/IP3A is already a legal entity : 1.5%
GP3A / IP3A Institutional Condition : 0.5 %
Ulu Ulu Meeting / Village P3A / GP3A : 2 %
P3A actively participates in surveys/tracing
Network : 1 %
P3A participation in network repair
And handling natural disasters : 2%
P3A fees are used for repairs
Tertiary network (100%) : 2 %
P3A participation in planning
Planting arrangement and water allocation : 1 %

Procedures for Physical Assessment of Building Components in Irrigation Networks

Provisions in the assessment of physical infrastructure refer to the standards contained in Appendix II of the PUPR Ministerial Regulation, Number: 12/PRT/M/2015 dated 06 April 2015 The classification of the physical condition of irrigation networks is as follows:

1. Good condition if the level of damage is <10% from the initial condition of the building/canal and routine maintenance is required.

2. Slightly damaged condition if the level of damage is 10-20% of the initial condition of the building/canal and periodic maintenance is required.
3. Moderately damaged condition if the level of damage is 21 – 40% of the initial condition of the building/canal and remedial maintenance is required.
4. Severely damaged condition if the level of damage is > 40% from the initial condition of the building / canal and requires major repairs or replacement [11].

Result and Discussion

Hydrological Analysis

The need for irrigation water depends on the cropping pattern and the type of plant. For optimal use of water, it is necessary to investigate cropping patterns so that optimal planting areas are obtained. The planned planting pattern will be adjusted to the planting habits that have been implemented by farmers/local communities, namely: Existing Conditions of PADI (100%) - RICE (53%) + PALAWIJA (47%) - PALAWIJA (95%); Planned Conditions PADI (100%) – PADI (55%) + PALAWIJA (45%) - PALAWIJA (100%). Early planting begins in November for DI Renggung.

Figure 5. DI Water Balance Graph. Rendang Existing Conditions

Based on the results of the water balance analysis in the existing conditions, the start of planting was in the early November I planting period with a K factor probability of 50.0%. With little water availability, it is hoped that the water rotation system can increase the number of successful periods in meeting water needs.

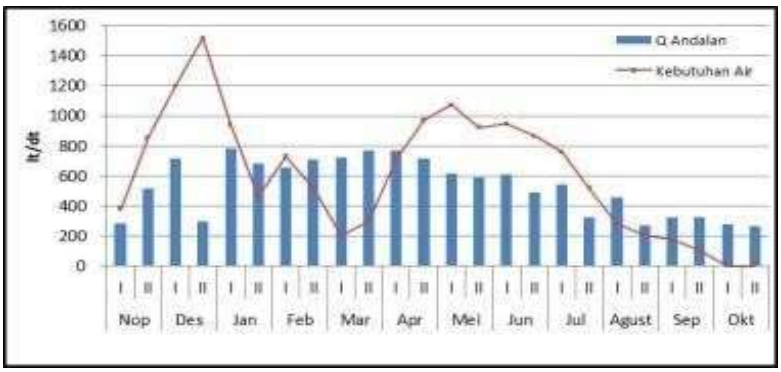

Figure 6. DI Water Balance Graph. Render Plan Conditions

PTT selection is based on the value of the K factor in each PTT scenario for one year. The PTT is selected by minimizing the occurrence of overturns in the trunk [12] [13]. Based on the results of the water balance analysis, it was obtained that the optimal initial planting period was November I and November II with an optimal K factor probability of 66.7%. However, early November I planting was chosen because it was in accordance with existing conditions.

Irrigation Water Management Conditions.

Irrigation management in DI. Renggung is included in the observer work area of UPT - DAS Renggung I in charge of 9 (nine) Irrigation Managers including Lendang Telaga, Bisok Bokah, Montong Gamang, Renggung I, Renggung II, Muncan, Mongges, Parung I and Parung II.

Number of personnel involved in irrigation management in DI. The current balance is as follows:

Irrigation Manager : 9 people
Guard Weir : 1 person
Water Gate Guards : 9 people

DI Irrigation Network Performance Index. Rendang

DI performance appraisal evaluation results. Renggung is 75.8% where the performance condition of Renggung Irrigation Area Irrigation is Good Performance, with details as shown in Table 4 below.

Table 4. DI Irrigation Network Performance Index. Rendang

Irrigation Network OP Condition Index	which exists	Max	Min	optimum
	%	%	%	%
Physical Infrastructure	33.5	45	25	35
Planting Productivity	12.4	15	10	12.5
Supporting facilities	7.0	10	5	7.5
Personnel Organization	14.0	15	7.5	10
Documentation	3.8	5	2.5	5
P3A	5.2	10	5	7.5
Amount	75.8	100	55	77.5

DI Irrigation Network Rehabilitation Recommendations. Rendang

It is necessary to repair physical infrastructure as well as maintenance and improvement of supporting facilities, to maintain cropping intensity and increase cropping productivity. Channel rehabilitation is proposed, among others:

Table 5. Rehabilitation of Rendang Irrigation Channels

No.	Channel Name	Nomenclature	Size of Service Area	Channel Length	Problem Identification				Service Area (HA)	Sediment Thickness	Information
			(Ha)	(m)	Sedimentation (m)	Good / Slightly Damaged (m)	Moderate Damage (m)	Heavily Damaged (m)			
1	Renggung Main Channel	BRG 0 s/d BRG 9	415.29	3761	3761	-	-	-	450.2	30 - 50	-
2	Ivan Supplement Channel	BRG.3 s/d BRG.1	16.25	1655	1655	-	-	1655	16.25	30 - 50	Proposed Current Rehabilitation Design
3	Renggung Secondary Channel	BRG.9 s/d BRG.15	208.41	2802	2802	-	-	-	208.21	30 - 50	-
4	Bakan Secondary Channel	BRG.9 s/d BBK.4	137.68	950	950	-	-	-	137.68	30 - 50	-
5	BR13 Secondary Channel	BRG.13 s/d RG.13 Kn.3	134.96	1500	1500	-	1500	-	123.84	30 - 50	Proposed Current Rehabilitation Design
6	Secondary Channel Iwan I	BIS.0 s/d BIS.3	98.48	1500	1500	-	-	1500	98.48	30 - 50	Proposed Current Rehabilit

											ation Design
7	Secondary Channel Iwan II	BID.0 s/d BID.3	166.46	1053	1053	-	-	1053	116.56	30 - 50	Proposed Current Rehabilitation Design

a. Aspects of Physical

Infrastructure DI channel rehabilitation. Renggung can be postponed temporarily considering the condition of irrigation performance in Di. Renggung is currently in Good Performance condition, with the achievement of planting intensity of 295% - 300%, and from the results of the analysis of benefits and construction costs, the EIRR value is 13.13%. This indicates that the cost of rehabilitation of irrigation networks is relatively high compared to the significant increase in profits made by repairing/making new canal linings so that network efficiency increases [14][15].

b. Productivity Aspect

The application of K Factor in the network must be properly planned, implemented and monitored in order to minimize irrigation operational failures.

To increase rice production, several things need to be done, including: counseling and cultivation assistance, improving the performance of OP officers and forming a cooperative platform that can overcome difficulties in production costs and distribute competitive yields[16].

c. Aspects of Supporting Facilities

As the holder of management authority, the NTB Provincial Office of Public Works through the Lombok PSDA Center is expected to be able to complete the basic needs of supporting facilities for OP activities in the Field, including: OP equipment, OP transportation facilities, Observer Office/UPT and Branch Office equipment, communication equipment for field officers.

d. Organizational Aspects of Personnel

Improvements are needed in the organizational aspects of OP personnel for DI. Responsible with clear boundaries of responsibilities and duties at all levels. As a reference, the Ministerial Regulation of Public Works and Pera No. 12/PRT/M/2015 Appendix II concerning: Exploitation and Maintenance of Irrigation Networks [17][18].

e. Documentation Aspect

So that the implementation of OP DI activities. Renggung becomes easier to implement and understand for all relevant officers, it is recommended to complete the existing documentation at the Observer's Office which includes documentation in the form of:

- Irrigation Area Data Book
- Maps and Pictures (data on office walls and executive drawings).

f. P3A Aspect

As far as possible P3A associations are formed as legal entities in accordance with existing provisions so that their existence is legal and in which their rights and obligations are embedded in accordance with applicable laws. The government through related agencies can conduct WUA training related to P3A internal administration, Procedures and Obligations for the Management of tertiary irrigation networks which are under their authority[19].

Discussion

Irrigation is one of the most important elements in agricultural activities in a broad sense. The function of irrigation for agriculture is to guarantee availability of water needed in the agricultural process. [20] [21]. Irrigation management in DI. Renggung is included in the observer work area of UPT - DAS Renggung I in charge of 9 (nine) Irrigation Managers including Lendang Telaga, Bisok Bokah, Montong Gamang, Renggung I, Renggung II, Muncan, Mongges, Parung I and Parung II. From the results of the canal inventory and field observations it can be

seen that the condition of the channels in the rasau river is covered with water plants, of course of course it affects the performance of the channel and in some parts it has happened siltation resulted in the channel not being able to function properly. So that maintenance, care and rehabilitation are needed channel on the Rasau and Antasan Dinis rivers so that they can return function. In addition, proper operation and maintenance is required in order for the channel in the village of Sungai Rasau can function optimally.

Conclusion

Based on the discussion above it was concluded that the human resources in the DI Observers. The ridges are sufficient and support the performance of DI irrigation. Rendang; association of farmers using water in DI. Renggung is not yet a legal entity, so there is a need for management legalization (GP3A/P3A); as well as irrigation observers coordinating with irrigation officers, sluice and weir officers, as well as GP3A and P3A in coordination and meetings for smooth operation and maintenance.

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