Analysis of Irrigation Management Performance in Tanah Laut Regency

Muhammad Galih Saputra
Civil Engineering, Faculty of Engineering,
Lambung Mangkurat University, Indonesia

Abstract:- **The management and planning of irrigation assets in Tanah Laut Regency is still in the unfavorable category in 2020, so it is necessary to recalculate irrigation performance in 2022 for strategies to improve irrigation performance. The purpose of this study was to determine irrigation performance factors, performance improvement strategies, and institutional management system implementation for all strategies. The research was conducted by collecting primary, secondary and other supporting data, then taking into account the performance of the existing irrigation system by considering physical facilities and infrastructure, plant productivity, supporting facilities, personnel organizations, documentation and associations of farmers using water. Furthermore, the target of distributing questionnaires to respondents in this study was farmers to irrigation stakeholders, accompanied by interviews with irrigation experts. Questionnaire data is tabulated using the Relative Importance Index (RII) method to determine the dominant factor of the institutional model that fits all existing aspects. Based on the results of the questionnaire, it is known that the dominant factors for irrigation in Tanah Laut Regency consist of planting productivity, irrigation institutions, staffing organizations, physical facilities, P3A, documentation and supporting facilities. While the irrigation evaluation from the field review obtained a value of 53.23% in the bad category and needs attention.**

Keywords:- Irrigation, Tanah Laut Regency, Questionnaire, Stakeholders, and RII

I. INTRODUCTION

Tanah Laut Regency is one of the regions in South Kalimantan Province which has a very large area of rice fields and plantations, making Tanah Laut Regency one of the rice granaries in South Kalimantan Province. Based on data from the Department of Public Works, Spatial Planning and Defense PUPR of Tanah Laut Regency (2019), The area of rice fields in Tanah Laut Regency is 56 thousand hectares, and the area of irrigated rice fields is 26 thousand hectares, with an active irrigation area of 111 (one hundred and eleven) units. This number is the result of a field check of 132 (one hundred and thirty-two) irrigation units recorded at the Ministry of Public Works and Public Housing [1].

Irrigation is an effort to bring in water by making buildings and canals to drain water for agricultural purposes, distributing water to rivers or fields in an orderly way, and disposing of water that is no longer used [2]. Meanwhile, based on the Regulation of the Minister of PUPR (2015), Irrigation is a way to get water to crops, control it, and get rid of it. Surface irrigation, swamp irrigation, underground water irrigation, pump irrigation, and pond irrigation are all types of irrigation [3].

Tanah Laut district does not yet have a long-term plan or master plan for irrigation. This has resulted in development being disoriented and prone to social conflicts and other technical problems. The construction that has been implemented does not have a clear plan regarding its management and maintenance, so existing buildings and canals become neglected and cannot be utilized by farmers and local communities, resulting in budgetary losses and other non-technical problems. By taking into account the irrigation assets, the condition of the available water, and the participation of farmers who are involved in the irrigation, an assessment is carried out regarding the performance of irrigation managers from the perspective of water users who are in the field [4]

Policy stakeholders, irrigation users, and those affected by irrigation are still operating separately, so there is no common vision or mission for irrigation. This has led to several conflicts related to the authority of each agency, such as the Public Works Office for Spatial Planning and Land Affairs with the Food Crops, Horticulture, and Plantation Services in the activities of irrigation access roads, farming roads, water gates, irrigation canals, and agricultural bridges, as well as with the Association of Water User Farmers (P3A) in their secondary and tertiary irrigation networks. Apart from that, conflicts also occurred between the Public Works Office for Spatial Planning and Land Affairs and the Fisheries Service regarding licensing activities for ponds and fish nurseries [5]. Another conflict involved the Department of Public Works and Agriculture when faced with the activities of entrepreneurs affected by irrigation [6]. In fact, conflicts often occur among irrigation users because the existing water discharge is not enough to irrigate all rice fields at once [7]. The main objective of this study is to examine how irrigation is done in Tanah Laut Regency so that later it can produce appropriate irrigation management to increase its performance [8].

II. MATERIALS AND METHODS

A. Data collection

Questionnaires were sent to the people who were supposed to answer them. They included the Regent, Head of BAPPEDA, Head of PUPR, Head of Agriculture Service, Inspectorate, and others from the government, as well as community leaders, the Water User Farmers Association (P3A), academics, and others from non-government groups. The distribution method is carried out by direct delivery to respondents. The target respondents were chosen by the researchers themselves based on certain backgrounds and knowledge related to the research being studied (purposive sampling). The number of filled questionnaires was 46 (forty six) respondents.

B. Respondent Demographic Data

Questionnaires were distributed to 46 respondents. There were 40 male respondents (87%) and 6 female respondents (13% of the total sample). While the age of most respondents was in the range of 41 to 50 years, as many as 15 people (32.6%). The gender and age profiles of the respondents are shown in Figure 1 and Figure 2.
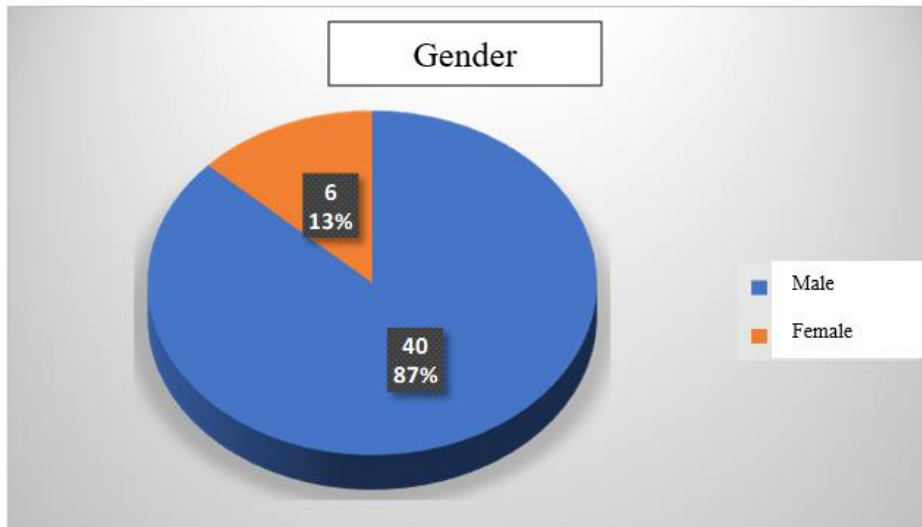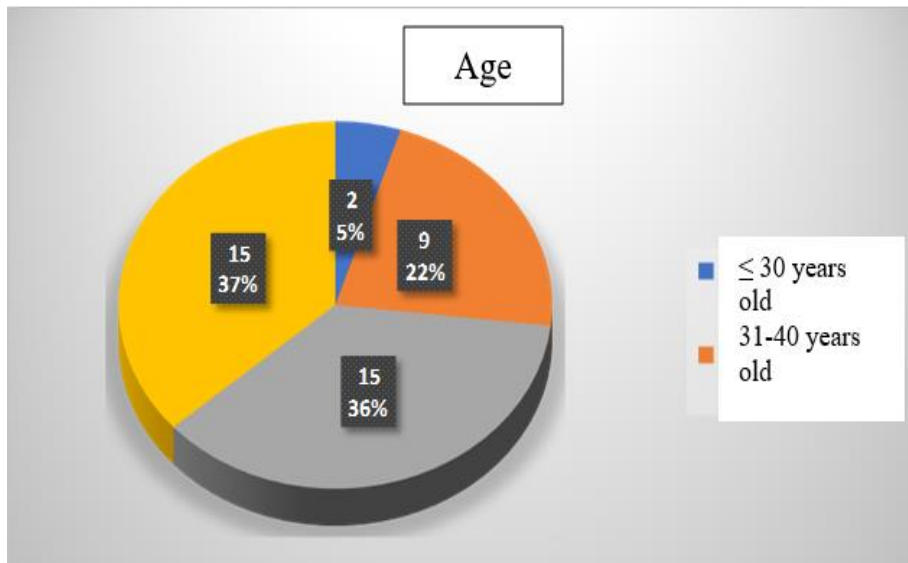

Fig. 1: Gender of Respondents

Fig. 2: Age of Respondents

The education level of the largest respondents was bachelor's degree and senior high school with 18 people each (39%), then master's degree with 7 people (15%), and education with the lowest number, namely a postgraduate, had 1 person (2%). Figure 3 depicts the respondents' educational profile.
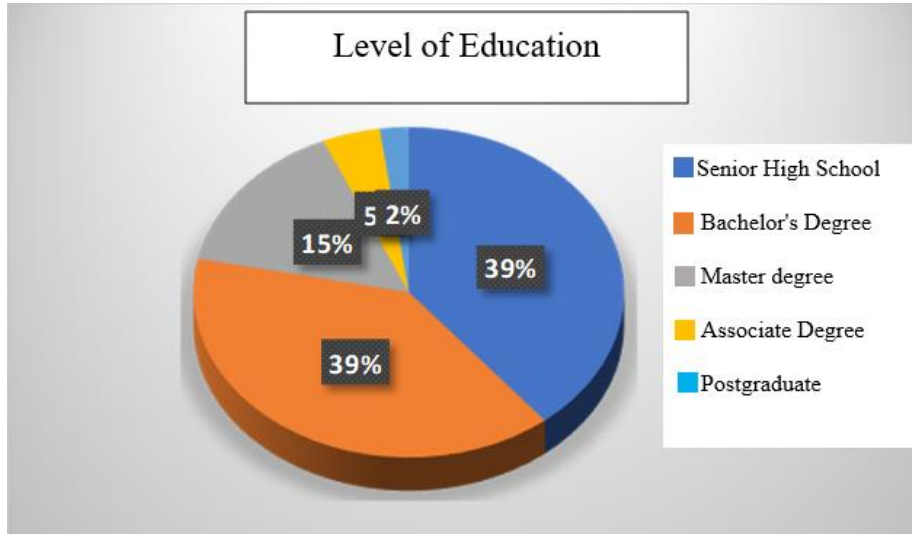
Fig. 3: Education Level Respondents

In comparison, the number of respondents from non-government elements is 24 out of 52. The distribution profile of the questionnaire is shown in Figure 4.
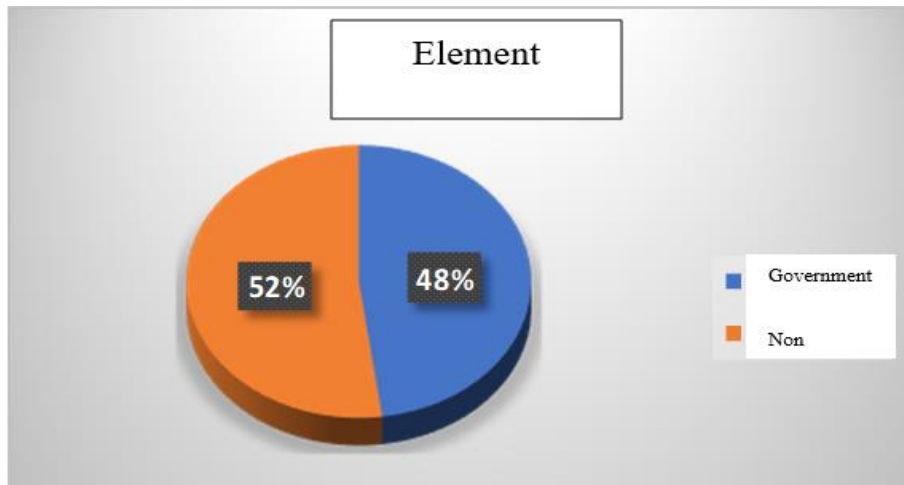

Fig. 4: Respondent Element

C. Validity test

A valid instrument means that the measuring instrument used to obtain and measure data is valid [9]. Validity means that the instrument can be used to measure what should be measured and can reveal data from the variables studied appropriately. Validity testing can use the formula. Spearman's correlation is as follows:

$$r_s = 1 - \frac{6 \sum d_1{}^2}{n\,(n^2 - 1)}$$

$$(1)$$

Where rs is the Spearman correlation coefficient, $d_1{}^2$ is the difference between the two ratings, and n is the number of respondents who answered the questionnaire (sample size).

➤ *Reliability Test*

A reliability test is a tool for determining the dependability of a questionnaire, which is a variable indicator. A questionnaire is said to be reliable if one's answers to these statements are consistent or stable from time to time. The Alpha Cronbach test is used to determine reliability:

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum \sigma_b^2}{\sigma_t^2}\right)$$

$$(2)$$

Where Where r_{11} is Cronbach's alpha reliability coefficient, $\sum \sigma_b^2$ is the number of question items tested, and σ_t^2 is number of item variants, and z is total varian.

➢ *Identification of Irrigation System Performance Factors*

To find out the dominant factors influencing the performance of irrigation and swamps in Tanah Laut District, an analysis was carried out using the method of the relative important index (RII). Ways The Relative Imporant Index (RII) examined the factors that were most influential in the research object. In addition, this analysis method is processed by statistical calculations with the results of the questionnaire as input, which will be processed into factors that influence the ranking system based on the weight of the value given by the respondent after filling out the questionnaire.

➢ *Irrigation System Performance Index*

The value of the irrigation performance calculation results for each aspect is then summed up, and the result of the assessment is the condition index of the irrigation network system. The results of the irrigation system performance index are as follows:

80-100 : excellent performance
70-79 : excellent performance
55-69 :Performance is deficient and requires improvement
55 : Poor performance that requires attention

III. RESULTS AND DISCUSSION

A. *Validity test*

A validity test can be done by comparing the values of r count and r table. The size of the r table, which is determined by the number of respondents using the formula N-2 = 46 - 2 = 44, is 0.297.

B. *Reliability Test*

The consistency and reliability of the instrument are intended to reveal the answers to the questions given by the respondents. The analysis can be seen in Table 1.

Cronbach's Alpha	N of Items
0.917	44

Table 1: Reliability Test

C. *Relative Important Index (RII)*

Based on Table 2, you can see the ranking column RII in order from highest to lowest. The dominant factor that has the most influence on the performance of the irrigation system of Tanah Laut Regency is planting productivity, which ranks first, followed by irrigation institutions, personnel organization factors, physical infrastructure, P3A, documentation, and supporting facilities [10].

Factor	5. N5	4. N4	3. N3	2. N2	1. N1	Total	N	A*N	RII	Rank
Aspects of Physical Infrastructure	880	264	87	10	0	1241	276	1380	0,899	4
Aspects of Planting Productivity	175	40	3	0	0	218	46	230	0,948	1
Aspects of Supporting Facilities	255	276	150	26	1	708	184	920	0,770	7
Organizational Aspects of Personnel	275	132	12	0	0	419	92	460	0,911	3
Documentation Aspect	210	136	48	0	0	394	92	460	0,857	6
Aspects of Water User Farmers Association (P3A)	495	196	99	6	0	796	184	920	0,865	5
Aspects of Irrigation Asset Management	155	40	15	0	0	210	46	230	0,913	2

Table 2: Relative Important Index (RII)

The results of the RII calculation show that respondents strongly agree that all of the above aspects have an effect on irrigation performance in Tanah Laut Regency, where the value is 0.800.

Respondents also, based on the results of interviews, believed that the establishment of an irrigation institution in Tanah Laut Regency would improve the reliability of irrigation in Tanah Laut Regency in the future. Irrigation performance has been declining as a result of massive construction and improvements in recent years, as well as a lack of awareness among users and implementers about their operational and maintenance activities [11].

Academics from universities and experts from provinces and ministries also agreed to see a tendency for irrigation policies not to be based on proper standards and procedures. The involvement of all aspects of the organizers makes the ongoing direction of development less effective and efficient. An understanding of irrigation that is not evenly distributed for all stakeholders ultimately really needs a forum for coordination and determining the right, effective, and efficient policy direction for Tanah Laut Regency.

D. *Physical Infrastructure*

The buildings in irrigation networks and the buildings that support them are used to measure the physical infrastructure of a building. Items and their percentage of assessment can be described as follows:

- The condition of the main building, consisting of weirs, dams, ponds, and others, has the largest portion of the value, namely 29%, with an average value of 6.70 out of 13.

- The condition of the channel that carries water from the main source or building to the rice fields is in second place, namely 22% with an average value of 5.15 out of 10.
- The condition of regulatory buildings in the carrier channel, such as dividing, tapping, and tapping buildings, occupies the third position, namely 20%, with an average value of 4.64 out of 9.
- The condition of supporting buildings to facilitate activities in the field, consisting of observer offices, official houses, and complete warehouses, is in fourth place, namely 11% with an average value of 2.58 out of 5.
- The condition of the exhaust ducts and their regulatory structures is in fifth place with 9%, and the average value obtained is 2.06 out of 4.

Based on the results of the assessment, physical infrastructure has a bad score of 23.19, or 51.53%, with only 4 irrigation systems having good physical infrastructure, or a percentage of 3.45%.

E. Plant Productivity

The success of an irrigation system can be seen in the increase in agricultural yields in the irrigation area and is a determinant of the success of its planning and management. Items and their percentage of assessment can be described as follows:

- Conditions for fulfilling water needs are obtained from the results of the planning and calculation of the latest discharge. The weight for this assessment is 60%, with an average score of 4.54 out of 9.
- The realized planting area is the value obtained from the percentage of functional area that can be planted 2-3 times a year. This weight is in second place, namely 26.7%, with an average value of 2.02 out of 4.
- The condition of rice planting productivity is the value obtained from agricultural products, occupying the third position, namely 13.3% with an average value of 1.01 out of 2.

Based on the results of the assessment, crop productivity has a bad value of 7.56 or 50.43%, with only 10 irrigation systems where crop productivity is in good condition or has a percentage of 8.62%.

F. Supporting facilities

Maintenance of irrigation assets is very important to maintain irrigation reliability. Operational and maintenance equipment, as well as office equipment, are very important items to support all operation and maintenance activities. Items and their percentage of assessment can be described as follows:

- The condition of irrigation network operation and maintenance equipment, such as routine maintenance equipment, personnel equipment, and heavy equipment for maintenance, has the largest portion of value, namely 40%, with an average value of 2.06 out of 4.

- For operational and maintenance staff, the condition of the transportation equipment is worth 20%, with an average score of 1.03 out of 2.
- The condition of office equipment, such as furniture and work equipment, in the observer's office accounts for 20% with an average score of 1.03 out of 2.
- The condition of communication tools is a means of communication for operation and maintenance officers, and the maintenance team has a portion of 20% with an average value of 1.03 out of 2.

Based on the results of the assessment, the supporting facilities have a bad score of 5.16, or 51.60%, because there is no irrigation system whose supporting facilities are in good condition.

G. Personnel Organization

The rapid development of irrigation has resulted in an increased need for field workers for the operation of the main building and its water gates [12]. Items and their percentage of assessment can be described as follows:

- The condition for the preparation of the operation and maintenance organization, consisting of observers, interpreters, sluice officers, weir operational officers, and canal workers, has a portion of 33.3% with an average value of 3.70 out of 5.
- Personnel conditions, which consist of fulfilling the needs of operation and maintenance officers and officers' understanding of operations and maintenance in Tanah Laut Regency, account for 66.7%, with an average value of 7.40 out of 10.

Based on the results of the assessment, the personnel organization has a good score of 11.10, or 74.01%, with 115 irrigation systems where the personnel organization is in good condition, or has a percentage of 99.14%.

H. Documentation

The completeness of irrigation data is critical for discussion activities, institutions, meeting minimum value of service standards, and determining future irrigation conditions. Items and their percentage of assessment can be described as follows:

- The condition of the data book is data and reports on irrigation areas from the preparation, planning, development, rehabilitation, and improvement activities, which have a value portion of 40% with an average value of 1.28 out of 2.
- The condition of maps, drawings, and schematics are the overall search results, which have a value portion of 60% with an average value of 1.92 out of 3.

Based on the results of the assessment, documentation has a low value of 3.22 or 63.90% with only 8 irrigation systems having documentation in good condition or a percentage of 6.90%.

I. Water User Farmers Association (P3A)

Construction of irrigation networks requires water regulation for agricultural activities around the network [13]. It is hoped that the role of implementing the distribution of water for the surrounding rice fields will also be carried out by farmers in the association of water-using farmer associations (P3A) [14]. Items and their percentage of assessment can be described as follows:

- P3A legal status conditions have a portion of 15% with an average value of 0.44 out of 1.5.
- The condition of P3A's institutional development since its establishment until now has a portion of 5% with an average value of 0.15 out of 0.5.
- The condition of P3A meetings has a portion of 20% with an average value of 0.59 out of 2.
- The condition for P3A participation in network tracing activities has a portion of 10% with an average value of 0.3 out of 1.
- The condition of P3A participation in network repair activities has a portion of 20% with an average value of 0.59 out of 2.
- The condition for P3A participation in the collection of contributions for the continuity of P3A has a portion of 20% with an average value of 0.59 out of 2.
- The condition of P3A participation in planting patterns and planning activities has a portion of 10% with an average value of 0.3 out of 1.

Based on the results of the assessment, P3A has a bad score of 2.99, or 29.61%, with only 5 irrigation systems where P3A is in good condition, or has a percentage of 4.31%.

J. Analysis of Irrigation Management of Tanah Laut District

Based on the results of the assessment of irrigation asset management referred to in government regulations PU number 12 of 2015, the value obtained is 53.23% of the maximum value of 100%, and the condition obtained is BAD. The Government of Tanah Laut Regency, as the organizer of irrigation activities under its authority, has also become the center of attention. In addition to improving and repairing the irrigation system as a whole, it is also important to pay attention to how users and those affected by irrigation rate an irrigation system that has been set up to affect agricultural output in Tanah Laut Regency.

K. Data analysis

Based on the results of network tracing, field observations, assessment of the latest irrigation performance, and filling in questionnaires by influential respondents, the results obtained are in accordance with those described in Table 2.

Factor	Questionnaire		Field Assessment	
	RII	Rank	Assessment (%)	Rank
Aspects of Physical Infrastructure	0,899	4	51,53	3
Aspects of Planting Productivity	0,948	1	50,43	6
Aspects of Supporting Facilities	0,770	7	51,62	4
Organizational Aspects of Personnel	0,911	3	74,01	7
Documentation Aspect	0,857	6	63,90	2
Aspects of Water User Farmers Association (P3A)	0,865	5	29,61	1
Aspects of Irrigation Asset	0,913	2	53,23	5

Table 3: Comparison of Questionnaire Results and Field Observations

There are differences in the results of the questionnaire and direct assessments in the field. This is due to differences in the views of the Regional Government of Tanah Laut Regency and irrigation users, with the Ministry of Public Works and Public Housing as the maker of technical guidelines for irrigation evaluation. The results of the questionnaire were obtained by the respondents based on the facts seen in the field without going through detailed calculations and each respondent's understanding of different irrigation methods. Meanwhile, performance evaluation is obtained from detailed network tracing by paying attention to all aspects that affect the performance of irrigation systems [15].

L. Strategy and Recommendations for Improving Irrigation System Performance

The recommended solution to the problems found in this research is for the government of Tanah Laut Regency to prioritize coordination and cooperation and have the same direction in increasing the reliability of irrigation. The strategy for improving irrigation performance can be summed up as increasing operation and maintenance officers and resources in the Water Resources Sector and establishing an irrigation commission institution as a maker of policy directions and strategic plans for irrigation management in Tanah Laut Regency. Training and increasing understanding for all fields, both government and non-government, The formation of P3A as the spearhead of irrigation commissions in their respective irrigation areas has made irrigation policy directions more effective and efficient [16].

IV. CONCLUSION

Based on the results of the research and data processing that have been done, the following conclusions can be drawn:

- The irrigation performance of Tanah Laut Regency is in the poor category with a value of 53.23%.
- There are six main causes of poor irrigation system performance, which are divided into 23 subfactors.The performance aspect of the irrigation system that is most dominant, or the factor that has the most influence on the irrigation system, is the factor with an RII value above 0.800, so that it is considered important or dominant, namely crop productivity, irrigation institutions, personnel organization, physical infrastructure, P3A, and documentation.
- The results of the evaluation of irrigation performance obtained from field observations are as follows:

✓ Physical infrastructure has a bad score of 23.19, or 51.53%, with only 4 irrigation systems whose physical infrastructure is in good condition or has a percentage of 3.45% of the total irrigation in Tanah Laut Regency.

✓ Planting productivity has a bad value of 7.56, or 50.43%, with only 10 irrigation systems where crop productivity is in good condition or has a percentage of 8.62% of the total irrigation in Tanah Laut Regency.

✓ Supporting facilities have a bad value of 5.16, or 51.60%, in the absence of an irrigation system whose supporting facilities are in good condition.

✓ Personnel organization has a good value of 11.10 or 74.01% with 115 irrigation systems where the personnel organization is in good condition or has a percentage of 99.14% of the total irrigation in Tanah Laut Regency.

✓ The documentation has a low value of 3.22, or 63.90%, with only 8 irrigation systems whose documentation is in good condition or has a percentage of 6.90% of the total irrigation in Tanah Laut Regency.

✓ P3A has a bad value of 2.99, or 29.61%, with only 5 irrigation systems where P3A is in good condition or has a percentage of 4.31% of the total irrigation in Tanah Laut Regency.

CONFLICTS OF INTEREST

The authors say that putting out this paper does not involve any conflicts of interest.

REFERENCES

[1.] Indonesian Government, "Ministerial Regulation Ministry of Public Works and Public Housing N0. 14 of 2015 on Criteria and Determination of Irrigation Area Status," Jakarta, 2015. [Online]. Available: birohukum.pu.go.id.

[2.] P. Aryastana, C. A. Yujana, and I. M. Ardantha, "Irrigation Water Management by Using Remote Sensing and GIS Technology to Maintain the Sustainability of Tourism Potential in Bali," *J. Infrastruct. Facil. Asset Manag.*, vol. 2, no. 1, pp. 63– 72, 2020, doi: 10.12962/jifam.v2i1.6965.

[3.] Indonesian Government, "Ministerial Regulation Ministry of Public Works and Public Housing N0. 23 of 2015 on Irrigation Asset Management".

[4.] Jannata, S. haji Abdullah, and A. Priyati, "Performance Analysis of Irrigation Management in the Lemor Irrigation Area, East Lombok Regency, West Nusa Tenggara 'Analisa Kinerja Pengelolaan Irigasi Di Daerah Irigasi Lemor, Kabupaten Lombok Timur, Nusa Tenggara Barat,'" *J. Ilm. Rekayasa Pertan. dan Biosist.*, vol. 3, no. 1, pp. 112–121, 2015.

[5.] S. P. Vimal, N. Sathish Kumar, M. Kasiselvanathan, and K. B. Gurumoorthy, "Smart Irrigation System in Agriculture," *J. Phys. Conf. Ser.*, vol. 1917, no. 1, 2021, doi: 10.1088/1742-6596/1917/1/012028.

[6.] M. ARIK and İ. KORKUT, "Irrigatıon in Agriculture and Automation Based Irrigation Systems (Mini-Review)," *J. Sci.*, vol. 10, no. 2, pp. 360–367, 2022, doi: 10.29109/gujsc.1108504.

[7.] I. Hari, E. Rahmarestya, and H. Harsono, "Development of IoT Based Smart Irrigation System with Programmable Logic Controller," *Int. J. Agric. Syst.*, vol. 9, no. 1, pp. 27–39, 2021, doi: 10.20956/ijas.v9i1.

[8.] Murtiningrum and S. S. Arif, "Assessment of Irrigation System Performance and Its Associated Impacts on Poverty," *Agritech*, vol. 25 (1), pp. 15–23, 2005.

[9.] Sugiyono, *Quantitative Approach Educational Research Methods, Qualitative, and R&D "Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D."* Bandung: Alfabeta, 2014.

[10.] S. G. Def and F. S. Abc, "Farmers ' participation in Water User Association in western Iran," *J. WATER L. Dev.*, no. No. 35, pp. 49–56, 2017, doi: 10.1515/jwld-2017-0067.

[11.] F. Djufry, A. W. Rauf, and M. S. Palad, "Effectiveness of Irrigation Methods and Time of Providing Water in Maintaining Soil," *AGRIVITA J. Agric. Sci.*, vol. 43, no. 3, pp. 627–634, 2021.

[12.] T. B. Prayogo, S. Wahyuni, and M. Iqbal, "A Study of Irrigation Performance Index and Real Cost Value of Irrigation Operations and Maintenance in Surak Irrigation Area," *Civ. Environ. Sci. J.*, vol. 4, no. 1, pp. 30–42, 2021.

[13.] H. Van Vu, H. Ho, and Q. H. Le, "Impact of Farmers' Associations on Household Income: Evidence from Tea Farms in Vietnam," *Economies*, vol. 8, no. 4, pp. 1–16, 2020, doi: 10.3390/ECONOMIES8040092.

[14.] D. Ratnasari, Z. Kusuma, and I. Hanafi, "The Managementof Community-Based Irrigation System (A Case Study of Water Users' (Farmers) Association in Suak, Manis Raya Village, Sepauk District, Sintang Regency)," *J. Pembang. dan Alam Lestari*, vol. 9, no. 2, pp. 140–149, 2018, doi: 10.21776/ub.jpal.2018.009.02.11.

[15.] M. H. Aydoğdu, M. Aydoğdu, and K. Yenigun,

"Factors Affecting Farmers ' Satisfaction from Water Users Association in the Factors Affecting Farmers ' Satisfaction from Water Users Association in the Harran Plain-GAP Region , Turkey," *J. Agric. Sci. Technol.*, no. December, 2015.

[16.] M. Bartling, A. C. Robinson, H. A. Estrella, and A. Eitzinger, "The impact of user characteristics of smallholder farmers on user experiences with collaborative map applications," *PLoS One*, vol. 17, no. 3 March, pp. 1–30, 2022, doi: 10.1371/journal.pone.0264426.