A Saprobic Index for quality of Minapadi Water and the Fish Osmotic Performance Level of Minapadi

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Abstract. Ending hunger is one of the Sustainable Development Goals (SDG) that must be achieved to achieve prosperity. The supply of these food needs connects with human dwelling requirements. Numerous technologies have been developed to solve these difficulties. One of these technologies is minapadi, which uses land effectively. For sustainability objectives to be realized, using such technology must preserve environmental quality. This research intends to assess changes in water quality resulting from the usage of minapadi, as well as fish osmosis performance in minapadi. This research is performed to determine the effect of minapadi technology on water and fish. Samberembe Sleman is the location that has been adopting minapadi for a long time and is the Food and Agriculture Organization of the United Nations (FAO) pilot site. In order to acquire data for use in computing the Tropic Saprobity Index, the minapadi water of Samberembe was collected monthly for four months during the study. Blood samples from tilapia (Oreochromis niloticus) were collected in the fourth month to determine osmotic performance levels. The acquired findings have the highest SI value of 0.986 and the lowest SI value of 0.968. The state of β (meso/oligo saprobik) has the highest TSI value with a value of 1.011, while the state has the lowest TSI value with a value of 0.995 β (meso saprobik). Iso-hyperosmotic is the pattern of osmoregulation in tilapia (Oreochromis niloticus) in minapadi. Stable SI and TSI levels at Minapadi do not fluctuate. This result suggests that the water quality is with lightly contaminated water, yet the TSI value indicates that the water is fertile and potable. The normal condition of fish in minapadi indicates that the use of minapadi does not affect environmental conditions.

1 Introduction

The Sustainable Development Goals (SDGs) aim to enhance people's lives, boost prosperity, and safeguard the environment [1]. The requirement for food is one of the SDGs that must be addressed [2]. The fulfillment of this nutrition overlaps with the satisfaction of the human

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house's demands [3,4]. Numerous technologies have been developed to solve these difficulties. One of these technologies is minapadi, which uses land effectively [5]. In Indonesia, minapadi has become a popular technology [6]. The significance of this technique was added to the cultural identity of the globe in 2005 [7]. For sustainability objectives to be realized, using such technology must preserve environmental quality [8]. There has been researched on minapadi [9–11], but it has not been continuously monitored. Samberembe Sleman is the location that has been adopting minapadi for a long time and is the Food and Agriculture Organization of the United Nations (FAO) pilot site [12].

Phytoplankton may serve as an indicator of water quality [13–15], one of these methods is the saprobic index. Aquatic saprobic is the condition of water quality induced by the addition of organic matter, which is typically an indication of the quantity and arrangement of organism species in the water. Saprobic is comprised of the Saprobic index and Trophic Saprobic index. The Tropical Saprobic Index is used for assessing the parameters of the fertilizer, and the Saprobic Index is used for the parameters of polluters [16–19]. Numerous studies on water quality utilizing the saprobic method have been conducted [20–23].

This research also examines osmosis fish as another variable. One of the elements impacting the physiology of aquatic species is salinity, one of which impacts osmotic working pressure [24]. Too-high osmotic work pressure will result in discrepancies in fluid concentration between the body and the environment [25]. Balancing the fluid concentration needs a great deal of energy, which will hinder the development of the fish. The energy used for growth is also needed to sustain the fluctuating osmotic pressure. Fish incapable of controlling the osmoregulation mechanism inside their bodies can incur stress, poor health, and even death [26]. This research intends to investigate changes in water quality resulting from the usage of minapadi, as well as the osmosis performance of fish living in minapadi. Osmotic Performance Level is performed to determine the effect of minapadi technology on water and fish.

2 Method

Sampling was conducted in Samberembe, which used the minapadi technique. Over four months, four water samples and one fish sample were collected. The sampled minapadi land was around 3 hectares in size and was taken from one of the minapadi ponds (Fig 1). The specimen was gathered by sifting 20,000 ml of water down to 50 ml using a plankton net. The filtered water is examined in the laboratory by applying 1 ml of a 10% formalin solution.

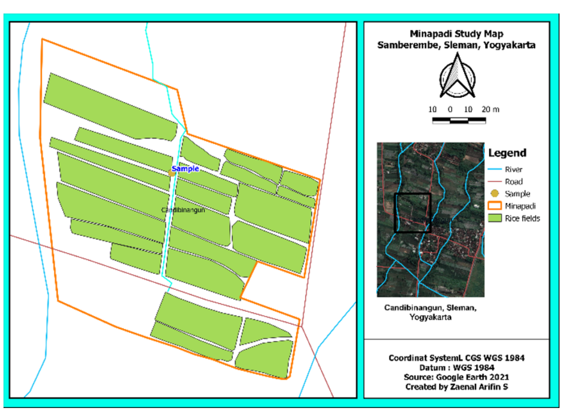

Fig. 1. Research location Samberembe, Sleman Yogyakarta Indonesia

The objective of fish sampling is to collect blood samples. There are several techniques for taking blood samples from fish, including the Severing Caudal Peduncle technique (blood is taken after the fish is split in the peduncle), the Puncturing the Caudal Vessel technique (blood is taken using injections through the tail vessels), the Cardiac Puncture technique (heart puncture), and the Dorsal Part Puncture Aorta technique [27]. Collecting blood from tiny fish (<10 cm) by severing the peduncle is used to collect blood samples. In this research, utilizing injections via the blood arteries of the tail to draw blood has the benefit that it may be done repeatedly on the same fish. In this approach, blood from a 200-gram fish can be retrieved between 0.5 and 1 ml.

Using an automatic micro osmometer roebling Type 13/13 DR Autocal osmometer [28], the Osmotic Performance Level of fish samples from minapadi was determined by measuring the osmolarity of fish blood and water media (Fig. 2). Blood osmolarity is measured by drawing as little as 0.01 ml of fish blood for analysis. Blood from the fish sample is placed in a container containing 10% EDTA (Ethylene Diamine Tetra Acetic acid) to avoid clotting. The blood is then drawn using a syringe/syringe of size 0.5 ml, placed in a micro tube of size 0.5 ml, and added reagents. Similarly, water samples are measured without using preservatives in the instrument.

Fig. 2. Automatic micro osmometer roebling tool

Observation test of plankton in the lab using microscopes magnifying at 100x, 200x, and 400x [29]. The Saprobic Index (SI) and the Total Saprobic Index (TSI) are used in the determination of water quality by equation (1) [16,30].

$$SI = \frac{1C + 3D - 1B - 3A}{1A + 1B + 1C + 1D} \tag{1}$$

Where:

- SI - Saprobic Index, between of -3 to +3
- A - the amount of species groupings Cyanophyta (Polysaprobic)
- B - the amount of species groupings Euglenophyta (α-mesosaprobic)
- C - the amount of species groupings Chloroophyta (β -mesosaprobic)
- D - the amount of species groupings Crhysophyta (Oligosaprobic)

Saprobic is the condition of water quality induced by adding organic matter to a body of water, the quantity and arrangement of organisms in these waters are often used as an indicator. A Tropic Saprobic (TROSAP) analysis with a value obtained by the following formula (2) [18,31,32]is utilized to calculate the saprobic of the waters. The SI and TSI calculation results are interpreted using Table 1.

$$TSI = \frac{(nC) + 3\ (nD) + 1\ (nB) - 3\ (nA)}{1\ (nA) + 3\ (nB)\ + 1\ (nC) + 1(nD)}\ x\ \frac{nA + nB + nC + nD + nE}{nA + nB + nC + nD} \quad (2)$$

Where:

- TSI - Tropic Saprobic Index
- nA - Individuals constituting the organism Polysaprobic
- nB - Individuals constituting the organism α- mesosaprobic
- nC - Individuals constituting the organism β- mesosaprobic
- nD - Individuals constituting the organism Oligosaprobic
- nE - Individuals constituting the organism excluding A, B, C, D

Table 1. Relationship between Water Pollution Level and Saprobic Index [30]

Index SI and TSI	Saprobic Level	Fertilize	Pollute
(-3,0) s/d (-2,0)	Polysaprobic	difficult to utilize fertility	very heavy
(-2.0) s/d (-1,5)	Poly / (α – mesosaprobik)		
(-1,5) s/d (-1,0)	α – meso/polysaprobic		heavy
(-1,0) s/d (-0,5)	α – mesosaprobic		
(-0,5) s/d (0,0)	α/β(mesosaprobic)	fertility is possible to use	moderate
(0,0) s/d (+ 0,5)	β/α(mesosaprobic)		delicate
(+ 0,5) s/d (+ 1,0)	β (mesosaprobic)		
(+ 1,0) s/d (+1,5)	β (meso/oligosaprobic)		
(+ 1,5) s/d +2,0)	Oligo/β (mesosaprobic)	fertility is possible to use	very delicate
(+ 2,0) s/d (+3,0)	Oligo saprobic		

The fish blood test and water media results are used to calculate the Osmotic Performance Level based on the difference between the blood fish test osmolarity and the media's osmolarity [33], as shown in the following formula. There are two different types of osmotic regulation: hypoosmotic and hyperosmotic. Both regulations are used to maintain the ability of osmolarity and the balance system between intracellular and extracellular body fluids and their media fluids [34].

$$\text{Osmotic Performance Level} = [\text{P osmoblood} - \text{P osmomedia}] \quad (3)$$

Where:

- P osmoblood = Blood pressure osmotic, mOsm/l H_2O
- P osmomedia = Water pressure osmotic, mOsm/l H_2O

3 Results

Laboratory results serve as the foundation for looking for SI and TSI values. In the figure are depicted the results of such computations. Fig. 3. depicts the graph curve for SI values, which more closely resembles the model of the third-order polynomial equation than the linear equation. That is due to the proximity of 1 to the R square value of the third-order polynomial equation. Fig. 4. depicts a graph of the TSI value curve, much as the SI curve of the TSI graph corresponds more closely to the model of the third-order polynomial equation. According to the saprobic level, the water conditions are β (meso saprobic) and β (meso/oligo saprobic). The status of SI is greatest in the second month (0.986) and lowest in the third and fourth months (0.968). The SI value in a steady condition is unaffected by moderate pollution. The TSI value is greatest in month 1 (1.011) and lowest in month 2 (0.999). (0.995). That may be because the first month is the preparatory phase for rice planting when the TSI value is at its peak and the fertilizer level is possible to use.

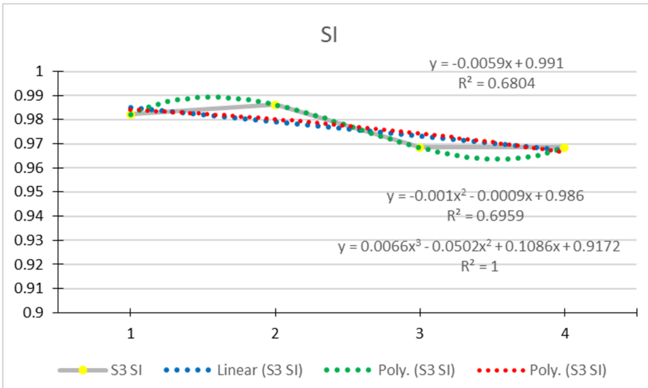

Fig. 3. SI rate of change over four months

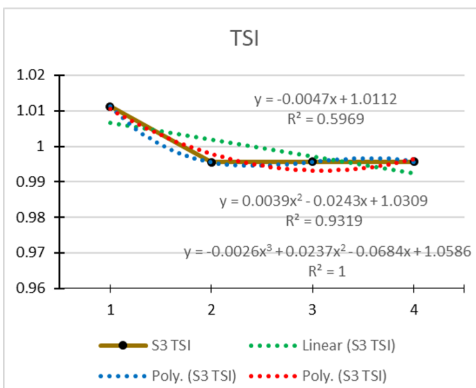

Fig. 4. TSI rate of change over four months

The osmoregulation pattern of fluid transfer in fish is used to monitor the fish's condition and identify its compatibility with its environment. Table 2. displays the findings of monitoring the osmoregulation patterns of fish in minapadi. The sampled fish is about eight weeks old, 20 centimeters long, and weighs 120 grams. A tilapia (Oreochromis niloticus) that has lived in the minapadi pond for about one month is a sample.

Table 2. Tilapia (Oreochromis niloticus) osmoregulation test results

No	Sample Media (mOsm/l H_2O)	Sample blood (mOsm/l H_2O)	Osmotic Performance Level	Osmoregulation regulation
1	78	84	6	Iso-hyperosmotic regulatory
	76	81	5	
	77	80	3	
2	38	47	9	

No	Sample Media (mOsm/l H_2O)	Sample blood (mOsm/l H_2O)	Osmotic Performance Level	Osmoregulation regulation
	41	49	8	Iso-hyperosmotic regulatory
	39	48	9	
3	45	50	5	Iso-hyperosmotic regulatory
	47	54	7	
	48	55	7	

Laboratory calculations demonstrate that the osmoregulation pattern of tilapia is Iso-hyperosmotic regulatory. That indicates that the fish is in a normal condition in which the quantity of chemical particles in the fish's body exceeds the number of chemical particles in the surrounding water. In general, the osmoregulation process in fresh fish and surrounding water is hypoosmotic regulatory [35]. However, in this instance, the osmoregulation process is Iso-hyperosmotic regulatory, which may be caused by more chemical particles in the surrounding water than in normal fresh water. These chemical particles may result from adding chemical compounds to dissolved rice fertilizers. If the osmoregulation pattern has shifted to hypo-osmotic, the fish will be agitated and create more mucus, but they may still survive normally.

4 Conclusion

Minapadi is one of the intensification methods that may increase the food supply. This technology has been implemented in the Samberembe neighborhood of Sleman Yogyakarta. Four months of investigation revealed that the condition of the water was unaffected by the use of minapadi technology. The fact that the SI and TSI levels have not altered demonstrates this. The highest SI value is 0.986, with the lowest SI value being 0.968. The water quality at this value falls within the range of (meso saprobic), indicating moderate pollution. The TSI value is at its maximum with a value of 1,011 in the state β (meso/oligo saprobic) or under circumstances of fertile waters. The lowest value, with a value of 0.995, is the state of β (meso saprobic), which may be exploited under fertile waters. The condition of fish in the waters of the minapadi remains normal. The pattern of osmoregulation in tilapia (Oreochromis niloticus) is Iso-hyperosmotic regulatory. That might be because the surrounding water held a higher concentration of chemical particles. These chemical particles may result from adding chemical compounds to dissolved rice fertilizers.

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