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Study of Water Quality Suitability in Sub-Watersheds for Tilapia, Gurame, and Catfish Farming in Lingsar Subdistrict, West Lombok Regency

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Abstract: This study evaluates the suitability of water quality in the Lingsar Sub-watershed, West Lombok, for the cultivation of tilapia (Oreochromis niloticus), gourami (Osphronemus gouramy), and catfish (Clarias gariepinus). Field measurements were conducted during June–July 2024 across several sampling points. Key water quality parameters were assessed and compared with established aquaculture standards and the physiological requirements of each species. The findings indicate that the general water quality conditions, including temperature, pH, dissolved oxygen, and levels of nitrogen compounds, support the growth of all three species. The sub-watershed is highly suitable for more tolerant species such as catfish and tilapia, while gourami cultivation is also feasible with more intensive management. It is concluded that the Lingsar Sub-watershed holds considerable potential for development as an integrated aquaculture zone. Sustainable development through regular water quality monitoring and the adoption of eco-friendly technologies is recommended.

Keywords: Freshwater Aquaculture; Water Ecology; Watershed Development.

Introduction

Freshwater aquaculture is one of the strategic sectors in food security and community economic improvement (Dahliana et al., 2023), especially in rural areas. Leading commodities such as tilapia (Oreochromis niloticus), gurame (Osphronemus gouramy), and catfish (Clarias gariepinus) have high economic value and increasing market demand (Adil & Akhmad, 2023). Lingsar District, located in West Lombok Regency, has the potential for water resources from sub-watersheds that have not been fully optimized for fish farming activities. The use of water resources from sub-watersheds for aquaculture requires a comprehensive evaluation of water quality (Simanjuntak et al., 2021), because unsuitable water quality can inhibit fish growth, reduce production, and even cause crop failure (Nurussalam et al., 2023).

Water quality suitability is influenced by physical, chemical, and biological parameters such as temperature, pH, dissolved oxygen (DO), nitrate, and ammonia (Adil & Akhmad, 2023). Therefore, studies on water quality suitability in this region are important to determine the potential and classification of water suitability for the cultivation needs of these three fish species (Marwan H et al., 2023). This approach has been used in various other regions, such as West Java, East OKU, Tanggamus, and Muara Enim, with results

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showing varying degrees of suitability depending on local conditions.

This study aims to analyze the water quality of the sub-watersheds in Lingsar District by assessing its physical and chemical parameters, and subsequently determine its suitability for the cultivation of tilapia, gourami, and catfish based on standard water quality criteria and the specific physiological requirements of each species.

The outcomes of this research are anticipated to deliver multiple benefits. Primarily, it will generate scientific data on the sub-watershed's water quality, serving as a foundational reference for developing freshwater aquaculture. Furthermore, the findings are expected to act as a valuable guideline for local governments and communities in managing water resources to ensure both sustainability and productivity. Ultimately, this study aims to support the enhancement of environmentally friendly aquaculture production that is grounded in principles of ecological suitability.

Method

The research was conducted in June-July 2024 in Lingsar District, West Lombok Regency, with water sampling locations at several sub-watershed points that were potential for fish farm (Figure 1).

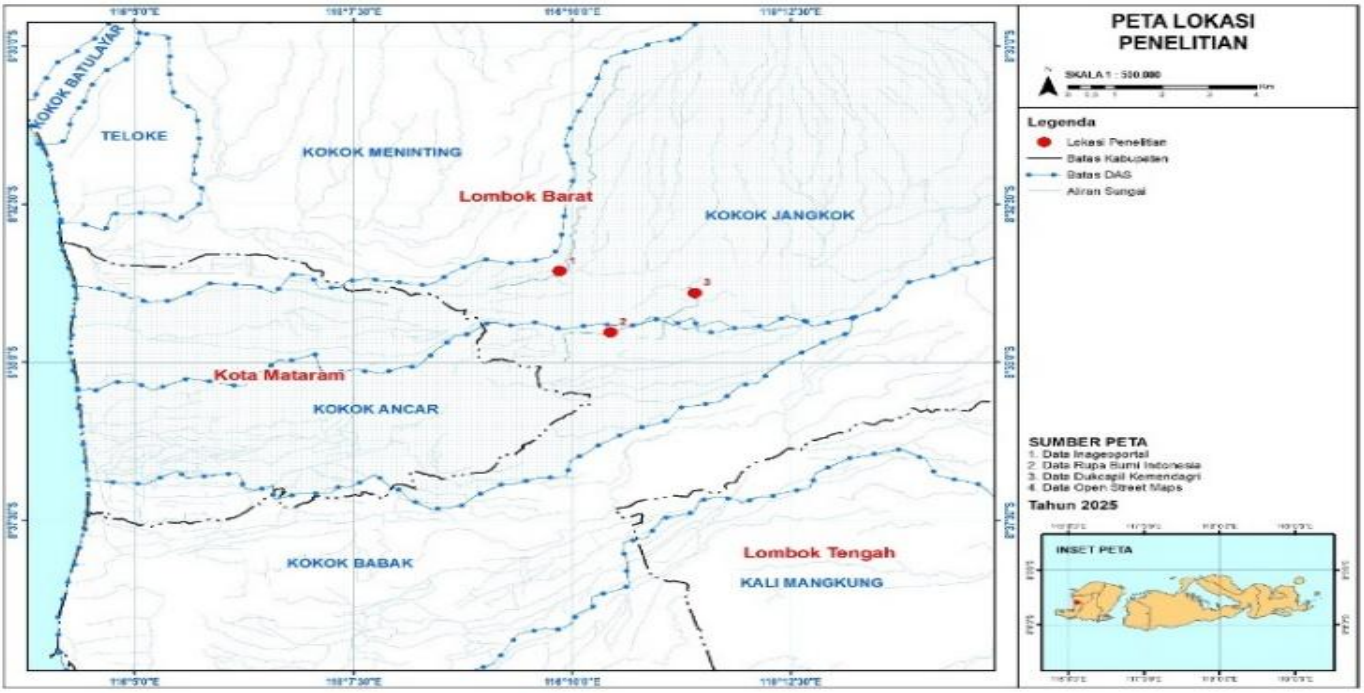

Figure 1. Locations

Data Type

Primary data: Water quality parameters (temperature, pH, DO, brightness, ammonia, nitrate, sulfate, and chlorine) measured in situ.

Secondary data: Sub-watershed area maps, rainfall data, farmed fish species data, as well as water quality standards and SNI standards for tilapia, catfish, and gurami farming (Badan Standardisasi Nasional, 1999; Pemerintah Republik Indonesia, 2001; SNI 01-6484.4-200, 2000; SNI 6848-5 2022 Pembesaran Ikan Lele, 2022; Sugianti & Hafiludin, 2022).

Data Collection Methods

Data were collected through an integrated approach combining field measurements, stakeholder engagement, and literature review. In-situ water quality parameters, including pH, dissolved oxygen, temperature, turbidity, and specific chemical levels, were measured directly using appropriate instruments such as pH and DO meters, a thermometer, a Secchi disk, and Visual Colorimetric Test (Test Kit Strip). To complement the empirical data, interviews were conducted with local fish farmers to gain insights into their aquaculture practices and perceived water quality challenges. Furthermore, a literature study was undertaken to gather supporting data and theoretical context from relevant academic sources.

Data Analysis

The analysis was conducted descriptively based on the classification of water quality suitability according to the physiological needs of each fish. The assessment

criteria were compiled with reference to the standards of Government Regulation No. 82 of 2001 concerning Water Quality Management and Water Pollution Control as well as the standard quality of aquaculture water according to SNI. The three categories of suitability, namely less suitable, suitable, and very suitable, are presented in Table 1 (Badan Standardisasi Nasional, 1999; Pemerintah Republik Indonesia, 2001; Peraturan Pemerintah No. 22 Tahun 2021, 2021; Radiarta et al., 2012; SNI 01-6484.4-200, 2000; SNI 6848-5 2022 Pembesaran Ikan Lele, 2022).

Results and Discussion

In the application of Best Management Practices (BMP) in fish farming, the availability of water sources in good condition is the foundation of biosecurity (Dermawan & Mujib, 2025). In Lingsar District, the water used for aquaculture comes from various sources, such as main rivers, sub-watersheds, and irrigation channels located near the farming area. The quality of the farming results is highly dependent on the condition of the water used from the outset. In commercial-scale fish farming operations, water is often a critical determining factor (Dermawan et al., 2016). Therefore, continuous monitoring of water quality is absolutely necessary to detect early contamination or pollution in these water sources. The results of water quality measurements at the research site are as follows:

Table 1. Water Quality

Parameters	Unit	Result	Less Suitable	Suitable	Suitability Perfectly suitable	References Criteria
Temperature	C°	26.42	<20 ; >35	20-28 ; 30-35	28-30	(Adil & Akhmad, 2023; Radiarta et al., 2012)
pH		7.24	<4 ; >9	4-6 ; 8-9	6-8	(Adil & Akhmad, 2023; Radiarta et al., 2012)
DO (Dissolved Oxygen)	mg/l	5.31	<2	2-4	>4	(Adil & Akhmad, 2023; Radiarta et al., 2012)
Parameter	Unit	Result	I	II	Water Class III	References Criteria
Visibility	cm	64	-	-	-	(Kulla et al., 2020; PP No. 22 - 2021, 2021; Yuli Astuti & Aman Damai, 2016)
Amonia	mg/l	0	0.1	0.2	0.5	
Nitrit	mg/l	0	0.06	0.06	0.06	
Nitrat	mg/l	10	10	10	20	(PP No. 22 - 2021, 2021)
Sulfat	mg/l	80	300	300	300	
Klorin	mg/l	0	0.03	0.03	0.03	

Discussion

Water Quality Suitability for Tilapia (Oreochromis niloticus) Farming

Water quality measurements in the Lingsar sub-watershed show that the average temperature is 26.4 °C with a pH of 7.2 and dissolved oxygen of 5.3 mg/L. These conditions are in accordance with the Indonesian National Standard (SNI) for tilapia farming, which specifies an optimal temperature of 25–30 °C, pH of 6.5–8.5, and DO >5 mg/L (Badan Standardisasi Nasional, 1999). Thus, the waters of the Lingsar Sub-Watershed are classified as suitable to highly suitable for tilapia farming.

This level of suitability supports the potential for tilapia development because this fish is known to have broad environmental tolerance and is efficient in feed conversion. A study Budiardi et al., (2022) shows that tilapia farming in locations with a high level of suitability can produce productivity >5 tons/unit/year with an R/C ratio of 1.5, making it feasible to develop this business. With the stable availability of water sources from the Lingsar Sub-DAS, the opportunity to integrate technology into earthen ponds with good feed management can increase tilapia farming productivity in this region.

Water Quality Suitability for Gurame Fish Farming (Osphronemus gouramy)

Gurame fish is a high-value commodity, but it has relatively slow growth and is sensitive to changes in water quality (Pio et al., 2023). Research results show that the waters of the Lingsar Sub-DAS have a pH of 7.2, a temperature of 26.4 °C, and DO >5 mg/L, which are still suitable for gurame. However, several studies report limitations in gurame productivity if water quality is not properly managed. In Central Bangka, despite pond water quality being classified as lightly to moderately polluted, gurame farming remains viable

with operational efficiency reaching 1.69 and profits exceeding IDR 38 million per cycle (Juni et al., 2021). Meanwhile, in Purbalingga, 60% of gurame farming ponds are categorized as S1 (very suitable), while 40% are categorized as S2 (sufficiently suitable) with the main limiting factor being high pH (average 9.2) (Nurhidayah et al., 2024). With the relatively stable water quality of the Lingsar Sub-DAS, which is close to the optimal range, the potential for tilapia development is very feasible. The main challenge is maintaining consistent water quality, especially regarding ammonia levels from uneaten feed. The application of green water system technology or integration with vegetation utilization to neutralize water quality could be a solution to enhance the sustainability of aquaculture (Puspitasari, 2018).

Water Quality Suitability for Catfish (Clarias gariepinus) Farming

Catfish are known to be the most tolerant species to water quality fluctuations compared to tilapia and gourami. Measurements taken in the Lingsar Sub-DAS showed temperature, pH, and DO values within the range specified in the standard for catfish farming(SNI 01-6484.4-200, 2000), namely temperature 25–30 °C, pH 6.5–8.5, DO >3 mg/L, and ammonia <0.1 mg/L (Kelana et al., 2021). Previous research on pearl catfish hatcheries in Pamekasan showed that water quality with a pH of 8.1–8.3, temperature of 25.7–27.8 °C, and DO of 8.5–8.7 mg/L was still in accordance with SNI standards (Sugianti & Hafiludin, 2022). Similar conditions were found in Kampung Lauk, Bandung, where most locations are suitable for catfish farming, although there are variations in pH that need to be considered (Kelana et al., 2021). Thus, the Lingsar sub-watershed is very suitable for catfish farming. Its high tolerance level makes catfish the most flexible commodity to be developed in this region. In addition, catfish grow relatively quickly with a short farming cycle (45–60 days), making them the primary choice for increasing local fishery productivity.

Conclusion

Based on the study results, the water quality of the Lingsar Sub-watershed is within the optimal range for aquaculture, demonstrating a high suitability level for farming tilapia, gourami, and catfish. Among the species, catfish shows the highest suitability level, followed by tilapia. Gourami also shows a good level of suitability for cultivation in the area. Overall, the Lingsar Sub-watershed has significant potential to be developed as an integrated aquaculture area, with catfish and tilapia as the primary commodities and gourami as a high-value diversification.

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Author Contributions

Conceptualization, A.D. and B.D.H.S.; methodology, A.D. and A.R.S.; formal analysis, A.D. and M.M.; Observation and sampling, A.D., S.F., and S.S.; writing—original draft preparation, A.D.; writing—review and editing, A.D., B.D.H.S., A.R.S., and M.M.; visualization, A.D., S.F.; supervision, A.D., B.D.H.S.; project administration, A.D. and S.S.; funding acquisition, A.D. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest

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