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The existing conditions of distribution parameters of physical and chemical factors of salt pond land on the Coast of Palang District, Tuban Regency, Indonesia

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Abstract

The purpose of this study was to determine the distribution value of physical and chemical factors that affect salt pond land. We employed a method to assess the current state of salt ponds in coastal regions. We conducted this study in Palang District, Tuban Regency, from May 1 to June 1, 2024. This research method involves various methods, including remote sensing and geographic information systems (GIS), to map and analyze land conditions. We will use data from satellite imagery and field measurements to evaluate the physical and chemical parameters for the development of salt ponds. Based on the research data, we have established that the physical and chemical parameters of salt pond land on the coast of Palang District, such as salt table height, seeding place, main embankment, intermediate embankment, pH, and pond bottom, are in good condition and meet the requirements for salt pond land development. In conclusion, the chemical parameters show that the quality of water and soil in salt ponds is still within acceptable limits, although there are several locations that show values approaching the standard quality threshold. We recommend implementing sustainable management practices in the development of salt ponds, which include periodic monitoring of physical and chemical parameters, further research on the impacts of climate change, and collaboration between government, academics, and communities in managing sustainable salt ponds and formulating policies that support the development of the salt industry in coastal areas.

Keywords: Existing; Land; Pond; Salt

1. Introduction

The existing condition of salt pond land in coastal areas plays an important role in the local economy, especially in areas that depend on salt production as a primary commodity (Rosyida, P., & Santoso, E. B., 2021). Various studies emphasize the importance of salt ponds in terms of economy and sustainability. Salt ponds in coastal areas function as the main source of salt production, which is an important commodity for the local and national economies. However, environmental conditions, including physical factors like topography, salinity, and water management, as well as chemical factors like soil quality and nutrient content, have a significant impact on the success of salt pond businesses (Amami, D., & Ihsannudin, I., 2016). Therefore, an in-depth analysis of these parameters is essential to determining land suitability and appropriate management strategies. We need to analyze physical parameters such as temperature, salinity, turbidity, and the soil's physical characteristics. Water and soil temperature can affect the metabolism of organisms living in them, while salinity is a key factor in determining the success of salt pond cultivation. Turbidity can affect the penetration of light into water, which impacts algae and other organisms' photosynthesis. Meanwhile, from a chemical perspective, analysis of parameters such as pH, nutrient content (such as nitrogen and phosphorus), and heavy metal content is very important. Unsuitable pH can affect the availability of nutrients for plants and aquatic organisms. In addition, high heavy metal content can be a threat to the health of the ecosystem and humans (Efendy, M., Sidik, R. F., & Muhsoni, F. F., 2014). By analyzing existing conditions, we can identify potential problems that may arise due to

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environmental changes, such as pollution or climate change. We can also use the results of this analysis to formulate better management strategies, such as choosing the optimal location for cultivation and employing suitable management techniques to boost the productivity and sustainability of salt ponds (Rosyida, P., & Santoso, E. B., 2021).

The study's goal was to determine the distribution of physical and chemical factors that affect salt pond land. The study employs a method to assess the current state of salt ponds in coastal regions.

2. Material and methods

We conducted this research in Palang District, Tuban Regency, East Java, which encompasses four villages: Karangagung Village, Pliwetan Village, Cepokorejo Village, and Ketambul Village. We intentionally chose the location based on the existing potential. We conducted the research from May 1 to June 1, 2024. This research method involves various methods, including remote sensing and geographic information systems (GIS), to map and analyze land conditions. We will use data from satellite imagery and field measurements to evaluate physical and chemical parameters, and to determine the suitability of the land for salt pond development (Arikunto, S., 2010). We hope to develop strategies that enhance the sustainability and productivity of salt ponds in coastal areas, while also enhancing the well-being of those reliant on this sector, by comprehending the current conditions of the physical and chemical factor distribution.

3. Results and discussion

3.1. Sampling Point Location

We collected data on the physical-chemical parameters of salt pond land during the eastern season in Palang District. We collected samples from 20 location points and recorded the sampling positions using the Global Positioning System (GPS) (Setiawan, W., 2018). Figure 1 below shows the sampling station's location:

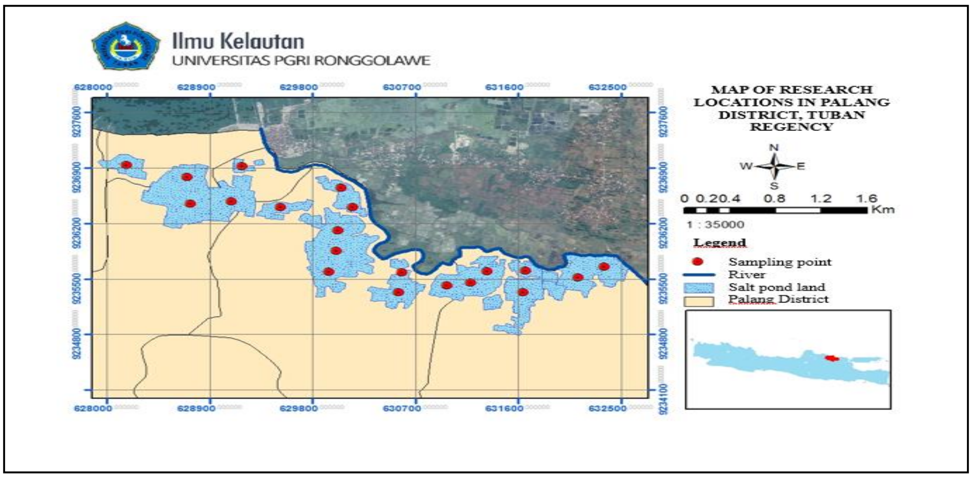

Figure 1 Research Location Map (Research (2024)

3.2. Physical–Chemical Parameters

The results of the measurement of physical-chemical parameters in salt show that several parameters have exceeded the specified tolerance value limits. Therefore, we need to make adjustments and improvements to maintain optimal water quality in the salt production process.

3.3. Salt Table Water Height

The results of the salt table water level show that the water level on the salt table ranges from 5 to 12 cm. This water level affects the salt crystallization process and can accelerate or slow down the seawater evaporation process, thus affecting the quality of the salt produced (Supriyo, E., 2021). The salinity level of seawater is a measure of the salt content dissolved in the water. The definition of salinity is often interpreted as the salt content of seawater, but there is actually a difference between the two. Salinity actually refers to the level of salinity or salt content dissolved in water, not only in seawater but also in fresh water, soil, or other earth elements. The salt table requires special treatment to produce high-quality salt. Rolling with a water height of 5-10 cm is necessary to achieve a solid and flat salt table. The salt table serves as both a place for the evaporation of old water into salt crystals and a harvesting area, as illustrated in Figure 2 below.

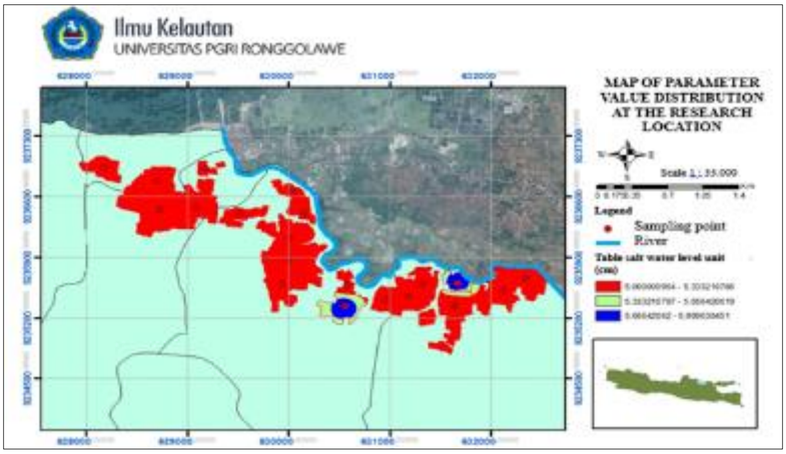

Figure 2 Map of Distribution of Salt Table Water Level Values (2024 Research)

The water in the salt table ranges in height from 5 cm to 6 cm. The researchers conducted their measurements during the salt production season. The salt table water in Palang District has an average height of 5 cm. This is related to the speed of salt harvesting, because the higher the salt table water, the longer it will take for evaporation.

3.4. Distance From Beach

The results of the distance from the coast to the salt ponds show that some salt ponds are near the coast, while others are far from the coast. According to these findings, the distance between the coast and the salt ponds can range from several kilometers to more than a hundred kilometers, depending on the location and geographical conditions of each region. Figure 3 below illustrates the distribution of distance values between the coast and salt ponds in Palang District:

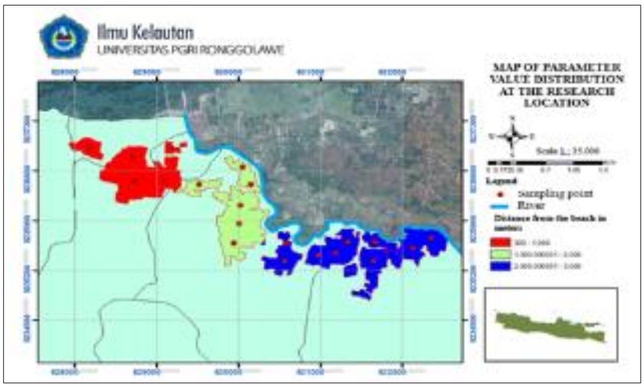

Figure 3 Map of Distribution of Distance Values between Coast and Salt Ponds (Research, 2024)

The results of the field measurements above indicate that the distance of salt ponds from the coast in Palang District varies depending on the village. Karangagung Village (station 15-station 20) and Pliwetan Village (station 11-station 15) demonstrate a high level of land suitability (S1), falling within the range of 300 meters to 1000 meters, while the remaining villages are not yet suitable. Ketambul Village (station 1-station 5) and Cepokorejo Village (station 6-station 10) demonstrate a highly suitable land distance (S2), falling between 1000 and 5000 meters.

3.5. Pond

The salt-making process uses a screening pond as a structure to separate seawater from crystallized salt. This process is essential because it allows the collection of purer salt and increases production efficiency (Bramawanto, R., 2017). The main function of a screening pond is to separate salt crystals from crystallized seawater. This process entails using sophisticated technology to accelerate seawater evaporation and improve the quality of the salt produced. Modern screening pond technology involves the use of threads on the bottom of the pond to accelerate the evaporation of seawater. These threads help increase the contact surface between seawater and air, thereby accelerating the evaporation process and producing purer salt. The distribution of values of screening ponds for salt ponds in Palang District is shown in Figure 4 below:

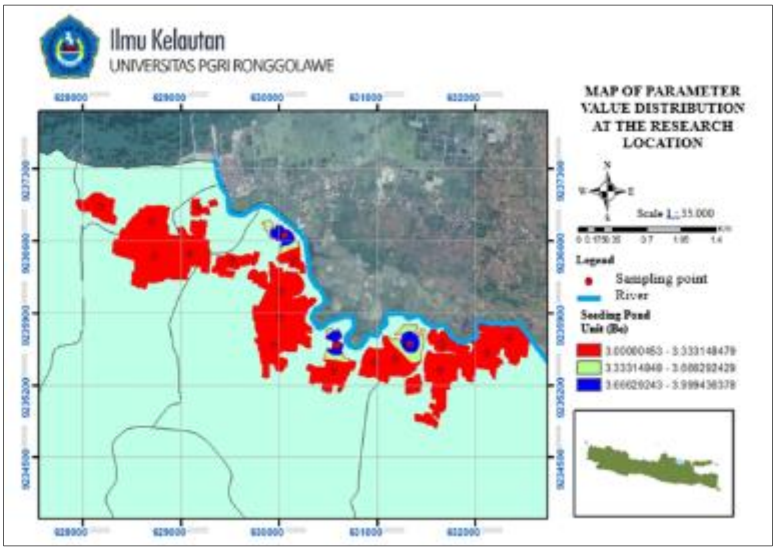

Figure 4 Map of Value Distribution of Salt Pond Ponds (Research, 2024)

The results of the field measurements above show that the salt pond breeding pond is very suitable (S1), namely in the range of 3°Be to 4°Be.

3.6. Old Water Pool

Old water pond technology has helped increase the efficiency of salt production and improve the quality of the salt produced. Using threads on the pond's bottom accelerates the seawater evaporation process, resulting in increased salt production within a shorter timeframe. As a result, old water ponds are an important component in the salt-making process, allowing for high-quality and efficient salt production (Indriyani, I., & Pandansari, T., 2018).

Figure 5 below illustrates the distribution of old water pond values for salt ponds in Palang District.

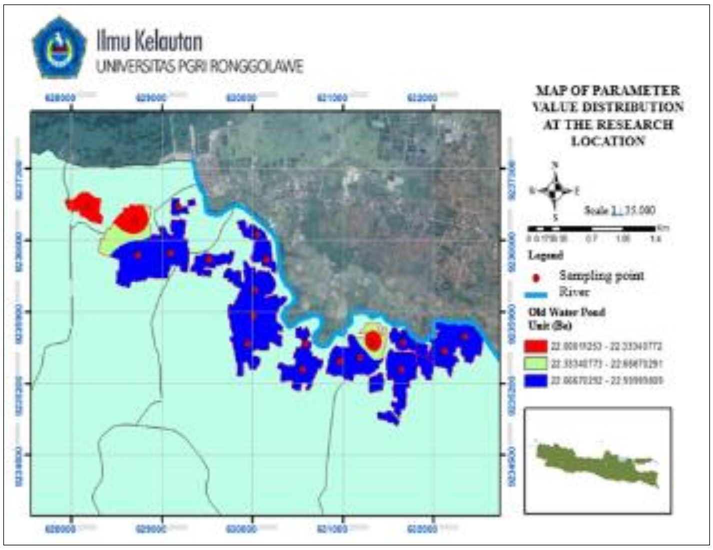

Figure 5 Distribution Map of Old Salt Pond Water Pool Values (Research, 2024)

The results of the field measurements above show that the old salt pond water pool is quite suitable (S2), which is in the range of 22°Be to 23°Be.

3.7. Salt Table Pool

The salt-making process uses a table pond as a structure to separate seawater from crystallized salt. This process is essential because it allows the collection of purer salt and increases production efficiency (Indriyani, I., & Pandansari, T., 2018). Figure 6 below shows the distribution of table pond values for salt ponds in Palang District.

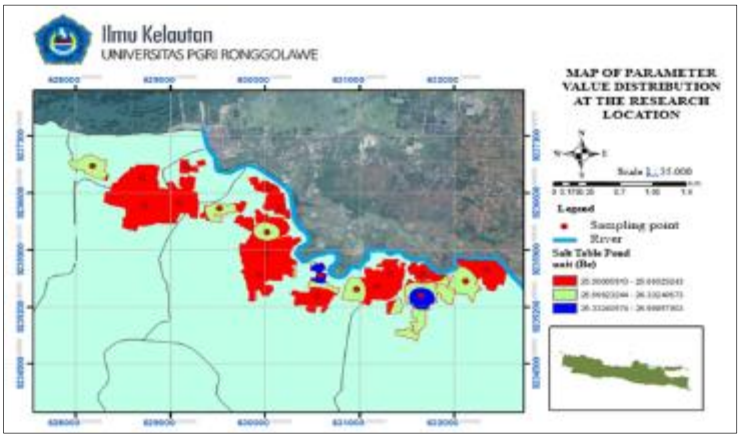

Figure 6 Map of Distribution of Salt Table Pond Values (Research, 2024)

The results of the field measurements above show that the salt table pond in Palang District is very suitable (S1), namely in the range of 25°Be to 29°Be.

3.8. Galengan Around the Seashore

Ekosafitri, K. H., Rustiadi, E., & Yulianda, F. (2017) use the term galengan around seawater to describe changes in salt concentration in seawater. Seawater has a relatively constant salt concentration throughout the world, but it can change locally depending on several factors, such as ocean currents, rainfall, and evaporation (Indriyani, I., & Pandansari, T., 2018). For the distribution of galengan values around the seashore of salt ponds in Palang District in Figure 7.

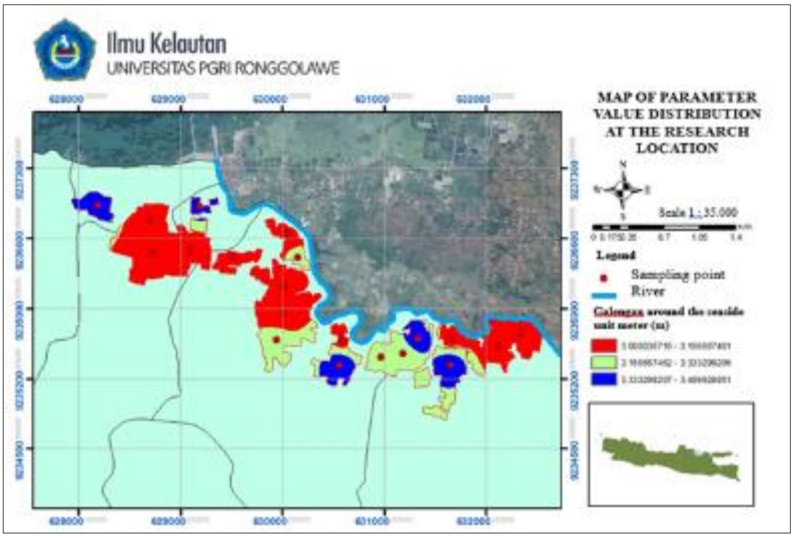

Figure 7 Distribution Map of Galengan Values Around the Seashore (Research, 2024)

From the results of the field measurements above, it shows that the galengan around the seashore of salt ponds proves that the suitability results are very suitable (S1) in the range of >3 meters. The distribution of galengan dimensions across salt ponds in Palang District is depicted in Figure 8.

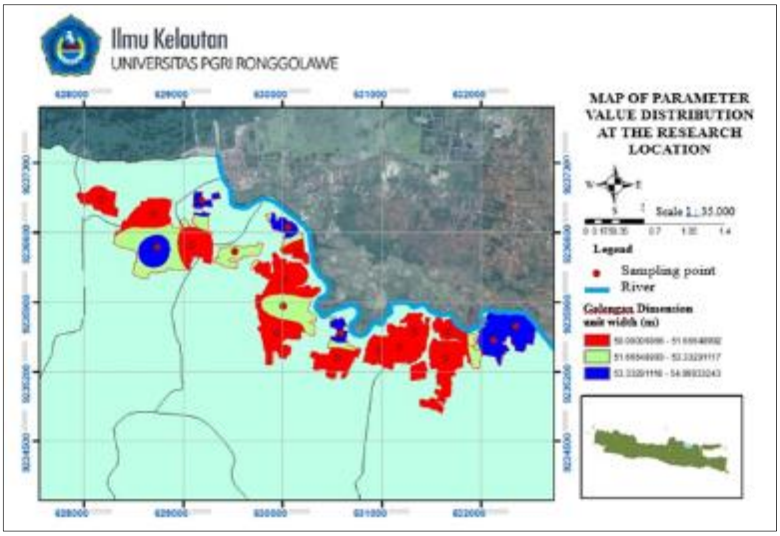

Figure 8 Distribution Map of Galengan Dimensional Values (Research, 2024)

3.9. Main Embankment

A salt pond's main embankment is a crucial structure that requires proper design and construction to ensure its stability and safety. With the right height, appropriate materials, and optimal slope, the main embankment can protect the pond area from various environmental threats and increase salt production effectively (Indriyani, I., & Pandansari, T., 2018). Figure 9 illustrates the distribution of main embankment values for salt ponds in Palang District.

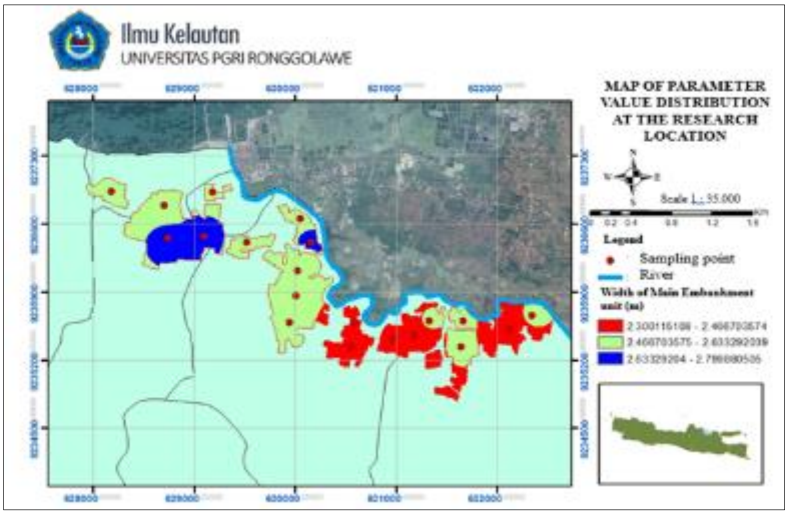

Figure 9 Map of Distribution of Main Embankment Values (Research, 2019)

The results of the field measurements above indicate that the height of the main embankment of the salt pond is very suitable (S1), falling within the range of 2.5 meters.

3.10. Intermediate Embankment

The intermediate embankment is a mound of soil that limits each salt pond plot located within the main embankment (Hapsari, N., 2008). The intermediate embankment itself serves as a boundary for each salt pond. The water channel in the pond plot plays an important role in entering and draining water effectively. After working on the crystal table, we create the channel, which is located next to the crystallization table. As a result, the pond plot maintains its water quality, and the salt processing process operates smoothly. The ideal intermediate embankment has a height of 0.25 meters to 0.3 meters, which is higher than the height of the salt table (Indriyani, I., & Pandansari, T., 2018). Figure 10 illustrates the distribution of intermediate embankment values for salt ponds in Palang District.

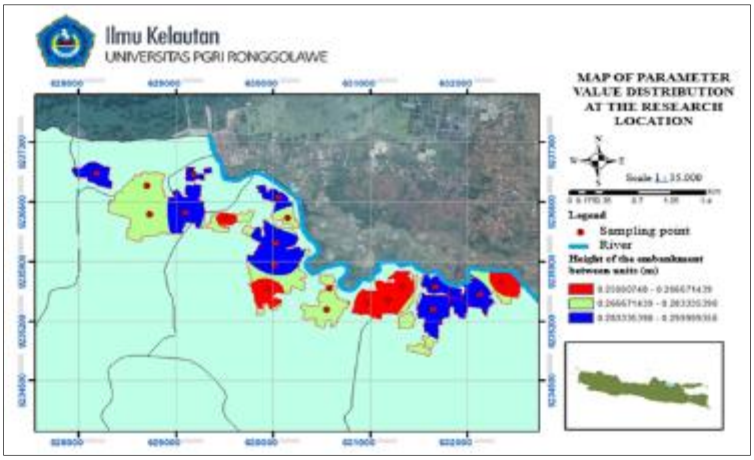

Figure 10 Map of Distribution of Intermediate Embankment Values (Research, 2019)

The results of the field measurements above demonstrate that the intermediate embankment's height (S1), which ranges from 0.25 meters to 0.3, is very suitable.

3.11. pH

When choosing a location for salt ponds, it's important to consider factors such as the cleanliness of the seawater, its salt content, its pH, and its freedom from pollution, tidal phenomena, weather and climate, wind, and so on. Topography should be gentle and have a certain elevation. Gentle topography is an important criterion in the development of salt ponds. With gentle topography, farmers can easily regulate water flow, minimize construction costs, and optimize the salting process. This allows for more effective salt production and better salt quality (Aulia, I., Risnawan, W., & Henriyani, E., 2023). Figure 11 illustrates the distribution of pH values across salt ponds in Palang District.

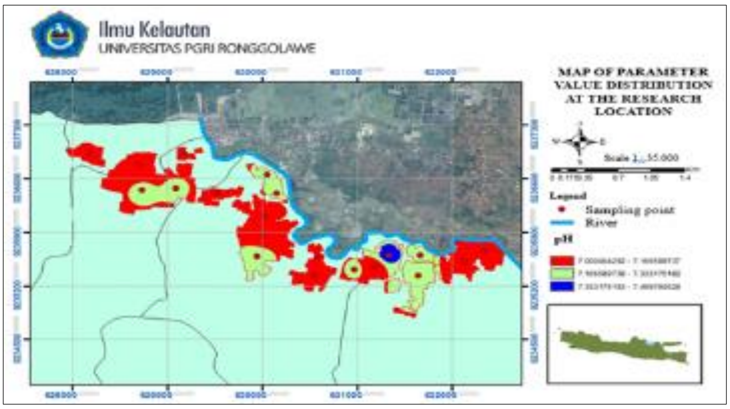

Figure 11 Map of pH Value Distribution (Research, 2024)

The results of measuring the pH of the pond soil also show that the pH value tends to be neutral, with a pH value of around 6-7 proving that the suitability results are very suitable (S1). This affects the availability of macronutrients such as P and K.

3.12. SO_4

We divide salt into two groups: consumption salt and industrial salt, based on their respective uses. People consume salt for cooking and household needs. Additionally, the human body uses consumption salt as a carrier of iodine to combat epidemic mumps and cretinism, and local Indonesian farmers can meet the SNI-set standards for consumption salt. Other industries, including the pharmaceutical, cosmetic, and textile sectors, utilize industrial salt as a raw material or auxiliary material. Both traditional and modern fishery processing industries use industrial salt (Puspita, G. D. D., Fadila, N., Rachmaniah, O., & Rachimoellah, M., 2020). Industrial salt has its own stricter standards and classifications, such as NaCl content > 95% and impurities <0.5% (Rusiyanto, R., Soesilowati, E., & Jumaeri, J., 2013). To ensure that the process of forming mineral salts in salt ponds runs quickly and smoothly, the water used should be alkaline (basic) and stable (pH shocks are not too large). The ideal pH ranges from 7 to 8. Therefore, the SO_4 ion content value must be below 0.1 mg/kg to avoid affecting pH fluctuations in salt pond land. Figure 12 illustrates the distribution of SO_4 values in salt ponds in Palang District.

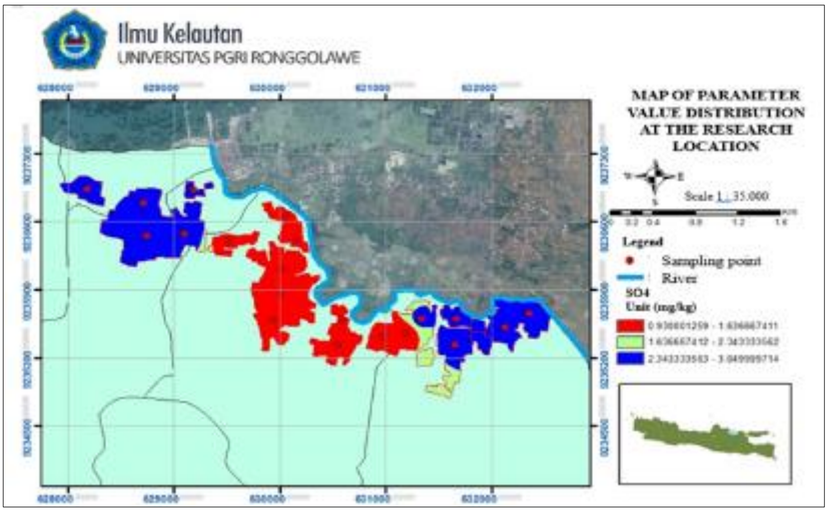

Figure 12 SO_4 Value Distribution Map (Research, 2024)

The results of measuring the SO_4 ion content value in salt ponds show that the sulfate ion content tends to be low and the suitability is less suitable (N), which is in the range above 0.1.

3.13. Pond Base

Soil is one of the factors that can affect the productivity of salt ponds because it has the ability to absorb or release nutrients. The porosity of the soil influences the pace at which seawater seeps into the processed soil or onto the table. If the rate of seepage is greater than the rate of evaporation, especially if it rains during salt production, no salt will be produced. The type of soil also affects the color and impurities carried by the salt produced. For salt fields, a good soil texture is heavy clay with a little fine sand. In selecting the location of a salt pond, socio-economic aspects are also essential to consider in order to achieve sustainable salt production (Aulia, I., Risnawan, W., & Henriyani, E., 2023). The texture of the pond base soil must have a stable water content to ensure that water does not stagnate in the pond. The ideal water content usually ranges from 10% to 20% to allow the salting process to run smoothly. The pond bottom soil must have excellent absorption capacity to absorb seawater and drain water throughout the pond. This allows seawater to flow and evaporate effectively, so that salt production can increase. The water storage capacity of the pond bottom soil is also very important. Soil that can store water well will help maintain water quality and ensure that the water does not evaporate too quickly, so that the salting process can run continuously. The pond bottom soil must be able to filter dirt and small particles that can interfere with the salting process. This allows seawater to remain clean and not contaminated by dirt that can reduce the quality of salt (Prastio, L. O., 2019). The percentage value distribution of salt pond sand in Palang District is shown in Figure 13.

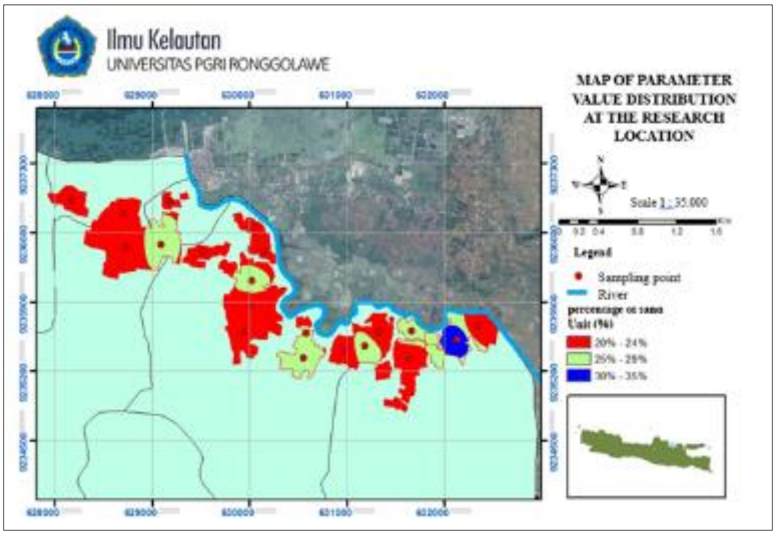

Figure 13 Map of Distribution of Sand Percentage Values (Research, 2024)

The results of measurements carried out by researchers show that the percentage of muddy sand ranges from 25% to 35% meters.

4. Conclusion

The research data confirms that the physical-chemical parameters of the coastal salt ponds in Palang District, such as the height of the salt table, the hatchery, the main embankment, the intermediate embankment, pH, and the bottom of the pond, are in good condition and meet the requirements for salt pond use. Chemical parameters indicate that the quality of water and soil in the salt ponds is still within acceptable limits, although there are several locations that show values approaching the standard quality threshold. Implementation of sustainable management practices is needed in the development of salt ponds, including regular monitoring of physical and chemical parameters; increasing the capacity of salt farmers through education and training programs that focus on good cultivation techniques, water quality management, and the use of modern technology in pond management; further research on the condition of salt pond land and the development of technology that can help adapt to these changes; the government, academics, and the community collaborate to manage sustainable salt ponds and formulate policies that foster the growth of the salt industry in coastal regions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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