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Analysis of substrate quality in relation to the development of milkfish (*Chanos-chanos*) cultivation in the coastal waters of Siddo Beach, Barru Regency, Indonesia

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Abstract
This research aims to determine the quality of soil substrate on the Siddo coast of Barru Regency, Indonesia, in relation to the development of milkfish cultivation. This research aims to determine the quality of soil substrate on the Siddo coast of Barru Regency, Indonesia, in relation to the development of milkfish cultivation. The data collected consists of substrate data, namely pH, nitrogen, organic matter, ammonia, nitrite, and substrate texture. The data was then analyzed using descriptive analysis. The results of the research show that pH, nitrogen, organic matter, ammonia, nitrite, and substrate texture are used as substrate parameters for milkfish cultivation, so it can be stated that they are still suitable for the development of milkfish cultivation on the Siddo coast, Barru Regency, Indonesia.

Keywords: Quality, substrate, beach, cultivation, milkfish

Introduction

One of the water areas that has the potential to be developed is the coastal area. The coastal area is a water area that has quite abundant natural resources. The uniqueness of coastal areas is that they have natural resources not only from aquatic resources but also from land resources [1]. Coastal areas are areas that are always experiencing change. This change is largely due to it being a meeting place for two different forces, namely from land and from the sea [2]. From a variety of planning and management perspectives, coastal areas are crucial to oversee. The transition between land and sea in coastal areas has formed diverse and highly productive ecosystems and provides extraordinary economic value to humans [3, 4]. Coastal and marine resources are currently experiencing considerable vulnerability. This is because many parties use this area without considering conservation aspects; in fact, their use tends to be destructive, with the increase in population in coastal areas resulting in increased degradation and conversion of land into residential areas [5].

Coastal areas have recently become a hot topic to discuss in Indonesia. The role of coastal resources is expected to increase in the future in supporting national, regional, and local economic development. Thus, to be able to utilize the space and resources of coastal areas optimally and sustainably, a deep understanding of the meaning and characteristics of this area and the people who inhabit it is needed [6]. In a coastal and marine area, there are one or more ecosystems and resource environments. This ecosystem can be natural or artificial [7]. With high population growth and rapid development activities on the coast for various uses (industry, ports, ponds, settlements), the ecological pressure on coastal ecosystems is also increasing [6].

Currently, it is widely recognized that coastal and marine natural resources have quite promising potential in supporting the economic level of society, especially for coastal communities, the majority of whom earn their living as fishermen [5]. The local population, which is primarily made up of fishermen, naturally makes direct use of the coastline potential in the area. Massive utilization of the potential of coastal areas to gain economic benefits in order to increase people's economic growth has not been widely implemented [8]. The estuary area (river estuary) is one location of the coast with the highest fertility rate [9]. Three ecological requirements must be satisfied for the optimal and sustainable development of coastal and marine resources: the use of coastal and marine resources in proportion to their carrying capacity, the harmonious use of coastal and marine space, and the use of coastal areas' assimilation capacity in proportion to the environment's carrying capacity [10].

The closer you are to the beach or bay, the finer the grain size obtained will be [11]. This situation shows that the sediment source has undergone a transportation process until finally deposition at each research location. The type of substrate found in river estuaries and rehabilitated mangroves is sandy substrate, while in natural mangroves it is muddy substrate [12]. Coastal and marine areas have unique properties and characteristics, both the nature and characteristics of coastal ecosystems and the nature and socio-cultural characteristics of coastal communities [13]. One measure of a region's development, both economically and culturally, is the growth of its natural resources along the shore [14]. Meanwhile, the close distance between residential locations and the central business area puts pressure on local settlements [15]. One fishery commodity that can be developed in coastal areas is milkfish (*Chanos chanos*).

Milkfish is one of the brackish water fish that is in great demand in Indonesia for development. Evaluation of pond cultivation land is one of the benchmarks for whether or not a cultivated land is suitable for further development. Evaluation can be carried out by comparing the suitability of milkfish pond waters and the availability of klekap as a natural food source for extensive-scale milkfish cultivation [16]. The land used for pond locations is sought in areas that are still in tidal areas. The height of the entire place must not exceed the height of the highest tide level and must also not be less (lower) than the lowest tide level. To create a pond, its height must be adjusted to suit tidal differences [17]. In general, pond environmental factors (soil and water quality)

are the dominant determining factors in pond cultivation, so they are considered as criteria for land suitability for pond cultivation [18]. Pond environmental factors are important factors that influence production in ponds [19].

Material and methods

Sampling at the research location was carried out using purposive sampling by determining the sampling location based on the characteristics of different locations. The sampling location is location 1, namely the location around the hatchery; location 2 is the location around Siddo Pier; and location 3, namely the location around the community settlement in Toe Hamlet. Each location represents the study area at each predetermined location. The tools used in this research were a grinder, 2 inch paralon pipe 50 cm long, 5 kg sample bag, oven, calculator, Ohaus scale, pH indicator, stationery, camera, aluminum foil, and multi-level sieve [12]. Soil/substrate samples were collected using a 2-inch paralon pipe 50 cm deep at each research location. The paralon pipe that had been inserted was then pulled, and the sediment layer was seen [12]. Next, put the sample in a plastic bag and note the location where the sample was taken. Next, the substrate samples are taken to the laboratory to be analyzed for pH, nitrogen, organic matter, ammonia, nitrite, and substrate texture content.

Following its arrival at the laboratory, the substrate was dried and then sieved. Tiered filters are stacked from top to bottom, with the biggest filter diameter at the top and the smallest at the bottom. To eliminate the water content and create dry samples, samples collected from the research site were then dried in the sun and an oven set at a temperature of 100 to 110 degrees Celsius for around four hours. Following sample selection, the sediment bits are crushed in preparation for sifting. The sample is then put on a shaker filter (a particle separation machine) and sealed with the weight cap that is provided to push the multi-level filter, preventing it from shaking and spilling. Press to turn the machine on [12]. The results of the analysis of the substrate samples in the form of pH, nitrogen, organic matter, ammonia, nitrite, and substrate texture were then made into graphic images and analyzed using descriptive analysis.

Results

The research results related to pH, nitrogen, organic matter, ammonia, nitrite, and substrate texture can be seen in Fig. 1 to Fig 5.

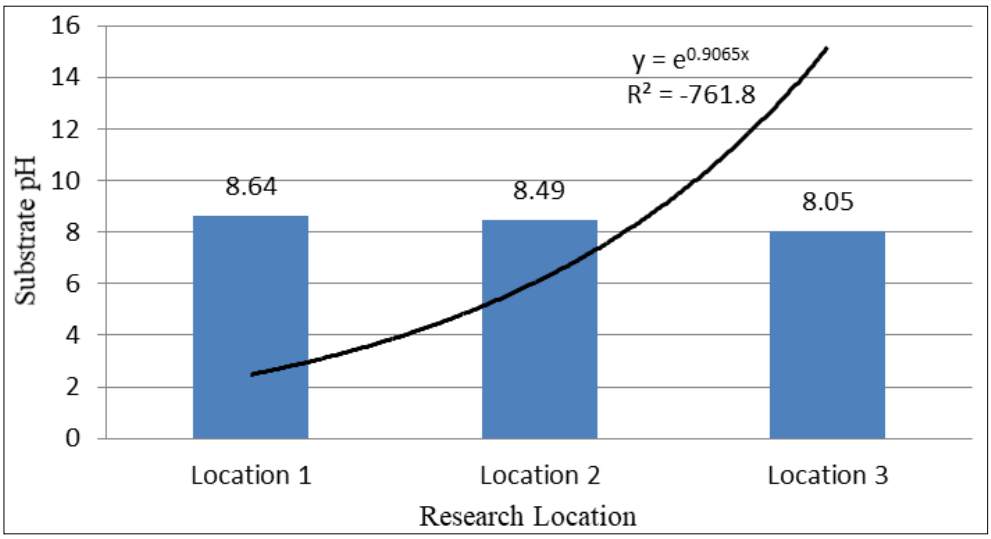

Fig 1: Substrate pH at the research location

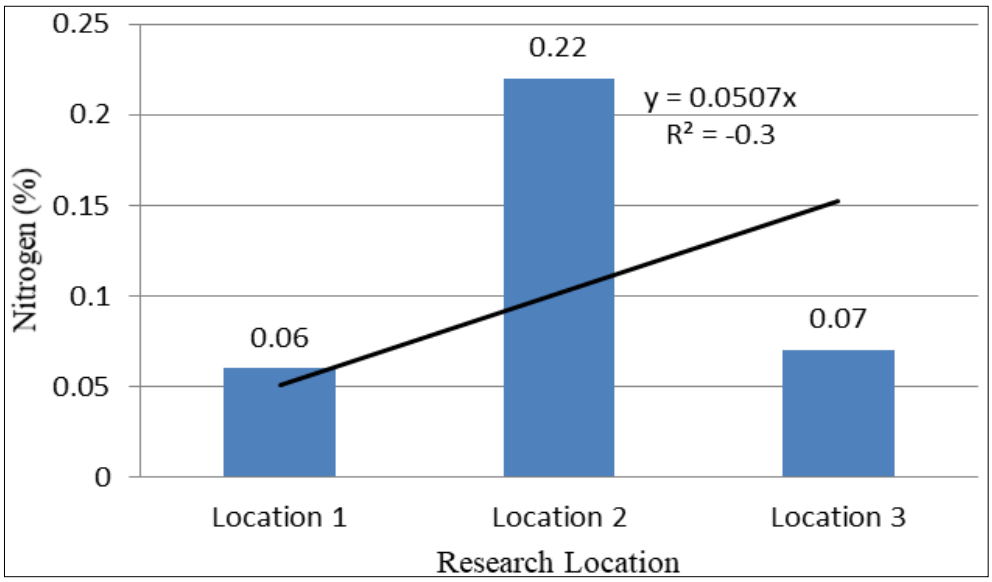

Fig 2: Substrate nitrogen at the research location

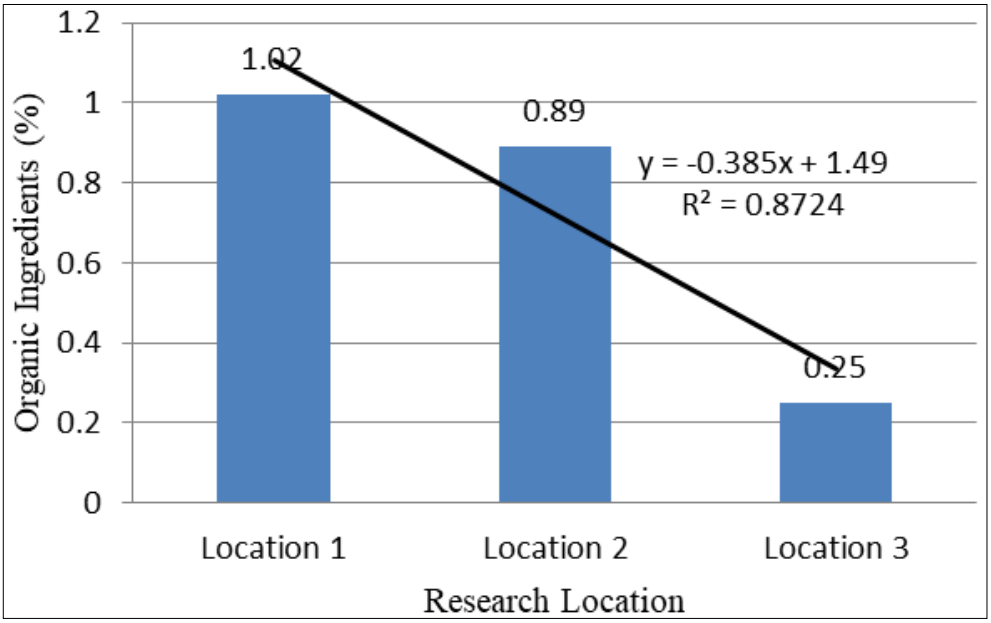

Fig 3: Substrate organic ingredients at the research location

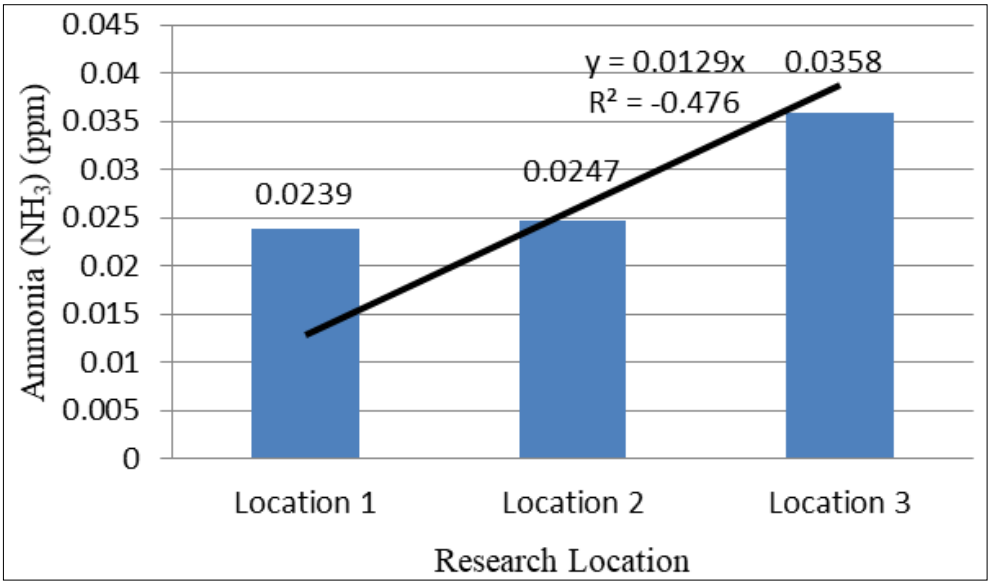

Fig 4: Substrate Ammonia (NH_3) at the research location

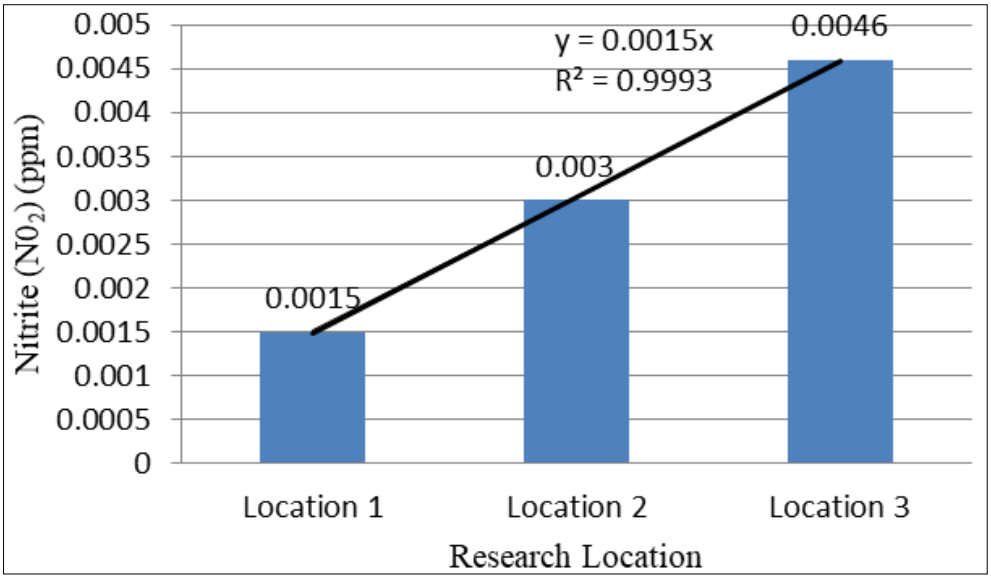

Fig 5: Substrate Nitrite ($N0_2$) at the research location

Table 1: Substrate Texture at the Research Location

Research Location	Substrate Texture
Location 1	Argillaceous Sand
Location 2	Dusty Clay
Location 3	Sandy

Discussion

pH

One factor to take into account while selecting a pond location is the pH of the soil. The pond site must have neutral or alkaline soil that doesn't react with acids [20]. Fig 1 shows that the substrate pH of the research location is in the range of 8.05-8.64, with the highest substrate pH value at location 1, namely the location around Siddo Pier, namely 8.64, and the lowest at location 3, namely the location near the community settlement in Toe Hamlet, namely 8.05. Karthik *et al*. (2005), in [21], stated that pond soil with a pH between 6.5 to 8.5 is classified as slight (suitable) because the pH value of the soil is classified as good and the barrier is very easy to overcome. Soil with a pH Between 6.5 to 8.5 is very good for making ponds because the pH in this range is rich in salt nutrients, which can stimulate the growth of claws. Meanwhile, soil with a pH below 4.5 or acidic soil is not suitable for use as a pond.

High and low pH can be caused by a small amount of organic material from land carried through river flows [22]. Low pH values can trigger the nitrification process. Low ammonium levels in water are caused by a decrease in the pH level of the water, which results in a reduction in the concentration of ammonium in the water [23]. Water biochemical processes will be impacted by pH variations; for instance, a low pH will stop the nitrification process [24]. The pH value is influenced by the rate of photosynthesis, industrial waste, and household waste [25]. To reduce soil pH, you can use sulfur [26]. At the mangrove point, the pH acidity level was 6.04, while at the coastal location it was 8.34, which means the pH acidity level at these two locations is still considered safe for marine biota [27]. One of the chemicals that is widely used for industrial and household purposes is detergent, which apparently causes a reduction in the pH value and oxygen concentration in river flows, which ultimately empties into the surrounding waters [27]. In general, the pH value indicates how acidic or alkaline a body of water is [28].

Nitrogen (%)

The source of nitrogen compounds, apart from the source water that enters the pond, is also from the soil [29]. The nitrogen element in soil comes from organic matter and N_2 in the atmosphere [30]. Nitrogen is the main macronutrient that plants need in large quantities [31]. Nitrogen is absorbed either in the form of ammonium or nitrate, depending on soil conditions. In general, the presence of these two types of ions is very beneficial [32]. Fig 2 shows that the substrate nitrogen value at the research location is in the range of 0.06-0.22%, with the highest nitrogen at location 2, namely the location adjacent to the Siddo Hatchery, namely 0.22%, and the lowest at location 1, near Siddo Pier, namely 0.06%. While it can reach 50–60% in mud deposits, the nitrogen content of soil on land ranges from 0.03-0.3% of all compounds. The majority of mud deposits are the consequence of organic material being deposited, particularly in river estuaries [30]. The nitrogen element in soil comes from organic matter and N_2 in the atmosphere [33]. Dissolved inorganic nitrogen is influenced by the content of nitrate, nitrite, and ammonium; increasing levels of ammonium are thought to not be oxidized to nitrite because Nitrosomonas bacteria cannot convert ammonium [34].

Matter organik (%)

Organic matter plays an important role in creating soil fertility. The role of organic matter in the soil is in relation to changes in soil properties, namely the physical, biological, and chemical properties of the soil, and organic matter forms granulation in the soil and is very important in the formation of stable soil aggregates [35]. Soil content is related to the organic matter content in the soil [36]. Fig 3 shows that the subtract organic material content at the research location is in the range of 0.25-1.02%, with the highest organic material at location 1, namely the location around Siddo Pier, namely 1.02%, and the lowest at location 3, namely the location near the Dusun community settlement. Toe is 0.25%. River estuaries are areas that contribute to inorganic nutrient content, including nutrients originating from estuaries [37]. The content of dissolved inorganic nutrients can influence tides in coastal waters towards the open sea [38]. Estuaries are areas that contribute organic and inorganic nutrients to nutrients originating from river estuaries. Rivers are one source of entry of organic materials and nutrients originating from land runoff into sea waters. The process of decomposing organic matter into mineral salts, such as ammonia, nitrate, and phosphate, is useful for phytoplankton and aquatic plants [39]. The process will be faster if the pH range is alkaline [40]. One of the supporting factors so that the composition of mangrove vegetation remains high is the mangrove substrate [41]. The type of substrate greatly influences the type and density of mangrove vegetation that lives on it [42].

Ammonia (NH_3) (ppm)

Low ammonium levels in waters are caused by the lowest tides in waters, which cause low ammonium levels [23]. Ammonia is the main product of protein breakdown, and if the concentration is very high, it can harm aquatic life [29]. Ammonia is a nitrogen element, which is a toxic element because it can cause aquatic organisms to experience respiratory problems, making it difficult to bind oxygen in the blood vessels [43]. Fig 4 shows that the ammonia (NH_3) content at the research location is in the range of 0.0239-0.0358 ppm, with the highest ammonia occurring at location 3, namely the location around the community settlement in Toe Hamlet, namely 0.0358 ppm, and the lowest at location 1, namely the adjacent location. With a hatchery or close to a seawater source, namely 0.0239 ppm. The low ammonia content at location 1 is caused by changes in water during the high and low tides. Ammonia is a waste that is a chemical compound that is an indicator of water pollution [44]. A significant amount of ammonia input sources come from agriculture, agrochemicals, and forestry. Under aerobic conditions with the help of bacteria, ammonia is converted into nitrite and nitrate. The toxicity caused by ammonia is

sublethal [45] and can be lethal (deadly) [46]. Nutrient content influences tides that move from the coast to the open sea [47].

Nitrite (NO_2) (ppm)

Analysis of nitrite levels on coasts adjacent to river estuaries is influenced by tides, which can change the nutrient content in the water to become low [23]. Nitrite ions are generally only present in small amounts and are easily oxidized to form nitrate [32]. Nitrite is a form of nitrogen that is only partially oxidized, and its presence is a temporary state of the oxidation process between ammonia and nitrate. Nitrite can be sourced from materials that are corrosive [48]. One of the factors that determines the high rate of the nitrification process is the number of bacteria found in the soil [49]. Fig 5 shows that the nitrite content of the substrate is in the range of 0.0015-0.0046 ppm, with the highest nitrite content at location 3, namely the location adjacent to the Toe Hamlet community settlement, namely 0.0046 ppm, and the lowest nitrite content at location 1, namely the location around the hatchery, namely 0.0015 ppm. The amount of inorganic waste will affect the number of bacteria that carry out nitrification. In general, nutrient concentrations are influenced by the nitrification process, which occurs more dominantly in estuarine areas and moves towards open sea waters [50]. The high and low levels of nitrate and nitrite content are influenced by biological activities and plants around the waters, which cause a decrease in acidity levels (pH) in the waters [51]. The distribution of average nitrite concentrations shows relatively similar amounts with low values. The low concentration of nitrite is thought to be caused by the fulfillment of dissolved oxygen concentration, which is assisted by the help of bacteria to oxidize nitrite to nitrate so that the concentration of nitrite in the waters becomes low [52]. The optimum pH value is thought to occur in the nitrification process at pH 8–9 conditions, which will produce high nitrate concentrations, and at pH 6 conditions there will be no reaction to the nutrient content [53]. The nitrification process, which turns nutrients into ammonium, is what causes low nitrite levels in waterways [54].

Substrate texture

The results of this research are in line with research [11], that the closer you are to the beach or bay, the finer the grain size obtained. This situation shows that the sediment source has undergone a transportation process until finally deposition at each research location [42]. Soil texture is very important to know because it can provide information related to the level of soil stability, the level of movement of groundwater, the level of gas diffusion into the air or vice versa, the level of activity of soil microorganisms and flora and fauna, as well as the amount of organic matter [55]. Table 1 shows that the subtract at the research location is different from one location to another. At location 1, which is the location adjacent to the hatchery, has a substrate texture, namely clayey sand; at location 2, namely the location adjacent to Siddo Pier, has a substrate, namely dusty clay; and at location 3, namely the location around the settlement of the Dusun Toe community, has a substrate, namely substrate. Sandy. Indirectly, soil texture also determines soil structure, which is important for the movement of air, water, and nutrients in the soil and also influences the activities of soil macro- and microorganisms [56].

Soil with a clay texture will have particles that have the taste of all three in proportion; if the feeling that is more dominant is sand, then it means the soil has a sandy clay texture [55]. Sandy loam texture is soil that is medium in texture but somewhat coarse [57]. The types of soil that are good for fish farming are sandy loam, sandy clay, silt clay, and clay. Sandy loam soil types are very suitable for the growth of natural food, while sand and silty sand soil types are very porous, so they cannot hold water and are poor in nutrients [58]. The addition of clay fraction will change the characteristics of the soil [59].

Conclusion

Based on research results from 3 research locations consisting of locations close to the hatchery, near Siddo pier, and near community settlements, it shows that the substrate pH of the research location is in the range of 8.05-8.64, and the nitrogen value is in the range of 0.06-0.22%, organic material in the range of 0.25-1.02%, ammonia (NH3) in the range of 0.0239-0.0358 ppm, and nitrite substrate in the range of 0.0015-0.0046 ppm, including substrates consisting of clayey sand and dusty clay and sand, all of which are still suitable for the development of milkfish cultivation. So it can be stated that at the research location, milkfish cultivation can be developed.

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