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ANALYSIS OF SUITABILITY OF LAND FOR CULTIVATION OF CRACKED FISH (*Channa striata*) IN PAYA NIE VILLAGE, BIREUEN

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Abstract

Snakehead fish (Channa striata) is a type of freshwater fish that is highly economical. Local snakehead fish in the village of Paya Nie Bireuen, Aceh Province are the fish most sought after by local communities, where the livelihood of some of these people is as traditional fish catchers. The problem faced by the community in Paya Nie Bireuen village is the decreasing catch of local snakehead fish, so there is a need for an alternative solution, namely cultivating local snakehead fish. This research aims to discuss the cultivation of snakehead fish (Channa striata) in Paya Nie Village, Bireuen. This sample research began with air collection carried out at 4 (four) points at 4 (four) stations and plankton carried out at 12 (twelve) points at 4 (four) stations. Physical and chemical parameters that are measured directly are: temperature, brightness, depth, dissolved oxygen (DO), salinity, pH, alkalinity, nitrate, nitrite, phosphate. The biological parameters explained in the laboratory are plankton identification which includes diversity, uniformity and dominance. The results of data analysis on water quality using the suspension method show that the land in Paya Nie Bireuen village is included in the appropriate category. Stations I and II showed that the suitability level was not suitable, this result showed that from the 10 parameters measured, only 3 parameters were suitable, namely pH, nitrite content and salinity. In general, it can be concluded that the land in Paya Nie Village is still suitable for cultivating snakehead fish.

Keywords: *Suitability of land, air quality, plankton, snakehead fish cultivation.*

INTRODUCTION

Snakehead fish (Channa *striata)* is a type of freshwater fish that can be consumed. This fish has a high albumin content so it can be used to treat certain diseases . The availability of land for cultivating freshwater fish in Indonesia provides a great opportunity for the community and even entrepreneurs to develop fish farming. Consumption of freshwater fish in the community has begun to increase so that fish farming businesses are growing. One type of freshwater fish that can be consumed is snakehead fish (*Channa striata*). This fish has a high albumin content so it can be used to treat certain diseases (Armando *et al.* , 2021) .

The distribution area of snakehead fish in Aceh Province is almost evenly distributed, one of which is in Bireuen . Bireuen Regency itself has abundant fisheries potential with a pond area of 4,945.67 ha and a freshwater station area of 150 ha with a production volume of 11,727.50 tons based on 2017 data (DKPP, 2018). Local snakehead fish in Aceh Province are the most sought after fish by the surrounding community, where the livelihood of some people in the Aceh area is as fishermen. Local snakehead fish (*Channa striata* .) is one type of swamp fish that has economic value (Saputra *et al* ., 2018).

Freshwater fish farming efforts are hampered by declining environmental conditions. Damaged water quality and environment will trigger the development of viruses and diseases in fish (Andayani *et al* ., 2014). According to Onyia *et al* . (2013), fish life is closely related to its habitat. Physical or chemical changes in the environment will affect the blood components of fish. If fish are exposed to certain chemical compounds, it will increase or

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decrease their hematology levels. Anemia is one of the disorders that occurs in fish blood tissue. This disorder occurs because fish are exposed to chemical pollutants or heavy metals, causing dysfunction in the osmoregulatory organs.

Research on the analysis of land suitability for cultivating snakehead fish (*Channa striata*) has been previously conducted by (Merdekawati and Agam, 2021) in Lake Sebedang, Sambas Regency . Nurchayati *et al.* 2021 has also conducted a study on land suitability analysis for cultivating saline tilapia (*Oreochromis niloticus*) in Pertabukan, Tayu District, where this study was to see the level of water suitability for cultivating saline tilapia (*Oreochromis niloticus*). Therefore, the author conducted a study by analyzing the suitability of land for cultivating snakehead fish in Paya Nie Village, Kutablang District, Bireuen Regency, to determine the suitability of the land.

MATERIALS AND METHODS

Time and Place

This research was conducted in July 2023 to December 2023. The research location is in Paya Nie Village, Bireuen Regency, Aceh Province. Sample identification was carried out at the Marine Biology Laboratory, Faculty of Marine Affairs and Fisheries, Syiah Kuala University.

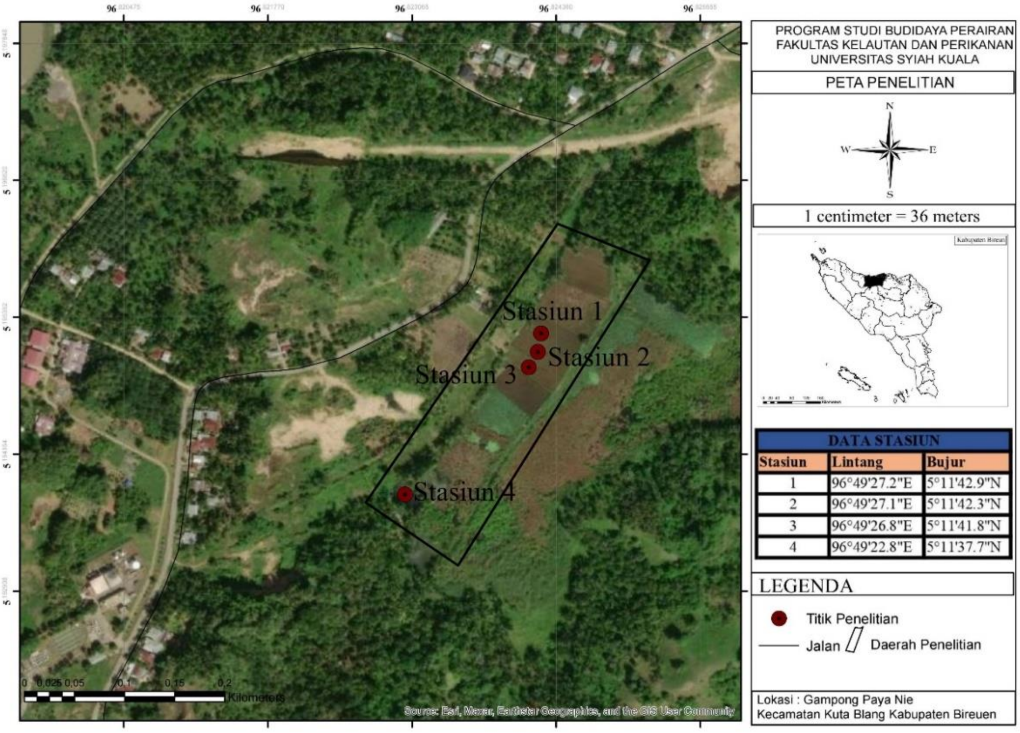

Figure 1 Location Map

Tools and materials

Stationery, camera, sample bottles, plankton net, thermometer, secchi disk, DO meter, refractometer, pH meter, litmus paper, bucket, microscope, plankton book,

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Research procedures
Location determination

The sampling used is *purposive sampling* . According to Nurchayati *et al.* (2021), it is explained that *purposive sampling* occurs when researchers want to select sample members based on certain criteria. Determination of the sampling location is based on certain considerations , including ease of reaching the sampling point location, as well as time efficiency based on the initial interpretation of the research location and sampling is only limited to sample units that meet certain criteria set based on research objectives. Samples were taken 1 time at 4 observation stations, with 3 sampling points per station.

Sampling

Water sampling was carried out at 4 points at 4 stations and plankton sampling was carried out at 12 points at 4 stations. Primary data measured directly in the field include parameters : temperature, brightness, depth, dissolved oxygen, salinity, pH, alkalinity, nitrate, nitrite, TDS. The parameters analyzed in the laboratory are plankton identification.

Measurement of temperature, brightness, depth, dissolved oxygen, salinity, pH, alkalinity, nitrate, nitrite, and TDS were measured at 09.00 WIB, measurements were taken once at each station. Plankton sampling was carried out with three repetitions at each observation station. 25 liters of station water was taken and then filtered with a plankton net. The filtering results were transferred into a sample bottle that had been equipped with information about the place/station. The samples obtained were then preserved with 3 drops of 4% alcohol solution. In accordance with the statement (Rahmatullah *et al* ., 2016.) Sampling was carried out using a plankton-net equipped with a storage bottle, by filtering 20 liters of water at each location and the results were put into a sample bottle (20 ml). Furthermore, preserved with 2-3 drops of 4% formalin and labeled. Each sample at each point was repeated 3 times.

Sample identification

Plankton samples in the sample bottle are taken and then shaken slowly until evenly mixed. Then take it using a dropper. then drip it on the glass slide, then cover it with a cover glass for microscope observation. Then observe under a microscope, with a magnification of 10x10. Then the plankton that has been counted is identified as plankton using the plankton identification book and the Marine and Freshwater Plankton.

Data analysis
Water quality analysis

Land suitability analysis is carried out based on water quality according to what is cultivated. The parameters measured can be seen in Table 1.

Table 1. Water quality parameter data

No	Observation	Equipment	Unit
1	Temperature	Thermometer	ºC
2	Brightness	Disk buckets	Lux
3	Depth	Meter	M
4	Dissolved Oxygen (DO)	DO meter	Ppm
5	Salinity	Refractometer	Ppt
6	pH	pH meter	-
7	Alkalinity	Litmus paper	Ppm
8	Nitrate	Litmus paper	-

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9	Nitrite	Litmus paper	-
10	TDS		-

Determination of land suitability class for cultivation stations begins with compiling parameters that are the requirements for the growth and development of snakehead fish cultivation. Analysis of water quality data using a scoring method, namely calculations with different weightings for each parameter and using the physical and chemical parameters of the water as a reference (Hidayah and Marson 2019). The weighting is determined based on the magnitude of the influence of the parameter on a fish cultivation feasibility designation by giving a higher weight. The suitability score is categorized with the numbers 1 (less good), 2 (good), and 3 (very good) (Nurchayati et al. 2021). The scoring or weighting of the suitability of the water quality parameter values is shown in the following table:

Table 2. Scoring of suitability of water quality parameters for fish farming

Parameter	Unit	Weight (B)	S1		S2		S3	
			Water Quality Range	Shoes (N)	Water Quality Range	Shoes (N)	Water Quality Range	Shoes (N)
Temperature	ºC	3	28-32	3	26-28	2	<26,>28	1
Brightness	-	2	30-40	3	25-<30->40-65	2	<25->65	1
Depth	Cm	2	90-100	3	50-90	2	<50,>100	1
DO	mg/l	3	>6	3	3-6	2	<3	1
Salinity	Ppm	3	0-3	3	>3-10	2	>10	1
pH	-	1	7,5-8,5	3	4-7,5/8,5-11	2	<4/>11	1
Nitrate	mg/l	1	0,4-0,8	3	0.1-0.4/0.8-5	2	>5	1
Nitrite	mg/l	1	0-0,001	3	>0,001-0,05	2	>0,05	1
TDS	mg/l	1	<100	3	100-1000	2	>1000	1
Alkalinity	-	1	120-160	3	100-120,>150-200	2	<100,>200	1

Source: Modified results from Nurussalam *et al* ., (2023) and Nurcahyati *et al* ., (2021).

Determination of the level of water suitability according to Trisakti (2003) can be divided into four classes, as follows:

a. Class S1: Highly Suitable , value 85 – 100%
b. Class S2: Moderately Suitable , value 75 – 84%
c. Class S3: Marginally Suitable , value 65 – 74%
d. Class N: Not Suitable , value <65%

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Furthermore, it is used to determine the suitability class of land for cultivating snakehead fish based on the characteristics of water quality and can be calculated using the following calculation (DKP 2002) :

$$Indeks\ kesesuaian = \frac{Total\ skor}{Total\ Skor\ max} \times\ 100\%$$

Diversity index (H')

Diversity can be calculated using the Shannon-Wiener index. Analysis of the species diversity index according to Shannon and Wiener (Magurran, 2004 is as follows:

$$H' = -\sum pi\ \text{In}\ pi \qquad pi = \frac{ni}{N}$$

Description: H' = Shannon-Wiener diversity index
ni = Number of species per plot (Importance value for each species)
N = Total number of types (Total importance value)
Pi = Number of species

The Shannon-Wiener diversity index value categories have a certain range of values:
H'< 1 = Low diversity
1 ≤H'≤ 3 = Moderate diversity
H' > 3 = High diversity

Uniformity (E)

The uniformity index is calculated using the Shannon-Wiener formula (Odum, 1993) as follows:

$$E = \frac{H'}{H\ max}$$

Description: E = Uniformity index (E)
H'= Diversity index
Hmax = 1n S
With the following range:
0< E ≤0 .4 = Low population uniformity
0.4 < E ≤0.6 = Population uniformity is moderate
E> 0.6 = High population uniformity

Dominance Index (C)

Small values of uniformity and diversity index indicate high dominance of a species over other species. The formula for dominance index is (Odum, 1971):

$$c = \sum_{t=1}^{s} Pi2$$

Description: C : Dominance index
Pi : Proportion of the number of individuals in a species
I : 1,2 3.., n

The index value ranges from 0-1 with the following categories:
0<C< 0.5 : Low dominance
0.5 < C ≤ 0.75 : Moderate dominance
0.75 < C≤1.0 : High dominance

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Species Density (D)

Density is the number of individuals per unit area (Brower et al., 1990) using the following formula:

$$D = \frac{Ni}{A}$$

Description: D : Density
Ni : Number of individuals of the species
A : Sampling plot area (m)

RESULTS AND DISCUSSION

Water quality test

Measurement and sampling of water quality were carried out at 1 station point . The measurement results and compliance with the water quality range can be seen in Table 3 as follows.

Table 3. Results of water quality parameter values

Pass the meter	Unit	Sampling Station			
		I	II	III	IV
Temperature	ºC	34^c	34^c	-	29^a
Brightness	Cm	28^b	28^b	-	$>100^c$
Dissolved oxygen	mg/l	5.6^b	5.6^b	-	3.4^b
Depth	M	49^c	50^c	-	$>2^c$
Salinity	Ppt	0^a	0^a	-	0^a
pH	-	8.5^a	8.4^a	-	7^a
Nitrate	mg/l	10^c	10^c	-	0^b
Nitrite	mg/l	1^c	0^a	-	0^a
TDS	mg/l	$<1000^b$	$<1000^b$	-	$<100^a$
Alkalinity	-	80^c	180^b	-	120^a

Information : a = very good
b = good
c = less

The results of determining the land suitability class in Table 4 show that there are differences in the results from each station, at station IV it has the highest suitability index value of 76%, including the fairly suitable class, and at stations I and II the suitability index values range from 57% - 61%, including the unsuitable class.

Table 4. Land suitability classes for aquaculture

Station	Total value (Weight x Score)	Conformity index (CC)	Suitability class
I	31	57%	It is not in accordance with
II	33	61%	It is not in accordance with
III	-	-	-
IV	41	76%	Quite appropriate

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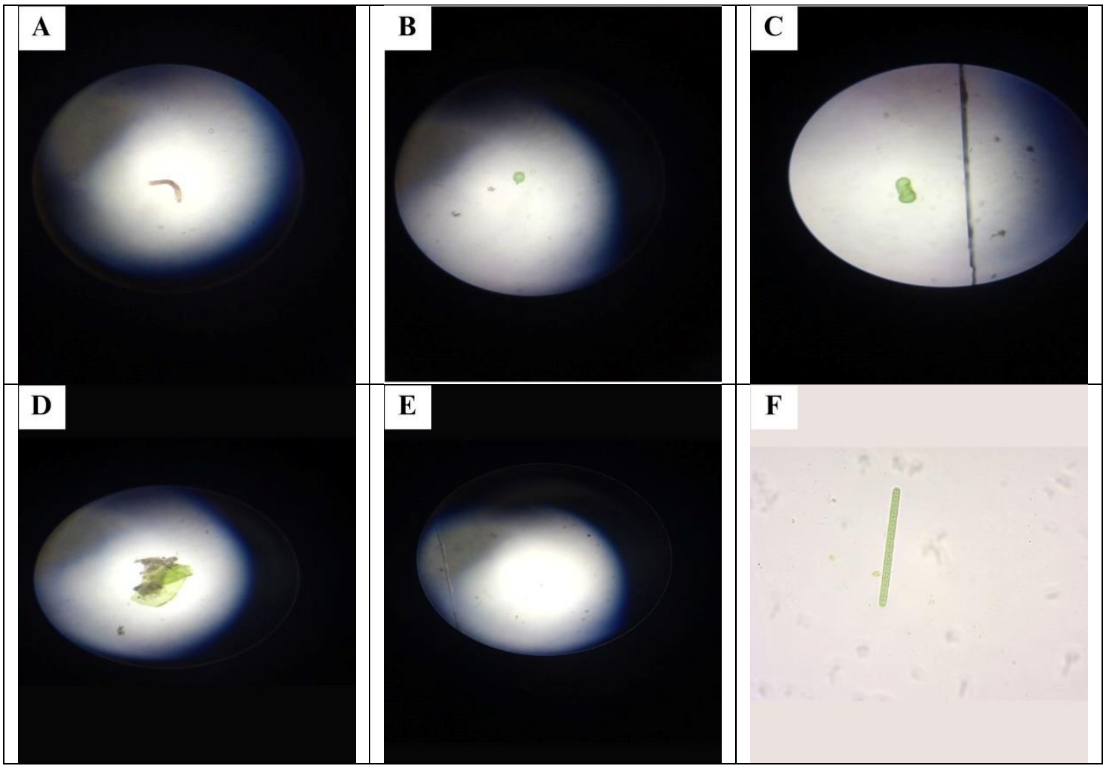
Plankton Identification

Based on the results of plankton identification, 13 species of Plankton were found at the research location.

Table 5. Types of plankton

No	Species	Station				Number of individuals
		I	II	III	IV	
1	Pandora	3	-	11	-	14
2	Oscillatory	212	175	31	143	561
3	Schistosoma	6	-	-	-	6
4	Scenedesmus	11	-	-	-	11
5	Nebela	9	9	4	-	22
6	Chlamydomonas	11	-	-	-	11
7	Circular meridian	4	-	-	-	4
8	Arm	1	-	-	2	3
9	Nostos	0	144	-	-	144
10	A vigorous Cyclops	-	6	-	-	6
11	Eucoconeis Sp.	-	-	7	7	14
12	Nitzschia scalaris	-	-	-	12	12
13	Phacus	-	-	-	3	3
Number of Individuals at Each Station		257	334	53	167	811
Number of Species		8	4	4	5	13



Picture.1Plankton, (A) *Schistosoma* , (B) *Pandorina sp* , (C) *Scenedesmus sp* , (D) *Nebela collaris* , (E) *Chalamydomonas sp* (F) *Oscillatoria sp*

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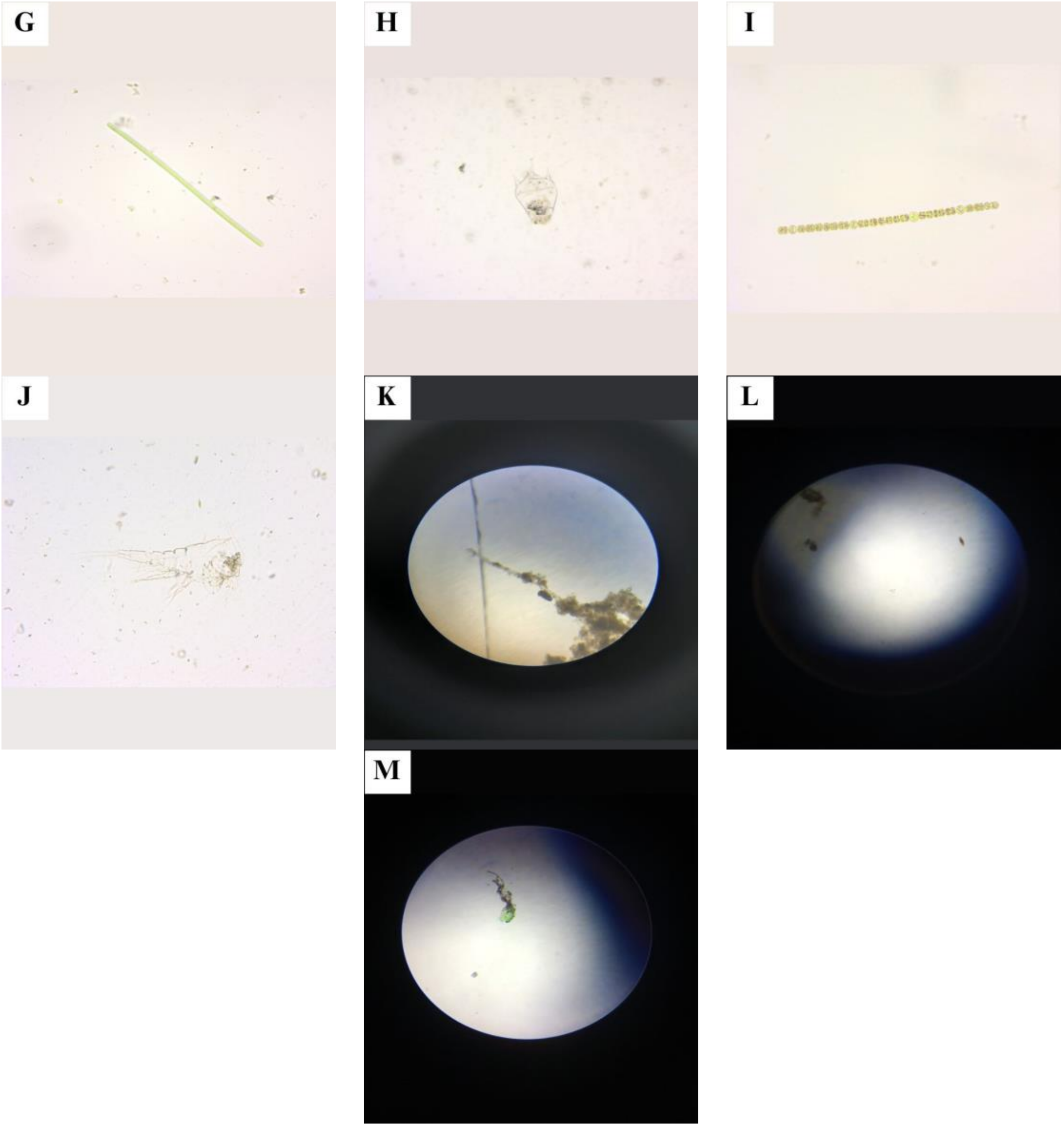

Gambar 3. Plankton yang tuwatan di lokasi peneltian, G) *Meridion circulare* , (H) *Brachionus picatilis,* (I) *Nostoc*, (J) *Cyclops strenuus* , (K) *Nitzschia scalaris* , (L) *Eucoconeis sp* (M) *Phacus sp*

Diversity index (H')

The results of the analysis of the diversity index (H') data can be seen in Figure 4. Station III has the highest diversity value among stations I-IV with a value of 1.10, followed by Station II which has a value of 0.87, Station III has a value of 0.77 and the lowest diversity value at Station IV which has a value of 0.58.

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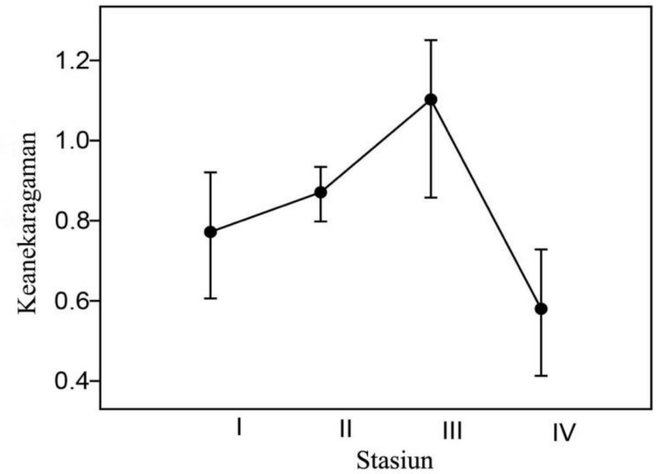

Figure 4 Diversity index (H') of Plankton

Uniformity index (E)

The results of the analysis of the uniformity index (E) data can be seen in Figure 5. The highest uniformity value was found at Station III which had the highest uniformity value among points I-IV with a value of 0.80, followed by point II which had a value of 0.63, point I had a value of 0.37 and the lowest uniformity value at point IV which had a value of 0.36.

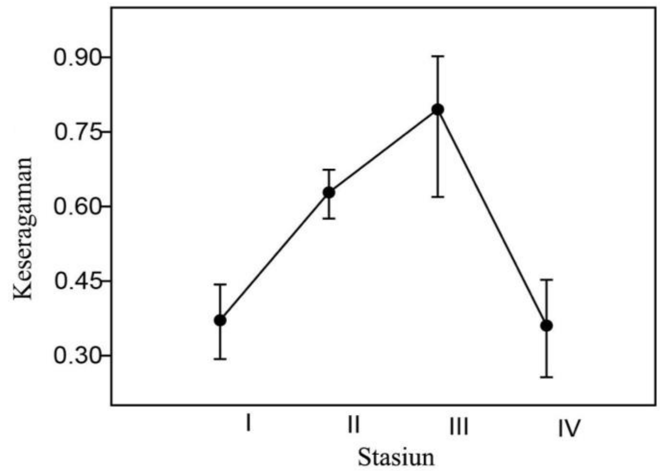

Figure 5. Plankton Uniformity Index (E)

Dominance index

The results of the dominance index (C) data analysis can be seen in Figure 6. The largest dominance value was found at Station IV which had the largest dominance value among stations I-IV with a value of 0.74, followed by point I which had a value of 0.69, station II had a value of 0.46, and the lowest dominance value at station III which had a value of 0.41.

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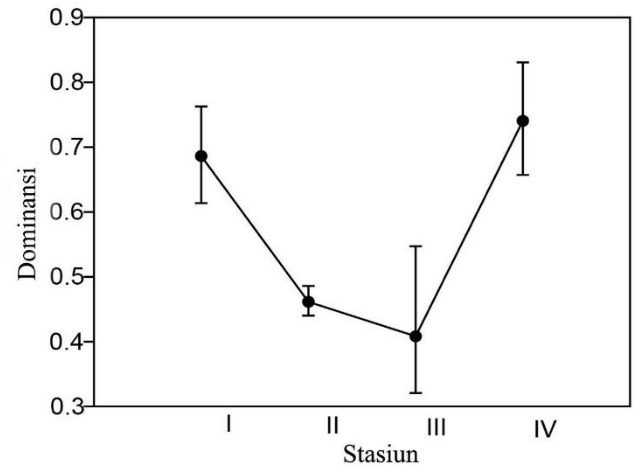

Figure 6. Plank ton Dominance Index (D)

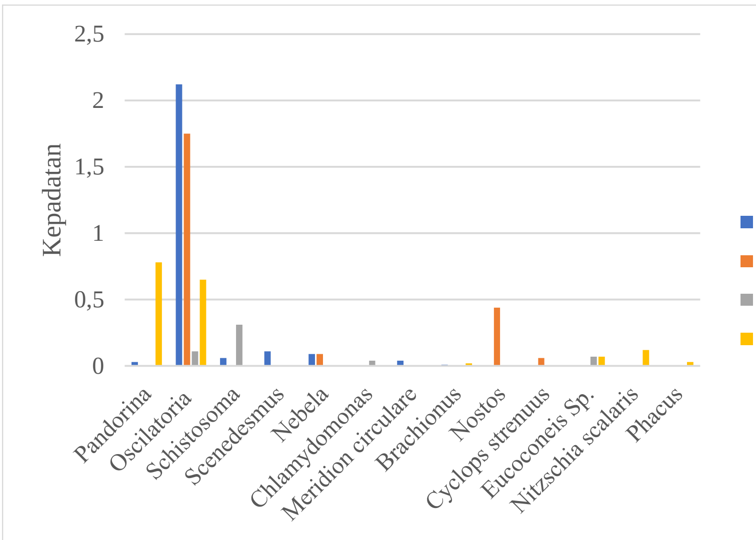

Figure 7. Density of Plankton Species

Discussion

Water quality is one of the supporting factors for the success of a cultivation effort where water quality plays a very important role in fish growth, disease occurrence, and survival. Temperature is an important factor in regulating the life processes and distribution of organisms. The results of water temperature measurements at each station show that the lowest temperature value is at station IV, while the highest temperature is at stations I and II. Kordi (2010) stated that one of the requirements for a snakehead fish cultivation location is a place with an optimum water temperature ranging from 28-31 ºC . Temperatures outside the limits of fish life will reduce fish feeding activity and can cause death (Armando *et al.,* 2021). The results of field measurements show different results at each station where stations I and II have temperatures of 34 ºC while station IV has a temperature of 29 ºC, so the temperature at stations I and II has a value that is not good and at station IV has a very good value.

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Brightness is measured to determine the extent to which there is still a possibility of assimilation processes in the waters. The results of water data collection at each station obtained the highest brightness value at station IV, while the lowest brightness values were obtained at stations I and II. Based on the brightness values obtained, it can be said that station IV has a fairly high brightness value. Mainagasi *et al.,* (2013) stated that good brightness for fish farming ranges from 0.30-0.40 m, if the brightness value is less than 0.25 m it will cause a decrease in dissolved oxygen levels. The results of field measurements show different results at each station where stations I and II have a brightness of 28 cm while station IV has a brightness of more than 100 cm, so that the brightness at stations I and II has a good value and at station IV has a less good value.

Oxygen is a very important parameter for all organisms in their lives. The dissolved oxygen value at each research station is classified as good for the life of snakehead fish, namely 3.4 mg/l - 5.6 mg/l. The highest dissolved oxygen is found at stations I and II, while the lowest dissolved oxygen value is found at station IV. Kordi (2019), good dissolved oxygen for snakehead fish cultivation ranges from 3-6 mg/l. Lack of dissolved oxygen concentration in waters will cause fish to become weak and can cause death.

Depth is one of the physical water quality parameters that greatly affects water quality. Depth in waters is closely related to the process of photosynthesis where the process is the same as the respiration process which can also be called compensation depth. Compensation depth occurs when sunlight penetrates the water surface. Compensation depth is greatly influenced by turbidity and the presence of weather so that it fluctuates daily and seasonally (Irawan et al., 2009). Based on the results of depth measurements at each station, the highest depth is at station IV, which is 200 cm and the lowest depth is at stations I and II, which is 50 cm. The depth values obtained at each station are classified as less suitable for snakehead fish cultivation.

The results of pH measurements at each station obtained values ranging from 7 - 8.5 , the pH value is classified as very good to support the life of snakehead fish. This is in accordance with Kordi's statement (2010) that the ideal pH value in snakehead fish cultivation is 4-9. A pH value of more than 10 will cause death in fish, while a pH value of less than 5 will inhibit fish growth (Koniyo, 2020).

Nitrate is the result of nitrite oxidation with the help of Nictrobacter bacteria. The nitrate value of natural waters is never more than 0.1 mg/l (Nurussalam *et al.,* 2023). The results of nitrate measurements at stations I and II were obtained at 10 mg/l, this was stated as unsuitable for snakehead fish farming activities, while at station IV the results were 0 mg/l which was stated as good for fish farming activities. Nitrite is a form of transitional compound between ammonia and nitrate. The results of the nitrite content analysis measured during the study ranged from 0 - 1 mg/l, with the highest nitrite measurement at station I, while the lowest were at stations II and IV. Kordi (2019) stated that nitrite in waters suitable for supporting freshwater fish farming activities is less than 0.2 mg/l. The nitrite concentration value obtained at station I was classified as unsuitable for the life of snakehead fish, while at stations II and IV it was classified as very good for supporting the life of snakehead fish.

TDS (*Total Dissolved Solid*) is the content of dissolved solids in water, either in the form of organic or inorganic materials. Based on the results of Total Dissolved Solid (TDS) measurements from each station, it ranges from <100 - <1000 mg/l-1. Based on the standard water quality book PP No. 82 (2001), the TDS range for good fish farming activities is 1000 mg/l, which means that the lower the TDS concentration in the waters, the better it is for fish farmers. The TDS values obtained at each station are classified as good for stations I and II, while for station IV it is classified as very good for snakehead fish farming.

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Alkalinity is a buffer capacity *that* functions to maintain the stability of water pH. The results of alkalinity measurements at each research station ranged from 80 - 180. The alkalinity value at station I is classified as not good for snakehead fish farming activities, station II is classified as good and station IV is classified as very good for snakehead fish farming activities. Alkalinity can affect nitrifying bacteria, an alkalinity value <20 will cause nitrifying bacteria to not function, so that it can increase nitrite and nitrate values (Utami *et al.,* 2021).

Based on the results of the weighting and scoring of the land suitability level at each station can be seen in (Table 4). It was found that each parameter showed a difference in variables at each observation station where station IV was classified as a fairly suitable class with a criterion of 76%, which means that the station has few limiting factors in the suitability of depth and brightness so that treatment is needed to overcome it. while stations I and II are included in the class not suitable with the criteria of 57-61%, which means that there are serious limiting factors in the suitability of land for cultivation development. This is indicated by the 10 parameters measured, only 3 parameters are suitable, namely pH, nitrite content and salinity.

Based on the results of plankton identification, 13 species of plankton were found at the research location , where at station I there were 8 species of plankton, station II found 4 species of plankton, station III found 4 species of plankton and station IV found 5 species of plankton. Plankton are microscopic organisms whose existence is very important in aquatic ecosystems. Plankton plays an important role in aquatic ecosystems through biotic and abiotic interactions at various trophic levels and can be used as a biomonitoring tool for changes in water quality parameters (Priyadarshi *et al.,* 2022).

Based on the results of the analysis , the greatest plankton diversity among stations I - IV with a value of 1.10 is found at station III which is categorized as moderate. Station II has a value of 0.87 categorized as low, station I has a value of 0.77 categorized as low, and station IV has a value of 0.58 categorized as low. The value of plankton diversity at each research station ranges from 0.58 - 1.10 which is included in the category of fairly stable to stable plankton communities. The value of plankton diversity for a stable aquatic environment ranges from 1.21-1.80 (Wibisono, 2005). According to Wibisono (2005) states that, a fairly stable plankton community condition indicates a poor aquatic environment. The results of the data analysis show that the greatest uniformity value is found at station III with a value of 0.80, categorized as high, followed by station II with a value of 0.63 categorized as moderate. Station I has a value of 0.37 which is categorized as low, and station IV has a value of 0.36 categorized as low. Akbarurrasyid *et al.,* (2022) and Prita *et al.,* (2014) stated that low evenness values indicate low species evenness and indicate changes in the structure of the plankton community and have an impact on the quality of the aquatic environment.

The dominance index is used to obtain information on the type of plankton that dominates. The results of the study obtained the dominance index at station IV with the highest value of 0.74 with a medium category, followed by station I with a value of 0.69 with a medium category, station II with a value of 0.46 with a low category and station III with a value of 0.41 with a low category. Based on the results of the dominance index obtained at each station, it is classified as stable because there is no value close to 1. Pamukas (2014) stated that if the dominance index approaches 1, it means that there are organisms that dominate and if the dominance index approaches 0, it means that there are no organisms that dominate.

The results of this study obtained the highest plankton density at station I with an average of 2.12 ind/m2 $^{\text{occupied}}$ by *Oscillatoria* type plankton , and the lowest density was found at stations I and II, with an average of 0.01-0.02 ind/m2 $^{\text{found in the}}$ *Brachionus* type . It

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can be concluded that the density of the plankton type that is often found is *Oscillatoria* . Generally, genera included in the Bacillariophyceae Class are cosmopolitan and grow rapidly in pond waters and Oscillatoria sp is one of the genera that can adapt to temperatures of 0 ºC to 37 ºC (Pirzan and Utojo, 2010).

Conclusion

Paya Nie Village, Bireuen Regency, Aceh Province has the results of determining the suitability class of physical and chemical parameters of the cultivated land, indicating that the cultivated land is included in the suitable category. Stations I and II showed an unsuitable level of suitability, this result is indicated from 10 parameters measured only 3 parameters are suitable, namely pH, nitrite content and salinity. Observation of biological parameters obtained the results of plankton identification found 13 plankton species at the research location. Station I contained 8, namely *Oscillatoria, Scenedesmus, Chlamydomonas, Nebela, Schistosoma, Meridion circulare, Pandorina* and *Brachionus* . Station II found 4 species, namely *Oscillatoria, Nostos, Nebela,* and *Cyclops strenuus* . Station III found 4 species, namely *Oscillatoria, pandorina, Nitzschia scalaris,* and *Nebela* . Station IV found 5 species, namely *Oscillatoria, Nitzschia scalaris, Eucoconeis Sp, Phacus* and *Nostos* . The results of the diversity index analysis (H') at station III are classified as medium, while stations I, II and IV are classified as low. The uniformity index (E) at station III is classified as high, followed by station II which is classified as medium, stations I and IV are classified as low. The largest dominance index (C) was found at stations I and IV which are classified as medium, while stations II and III are classified as low. The highest density value is found in the *Oscillatoria* species with a density value of 2.12. This species is found at every station and the highest at station I, while the lowest density value is found in the Brachionus species, with a density value of 0.01, this species is found at stations I and IV. In general, it can be concluded that the land in Paya Nie Village is still suitable for cultivating snakehead fish.

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