The diversity of plankton in fish aquaculture water of minapolitan Menayu village, Muntikan district, Magelang regency

A Wulandari¹, S P Putro¹, F Muhammad¹

¹School Program of Magister Biology, Department of Biology, Faculty of Science and Mathematics, Diponegoro University
Jl. Prof. Soedharto, S H, Tembalang, Semarang 50275, Indonesia
E-mail: ayuwulandari1980.aw@gmail.com

Abstract. Plankton is a group of the organism which takes an important role in a water ecosystem because Plankton is natural food for larva organism in the water. The level of plankton production in the water can be used for suspecting potency of stable and unstable water. The condition of water can affect Plankton’s life sustainability or their survival which is their diversity. The stability of water condition is the key successful determiner of aquaculture of Trout in Minapolitan, Merayu Village. From the four stations which had been taken its sample, it was found some Phylum of plankton such as Bacillariophyte, Chlorophyte, Cyanophyte, Dinophyte, Sarcodine, Copepoda and Rotifera with 31 genera. Data was taken then calculated by using the Shannon Wiener Method. Base on the Index value of diversity in Station I was about 1.54 – 1.72, Station II was about 1.71 – 2.37, station III was about 1.72 – 2.18 and the station IV was about 2.60 – 3.04. The index of homogeneity in the station I was about 1.27 – 2.08, station II was about 1.78 – 3.17, station III was about 2.12 – 2.96 and the station IV was about 2.48 – 4.43. The Index of dominance in the station I was about 0.93 – 0.96, station II was about 1.78 – 2.08, station III was about 0.78 – 0.91 and station IV was about 0.92 – 0.96. Based on the index value of diversity of plankton in aquaculture water was classified as medium, the index of homogeneity was evenly distributed, and its index of dominance was high. The condition of fish aquaculture in Minapolitan, Menayu village is still in good stability (stable) and proper for Trout Fish Aquaculture based on its index of Biology.

1. Introduction
Melayu village is one of the villages in Muntikan District (Kecamatan Muntikan), Magelang Regency, Central Java which is a village in Minapolitan in Magelang Regency. Based on Bupati Magelang Decree Number: 188.45/347/KEP/29/2011 about the location of Minapolitan in Magelang, followed by Maritime affairs and Fisheries Ministerial Decree number KEP 32/MEN 2010 about establishment Minolitan sector changed by Ministerial Decree number KEP 32/MEN/2011 about alteration of KEP 32/MEN/2010 about the establishment of Fisheries in Minopolitan, Magelang Regency are located in three sub-districts, included the sub-district of Mungkid, the sub-district of Sawangan R, and the sub-district of Muntilan [7]. For the development of Minopolitan sector in Muntikan regency is centered in Menayu village. It is based on the potency of Menayu village which is the village of Trout Fish
Aquaculture; it is almost 70% of the population are working in the farming or agriculture field, especially Fish Aquaculture.
Plankton is natural food for larva organism in the water. As the main producer in the water is phytoplankton, and as the consumer are zooplankton, Lara, fish, shrimp, crab, etc. The producer is the organism which has the ability for using sunlight as the energy sources in doing activities, while the consumer is the organism which utilizes the energy sources is resulted by another organism [5].

Plankton is a group of the organism which takes an important role in a water ecosystem especially in the food chain in the water because plankton gives the biggest contribution to total primary production in water. The important role f the Plankton for primary productivity of water because plankton is able in photosynthesis which produces many organics that rich of energy or even organism need which has a higher level. In agriculture, Plankton has a big role, especially in fish agriculture in the traditional pool. With the construction of the pool which directly touched upon the soil enables of plankton grows well, especially Phytoplankton [1].

According to Barnes and Mann (1991), the level of plankton production in a water can be used to presume the potency of water is tend to stable or unstable and if the population of plankton in a water is over saturation (blooming) can be indicator of biological pollution as well. Stable condition of environment in the pool is marked by high diversity of plankton, high amount of each species and evenly spread and also appropriate water quality with an organism of agriculture [3].

2. Material and Methods
This research was conducted on a location of Fish Aquaculture in Menayu village, sub-district of Muntilan, Magelang Regency, Province of Central Java. It was done in June-July 2015. The location of the research can be seen in figure 1.

![Figure 1. Map of Muntilan District](image)

2.1 Sampling and measurement of water sample
The plankton sample was carried out in 4 stations using Plankton net by repeating three times by taking water by a 3 liters-sized bucket two times and then pouring into plankton net. After that, the sample of plankton which is gained is put in a bottle of the sample and preserved by 3-4 drops of
alcohol. Moreover, then, it will be analyzed and accounted the amount and its species. The data of the Plankton which is measured is:

a. The Index value of diversity (H’) (Shannon-Weiner, 1949)

\[ H' = \sum_{i=1}^{N} P_i \ln P_i \]

Where:
- \( H' \) = The Index of diversity
- \( P_i = \frac{n_i}{N} \)
- \( n_i \) = The amounts of the first species
- \( N \) = Total of species

(Mason, 1981)

The total range of the diversity index can be classified as followed:
- \( H' < 2.3026 \): The Diversity is Small, and The stability is Low
- \( H' \leq 6.9078 \): The Diversity is Medium, and the stability of the community is medium
- \( H' > 6.078 \): The diversity is High, and the stability of the community is High

b. The index of homogeneity (E) (Simpson, 1949)

\[ E = \frac{H'}{H_{max}} \]

Where:
- \( E \) = The index of homogeneity
- \( H' \) = The index of diversity
- \( H_{max} = \ln S \)
- \( S \) = The number of species

The index of homogeneity \( E < 0.75 \) the homogeneity is LOW, it means the homogeneity of the species is not equaled. The inside of homogeneity is \( E > 0.75 \) is HIGH; it means the homogeneity of the species is Equalled [2].

c. The index of Dominance (D)

\[ D = \sum_{i=1}^{S} \left( \frac{n_i}{N} \right)^2 \]

Where:
- \( D \) = The index of Dominance
- \( n_i \) = The amounts of the first species
- \( N \) = Total of species

The criteria according to (Odum, 1971) as follows; D is close to 0 there are no dominant species, and D is close to 1 there are dominant species [8].

3. Result and discussion

Based on the observation result, there are some philums of plankton such as: Bacillariophyta, Chlorophyta, Cyanophyta, Dinophyta, Sarcodina, Copepoda and Rotifera, with 31 of genus which spread on 4 stations, those are on Kedung Klepu, Kedung Kupid, and Kedung Kembar and the area of Mr. Sultoni’s fish aquaculture. Moreover, from the result of high diversity is on Station 4, it was 2.06 – 3.04, it might happen because Station 4 is a fishing area which got the intensity of sun light is quite high and good water. The sedimentation of fish food on the bottom pool become nutrition source for
plankton to breed well. The level of plankton diversity on Station 2 was: 1.77 – 2.37, Station 3 was 1.77 – 2.18 and Station 1 was 1.54-1.82 by average of the diversity index $H' = 2.15$.

Based on the range of homogeneity index value can be concluded that Aquaculture in Minopolitan region, Menayu Village has a Medium level of homogeneity [4]. It indicates that water quality used in fish aquaculture in Menayu village is relatively good to support Agriculture or Aquaculture activity.
Figure 2. The Type And The Amount of Plankton In Each Station Information: Station I: Kedung Klepu, Station II: Kedung Kupit, Station III: Kedung Kembar, Station IV: Fish area culture.

Figure 3. Amount of 1st individu, b, Amound of total individu, c. Index value of homogenity, d. Index value of dominance, e. Index value of divercity of Plankton for its station.

The result of homogenity index from the four stations generally between 1,27 – 4,43. The value of homogenity on fish agriculture in Minopolitan region, Menayu Village showed that the homogenity of the species was relatively equal or in other words the amount of species was relatively equal, if the value of E > 0,75 so that its homogenity was high or good, while if the value of E < 0,75, so that its’
homogeneity was low (Ali, 1994). Based on the value of Plankton diversity index in fish aquaculture in Minopolitan region Menay village showed that the water ecosystem was stable and it supported fish aquaculture.

The Plankton domination index in fish aquaculture in the four stations was about 0.78 – 0.96, which means the Plankton species domination was in high condition. It was closed to 1 due to the average of domination is 0-1, and it showed there is domination, where there was species, was extremely dominated of others, nevertheless, it could be lowered by improving the habitat on the pool of agriculture that might it have been degradation. The effort that could be done was by applying of used of Probiotic of bacteria, calcium, food, organic fertilizer, and pesticides balanced based on Standard of Operational Procedure (SOP) that appropriate with the potency in local environment [9].

Based on the data of homogeneity index, the index of homogeneity and the index of domination of Plankton in aquaculture in Menayu village can be concluded that the condition of the water was stable and it supported Trout agriculture in Minopolitan region, Menayu village. It was necessary of counseling and socialization for the community around Kedung Kuwo, Kedung Kupit, and Kedung Kembar which are the main water sources used by farmer to keep the condition of water ecosystem. So that water conservation inMinoolitan region, Menayu village was stayed awake, and it is not impacted on Eutrofikasi, especially by Eichhormia crassipes or Water Hyacinth (enceng gondok) which have been happened.

4. Conclusion
The Fish Aquaculture in Menayu village, sub-district of Muntilan, Magelang regency had seven philums and 31 plankton species. Moreover, from the result of analysis of diversity index, and index of domination showed that fish aquaculture in Minopolitan, Menayu village was relatively stable, it was seen from its’ biological indicators, and it supported in fish aquaculture business.

References
[1] Anonim 2012 Kabupaten Probolinggo Dalam Angka 2012 Kerjasama Badan Pusat Statistik Kabupaten Probolinggo dan Pemerintah Daerah Kabupaten Probolinggo
[2] Amin M and Suwoyo H S 2012 Jenis dan Komposisi Plankton Pada Budidaya Polikultur Udang Windu, Udang Vaname, Ikan Bandeng dan Rumput laut di Tambak Prosiding Forum Inovasi Teknologi Akuakultur 2011 Jilid 2 Pusat Penelitian dan Pengembangan Perikanan Budidaya Tahun 2011 Jakarta.
[3] Barnes R S K and Mann K 1991 Fundamental of Aquatic Ecosystem(Prologue) Oxford: Blackwell Sci. Publisher.
[4] Basm H J 2000 Planktonologi: Planktonsebagai Bioindikator Kualitas Perairan Bogor: Fakultas Perikanan dan Ilmu Kelautan: Institut Pertanian Bogor (IPB).
[5] Djarijah A S 1995 Pakan Ikan Alami Jakarta: Kanisius p 187.
[6] Effendi R 2003 Penelaah Kualitas Air Yogyakarta: Penerbit Kanisius.
[7] Departemen Kelautan dan Perikanan (DKP) 2014 Keputusan Menteri Tentang Penetapan Kawasan Minapolitan. Jakarta : Departemen Kelautan Dan Perikanan RI.
[8] Odum, E P 1971 Dasar-dasar Ekologi: Edisi ketiga (Alih bahasa Tjahjono Samingan) Gajahmada University Press.
[9] Pirzan A M, Gunarto and Utojo 2006 Kelayakan dan kestabilan tambak dan sungai berdasarkan indikator diversitas plankton di Lakawali, Luwuk Timur, Sulawesi Selatan Jurnal Torani Fakultas Perikanan Universitas Hasanuddin Makassar.