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MICROBIOTA: THE VITAL ROLE IN SUPPORTING SUSTAINABLE DEVELOPMENT GOALS 2030 FROM A MICROSCOPIC SCALE

Hexa Apriliana Hidayah[1], Rosyid Ridlo Al-Hakim[2], Agung Pangestu[3], Ely May Sarroh Saragih[4]

[1]Faculty of Biology Universitas Jenderal Soedirman, Jl. Dr. Soeparno No. 63 Purwokerto Indonesia, Fax. +62281-638794
[2]Graduate School IPB University, Jl. Lodaya II No. 5 Kota Bogor Indonesia, Fax. +62251-8320417
[3]Faculty of Engineering and Computer Science Jakarta Global University, Grand Depok City Jl. Boulevard Raya No. 2 Depok Indonesia, Fax. +6221-8463692
[4]Faculty of Economics and Management IPB University, Jl. Agatis IPB Dramaga Campus Bogor Indonesia, Phone +62251-8626520
Post-el: hexa.hidayah@unsoed.ac.id[1],
alhakimrosyid@apps.ipb.ac.id[2],
agungp@jgu.ac.id[3],
elymay48@gmail.com[4]

Abstrak

Saat ini dunia berfokus pada SDGs (Sustainable Development Goals) 2030. Berbagai upaya telah dilakukan untuk mengimplementasikan SDGs 2030. Banyak negara telah bergerak dan menyadari bahwa SDGs 2030 akan berdampak pada spesies manusia di bumi—termasuk keanekaragaman hayati di mana ini merupakan kekayaan hayati yang harus dilestarikan, termasuk keanekaragaman hayati skala mikro. Air tawar merupakan sumber daya alam yang dihuni oleh mikrofita. Kami menjelaskan peran vital mikrofita dalam mendukung SDGs 2030 dari skala mikroskopis. Studi ini menunjukkan bahwa mikro-biota dapat berkontribusi pada lingkungan yang berkelanjutan, dengan studi kasus spesifik dari Jawa Tengah-Indonesia.

Abstract

The world is focusing on the 2030 SDGs (Sustainable Development Goals). Various efforts have been made to implement the 2030 SDGs. Many countries have moved and are aware that the 2030 SDGs would impact the human species on earth—biodiversity is a biological wealth that must be conserved, including micro-biodiversity. Freshwater is a natural resource inhabited by microphytes. We explain the vital role of microphytes in supporting SDGs 2030 from a microscopic scale. This study shows that micro-biota can contribute to a sustainable environment, with specific cases study from Central Java-Indonesia.

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INTRODUCTION

For a long time, anthropogenic activities have been responsible for environmental change. The widespread disruption of ecological anthropology has resulted in significant problems such as debasement, land deterioration, changes in a place's usual weather, water scarcity, and species extinction. These concerns have harmed ecosphere quality and habitat loss, resulting in the mass extinction of species (Arora et al., 2018). Research results have proven that if this trend continues, it is estimated that the environment will

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worsen in the future, and of course, it can threaten human civilization; this has become a significant crisis for researchers worldwide, so to minimize the crisis, green solutions such as microorganism engineering and modern biotechnology can be used. This applied technology can reduce or reverse the harmful effects of anthropogenic environmental problems to ensure environmental sustainability in the future (Arora et al., 2018) and contribute to SDGs 2030

The United Nations' 2030 Sustainable Development Goals (SDGs) made the country strive to ensure implementation to promote these SDGs' success (Arora & Mishra, 2019). Some countries have simplified the 2030 SDGs agenda, including Spain (Boto-Álvarez & García-Fernández, 2020), Poland (Raszkowski & Bartniczak, 2019), Romania (Firoiu et al., 2019), Nigeria (Modibbo et al., 2021), Africa (Chirambo, 2018; Mawonde & Togo, 2019), China (Yu et al., 2020), Indonesia (Azmanajaya et al., 2020), and Colombia (Pineda-Escobar, 2019). In the succession of these SDGs, multidisciplinary science is needed, such as tourism (Boluk et al., 2019), energy (Chirambo, 2018; Nurunnabi et al., 2020a, 2020b), economics (Asadullah et al., 2020; Palomares et al., 2021), science and technology (Isabelle & Westerlund, 2022; Kumar & Jakhar, 2022). Biodiversity has always become necessary to maintain, protect, use wisely, and care for it to be sustainable. Countries with the highest level of biodiversity include Indonesia, followed by the Americas (Deharveng et al., 2021; Marwayana et al., 2022; Sakir & Kim, 2021; Shin et al., 2019). This high level of biodiversity makes these countries a hotspot for existing biodiversity. The ongoing efforts to make this biodiversity hotspot sustainable have also received worldwide attention. Challenges that arise to maintain the sustainability of this biodiversity hotspot include natural disasters (Wanger et al., 2020), climate change (Condro et al., 2021), and applying DNA computing (Huhn et al., 2019). This issue needs special attention to enable the world's biodiversity hotspots to continue to be sustainable, and, of course, this will make the world's SDGs 2030 a success. The environment also contributes to the optimal SDGs. The appropriate and sustainable environmental conditions are vital for SDG (Arora et al., 2018).

However, based on these three issues, it is possible to seek the sustainability of the biodiversity hotspot instead. Ecosystem-based tsunami mitigation can be a study to reduce the risk of ecological disasters. The main topic is tropical biodiversity hotspots, such as Indonesia (Wanger et al., 2020). Besides, the issue of global climate change also threatens the sustainability of existing biodiversity hotspots. Indonesia is a biodiversity hotspot for primates. Efforts to build a specially protected area for this primate hotspot can be continued to maintain the life of endemic primates and avoid extinction (Condro et al., 2021). DNA barcoding technology can also be a tool to monitor the presence of invasive species in biodiversity hotspots. Of course, this is interesting because it requires further specialization in DNA technology. If done carefully and precisely, the role of invasive species can maintain the sustainability of biodiversity hotspots; this can support environmental sustainability (Huhn et al., 2019). One type of environment that can contribute to SDGs is the aquatic environment. Many things can be defiled in the aquatic environment, one of which is the role of biological biodiversity, including microscopic biodiversity. Besides, one of the crucial things of the aquatic biodiversity ingredients is biotic components (Nurfadillah et al., 2022).

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Microphytes (microalgae) are one of the types of microscopic algae. They are commonly known as microalgae or phytoplankton, organisms that live floating and drifting in the water and are capable of photosynthesis (Widiana, 2012). Microphytes are microorganisms that live swimming in the waters and have weak swimming abilities, so their swimming movements tend to be influenced by water currents. Microphytes or phytoplankton play an essential role in an aquatic ecosystem due to their autotrophic nature. Microphytes can convert inorganic nutrients into organic matter needed by living things through photosynthesis. Several environmental parameters and physiological characteristics influence the richness of plankton in the water. Plankton is the biotic component used to describe aquatic life (Fahmiaty et al., 2018; Sastranegara et al., 2020, 2021). Besides, this biotic component helped the water quality control (Soeprobowati et al., 2016) or bioindicator (Hariyati & Putro, 2019), environmental assessment (Hariyati & Putro, 2018), interaction with microplastic (Hadiyanto et al., 2021) and heavy metal (Permana & Akbarsyah, 2021), as well as heavy metal remediation (Soeprobowati & Hariyati, 2012) and bioremediation (Christwardana et al., 2020). The applied biotics engineering can be used for cultivation (Soedibya et al., 2021), microalgae biodiesel (Mahfud et al., 2020; Veza et al., 2021), and electricity generation (Christwardana et al., 2020) or bioelectricity (da Costa & Hadiyanto, 2018).

Within the reason to support the SDGs with biodiversity aspects, several scientific publications related to microphytes does not review yet. Besides, Central Java was reported to be used for high applications in human-daily aspects, especially in the form of aquatic vegetation as well as water quality conditions (Chulafak et al., 2021), and potentially to be one of the sources of microplastic pollution (Adji et al., 2022). Besides, Central Java also reported high microphytes diversity in Klaten (Akbar & Roziaty, 2018), as well as in the nearest province in West Java and (OHTAKA et al., 2006) East Java also reported (Arsad et al., 2021; Rahma et al., 2020). This study will review the microphyte (microalgae) diversity in Central Java Province, and it is potentially used for bio-engineering aspects, as well as to contribute to SDGs 2030.

METHOD

This study used a mini-review technique according to a previous study by Al Hakim et al. (R. R. Al Hakim, Satria, et al., 2021). Literature review, title selection, abstract screening, full-text reading, and mini-review are all part of the process design. All scientific papers type, language in Indonesian or English, academic publications (thesis or dissertation), and an infinite number of years of publication are included in the literature study inclusive criteria. Unpublished papers, indexed databases, and aquatic fauna biodiversity studies are among the exclusion criteria. Boolean rules were employed for keywords: "*microphyte OR microalgae OR AND Central Java OR Jawa Tengah AND water quality OR biodiesel OR biomass OR bioindicator OR bioremediation*." The *Publish or Perish* software was used for scientific literature surfing. The review result was categorized as division name and total number observed. The outcome of the mini-review was analyzed using the qualitative-descriptive approach.

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RESULT AND DISCUSSION

A recent study determines the microphytes community in some areas of Indonesia. For example, in Wadaslintang Reservoir found about 54 species of microphytes (see Table 1) (R. R. Al Hakim, 2019); another research report found in the same reservoir about 22 taxa of phytoplankton (microphytes) during the dry season. Twenty-nine taxa were found during the wet season, including Cyanophyta, Chlorophyta, and Chrysophyta (Piranti & Wibowo, 2020). In another country, Poland, The following categories were detected in Pond Zielone: diatoms (147 taxa), chlorophytes (79 taxa), and cyanoprokaryota (28 taxa) (Dembowska et al., 2018). In Russia, there were 38 species identified (11 phyla, 31 genera), including nine Chlorophyta species, 13 Bacillariophyta species, nine Cyanophyta species, four Euglenophyta species, two Chrysophyta species, and one Dinophyta species (Kostryukova et al., 2018). Based on the two countries that have been reported, it differs from Indonesia's cases. Because of the water condition and environmental factors accrued, microphytes are vital organism that has water's functionality. These creatures have chlorophyll, which can convert inorganic elements into organic compounds via photosynthesis. Organic matter from microphytes is used as a food source by zooplankton, fish larvae, and other aquatic animals. Microphytes play a critical function in the aquatic food chain. Microphytes act as the primary essential food ingredient in the food cycle in the waters. Thus the abundance of crucial microphytes in the waters (Andriani et al., 2017).

Previously research reported that environmental factors influenced the biodiversity of aquatic biota. Of course, ensuring that the environmental factors are continuously monitored is vital. We can use the recent artificial intelligence (AI) technology to avoid water pollution (Zharikova et al., 2022). Another technology, called the internet of things (IoT), patrol aquatic environments in actual time (Islam et al., 2022). In addition, many technological developments are modern, practical, simple, fast, efficient, and friendly (for use, cost, maintenance, and feedback/support). These technologies will always ensure the environmental condition of aquatic sites and protect the aquatic biodiversity, and environmental sustainability can be supported.

One aquatic habitat in Central Java is the Wadaslintang Reservoir (WR). Another study was reported in Rawapening Lake (RL) (Hariyati & Putro, 2019) and Umbul Kemanten-Klaten (UKK) (Akbar & Roziaty, 2018). The microphytes dominant in Wadaslintang Reservoir, Indonesia, are Diatoms (for example, see Figure 1) and Chlorophytes (R. R. Al Hakim, 2019); meanwhile, in Rawapening Lake, *Melosira* sp., *Aulacoseria granulata*, *Oscillatoria* sp., and *Synedra ulna* are the most dominant species (Figure 2). In addition, recently studied in Poland, Cyanoprokaryota remained the dominant group (Dembowska et al., 2018). Besides, in Russia, the dominant groups such as Cyanophyta and Bacillariophyta (Kostryukova et al., 2018). Non-dominant species of microphytes also make sure a sustainable aquatic environment (Melani et al., 2020) and support aquatic productivity (Nofdianto & Tanjung, 2019), as well as other aquatic macrophytes contribute (Nasution et al., 2019).

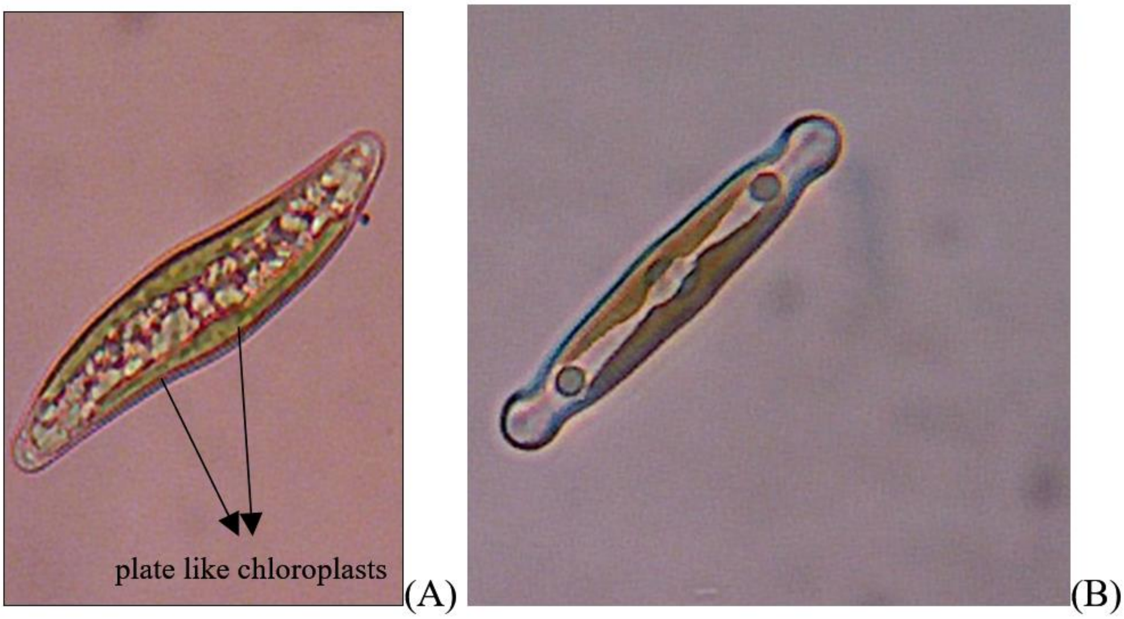

Figure 1. Two diatom species (A) Gyrosigma attenuate microscopic, with the plate-like chloroplasts, the prominent role for photosynthesis; (B) Pinnularia gibba microscopic, which have a specific function for nitrogen fixation. 400× zoom using a binocular light microscope. Documentation by (R. R. Al Hakim, 2019)**.**

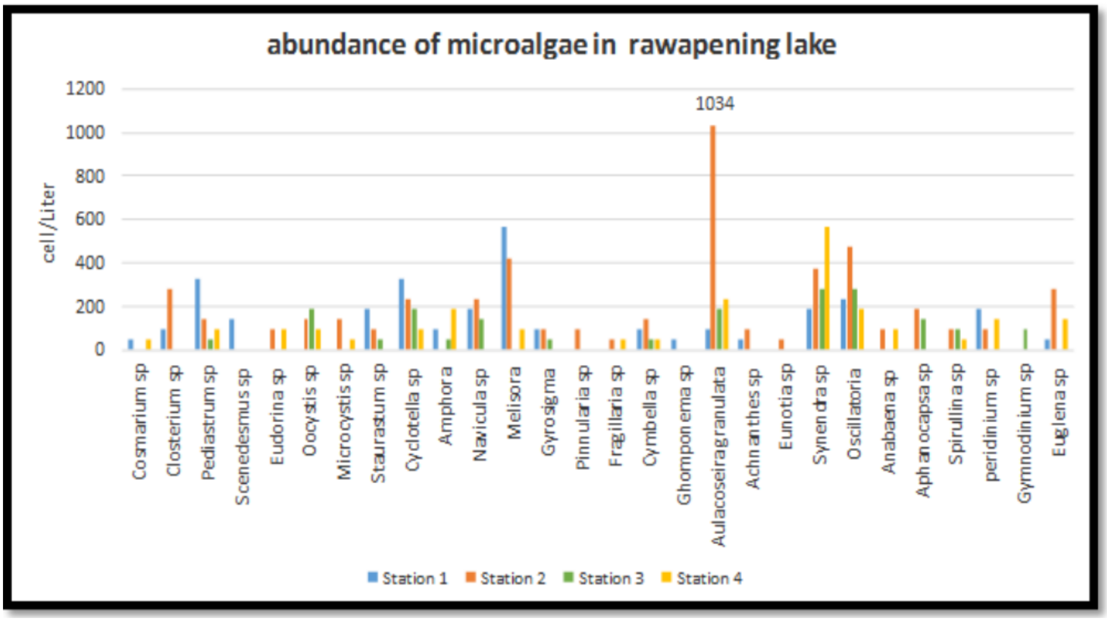

Figure 2. The abundance rate of microphyte diversity in RL (Source: (Hariyati & Putro, 2019)**).**

For this reason, all microphytes need to preserve and maintain ecological factors (Flitcroft et al., 2019; Hariyati & Putro, 2018). If any aquatic sites can constantly be monitored in actual time, and all stakeholders prove that they can protect, support, and conserve the aquatic biota, we can reach the goal of SDGs 2030 (Azmanajaya et al., 2020). The summary of species biodiversity in Wadaslintang Reservoir (WR) and Umbul Kemanten-Klaten (UKK) can be seen in Table 1.

Tabel 1. The total number of microalgae was summarized in WR and UKK.

Division	Total Species Found (∑) in WR	Total Species Found (∑) in UKK
Diatom	14	9
Cyanophytes	6	2
Euglenozoa	3	0
Chlorophytes	18	8
Charophytes	6	0
Miozoa	7	0
Conjugates	0	6
Flagellates	0	2

Source: Technical notes in Dec 2019 (R. R. Al Hakim, 2019) **and** (Akbar & Roziaty, 2018).

We know the energy crisis is in sight (Abd Wahid et al., 2016). So, the effort to overcome the energy crisis is to switch to renewable energy (R. Al Hakim & Juandry, 2022; R. R. Al Hakim et al., 2022). The recent renewable energy from natural green energy development (bioenergy) includes biofuel and biomass, bioethanol, and biodiesel (R. R. Al Hakim, 2020; R. R. Al Hakim, Arief, et al., 2021). Microphytes and algae are primary materials for biofuel and biomass (Christwardana et al., 2020; Wiranata et al., 2018). Sustainable energy is one of the most critical topics for achieving SDGs (Chirambo, 2018; Nurunnabi et al., 2020a, 2020b). Biodiesel from microalgae weighing 3.7 Kg dry weight can produce 1 liter of biodiesel (R. R. Al Hakim, 2020; Anggraini et al., 2018). Alternative (sustainable) energy to reduce the use of oil is used chiefly for the transportation and industrial sectors. The Indonesian government accelerates the utilization of the potential of bioethanol and biodiesel as a substitute for diesel and gasoline for transportation, industry, commercial, and power generation (R. R. Al Hakim, 2020; Kholiq, 2015; Sihombing & Susila, 2016). Reflecting on the efforts of the Indonesian government in optimizing the potential for green energy from bioenergy (Veza et al., 2021), this can be a bright spot for the unsustainable oil crisis. The actions of countries in the world in transitioning from non-renewable energy to renewable energy should be appreciated because they have supported energy and environmental sustainability. Public awareness to pay more attention to the future of new and green energy is needed to utilize the possibility used on a small scale so that awareness will be fostered to defend the environs, contribute to continuous development, as well as promote national emergency response exercises (R. R. Al Hakim, 2020).

In addition, however, the role of biology (living things) that have the ability to photosynthesis can function in the storage of green energy, mainly solar energy (Salimijazi et al., 2019), one of the biological taxa is microphytes that can store solar energy. Mineral oil has been utilized in electric power systems for transformer oil for several decades. However, mineral oil has been shown to have flaws connected to its usage in the electric power system, which might pose environmental issues if an accident happens, such as an oil spill or transformer explosion; this is due to the nature of mineral oil's non-biodegradable and flammable. An alternative hydrocarbon oil with environment-friendly qualities and good electrical and chemical properties has been studied as a viable substance to replace for-sale oil. The role of biodegradable living things is essential in this case (Arief et al., 2021). Recent research into the role of biological things for food–energy–water–CO_2 nexus across metal-coupled systems (Xu et al., 2020), this prospect is outstanding to support SDGs 2030 if further researched and put into practice. In terms of environmental sustainability, it will impact nutritional safety and health risks (Damerau et al., 2020). The most important thing for this statement is the role of natural resources, including land and freshwater. We know microphytes also have an aquatic habitat, such as freshwater.

CONCLUSION AND RECOMMENDATION

Microphytes have an essential role in biodiversity and environmental sustainability. Its ability in photosynthesis and the binding of micro-molecular elements is crucial in aquatic ecosystems. Based on three difference aquatic habitats in Central Java Province-Indonesia (WR, UKK, RL), freshwater has excellent potential to support SDGs 2030, such as microphytes as aquatic biota. In addition to macro-biodiversity conservation efforts, it is also essential to obey micro-biodiversity maintenance or sustainability efforts because they have a central role in many sustainable things. This short communication study is expected to be the basis for conservation efforts for micro-biodiversity or aquatic environment biodiversity. Because of the limited study, we look forward to any feedback on this brief study.

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