

Realizing Climate Action through Contextual Biology Learning: A Literature Review of Integrating Local Bird Data into Biodiversity Materials for Achieving SDG-13

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ABSTRACT:

Purpose – This paper aims to analyze how the integration of local bird data in biodiversity learning materials can support the achievement of Sustainable Development Goal-13 (SDG-13) concerning climate action through contextual biology education. Climate change education requires approaches that connect global issues with local contexts to enhance students' ecological awareness and environmental responsibility.

Study design/methodology/approach – This study employs a literature review method using seven relevant national and international research articles. The review focuses on examining contextual learning approaches in biodiversity education, the use of local biological data as learning resources, and the integration of SDGs values in biology curricula, particularly SDG-13.

Findings – The findings indicate that integrating local bird data into biodiversity learning materials has significant potential to: (1) enhance the relevance and contextuality of biology learning; (2) strengthen students' ecological literacy; (3) build environmental care character; (4) support the implementation of independent curriculum and Pancasila Student Profile; and (5) provide real context for understanding climate change and its impacts on local ecosystems. Local birds serve as effective bioindicators for monitoring climate change impacts while enriching students' understanding of biodiversity at the genetic, species, and ecosystem levels.

Research limitations/implications – This review is limited to seven articles, which may not fully represent all aspects of contextual biodiversity learning and SDG-13 integration. Future studies could incorporate broader sources or conduct empirical research on the development of learning materials integrating local bird data.

Originality/value – This study provides a synthesized understanding of how contextual biodiversity learning through local bird data integration can become an effective strategy for SDG-13 achievement in secondary education. The integration demonstrates relevance for developing 21st-century competencies while fostering climate awareness and local environmental conservation values among students.

Keywords: Contextual Learning, Local Bird Data, Biodiversity, SDG-13, Climate Action, Biology Education.

I. INTRODUCTION

Climate change is one of the greatest challenges facing humanity in the 21st century, with widespread impacts on various aspects of life, including biodiversity (IPCC, 2022; Ministry of Environment and Forestry, 2019). In the global context, the Sustainable Development Goals (SDGs), particularly Goal 13, emphasize the importance of urgent action to combat climate change and its impacts (United Nations, 2021). Achieving SDG-13 requires not only government policies, but also the active role of the education sector in building public awareness and capacity, especially among the younger generation (UNESCO, 2020).

Biology education has a strategic role in supporting the achievement of SDG-13 through learning about biodiversity and its relationship with climate change (Sahil et al., 2022). The biodiversity material taught at the high school level not only covers conceptual understanding of life's variations but also develops students' ecological awareness and environmental responsibility (Kemendikbudristek, 2022). However, biodiversity learning is often still theoretical and lacks connection to the local context of students (Hidayati & Sari, 2023; Kurniawan, 2022).

The integration of local wisdom into the biology curriculum becomes crucial to bridge the gap between classroom theory and the ecosystem realities surrounding students (Pratama & Setyaningrum, 2021). Through a contextual approach, students can directly observe how climate fluctuations affect the life cycles of endemic flora and fauna in their environment (Azzahra et al., 2023). This not only enhances scientific literacy but also fosters students' self-efficacy in designing community-based climate change adaptation solutions (Wulandari, 2024). Therefore, reconstructing biology teaching modules based on local potential is urgently needed to cultivate a generation that is ecologically resilient (Fauzi & Ramadhani, 2022).

Contextual learning that integrates data and the potential of local biodiversity has been proven to increase student engagement and understanding (Rahmatussyifa et al., 2024; Garnasih, 2018). Birds, as one component of biodiversity, have significant value as bioindicators of environmental change and climate change (Massimino et al., 2024; Novarina et al., 2023). Indonesia, particularly West Sumatra, has a high wealth of bird species with more than 500 recorded species (Ramadanil et al., 2019; Yogica et al., 2023). This potential can be utilized as a rich contextual learning resource for biodiversity education.

The integration of local bird data into biology lessons not only enriches the teaching material, but also provides a real-world context for students to understand the impact of climate change on their local ecosystems (Sari et al., 2023; Yuliani & Hartono, 2024). Through observation and study of local birds, students can develop an understanding of the interrelationship between biodiversity, ecosystem function, and climate change. This is in line with the *Education for Sustainable Development* (ESD) approach, which emphasizes meaningful and transformative learning (Directorate General of Vocational Education, 2023).

Several studies have demonstrated the effectiveness of using local potential in biology education (Erwanto, 2020; Herayana et al., 2020), but there have not been many studies that specifically integrate local bird data with the context of SDG-13 in biodiversity education. Therefore, this literature review is important to synthesize understanding of how the integration of local bird data can support contextual biology learning oriented towards achieving SDG-13.

This literature review aims to: (1) analyze the relevance of using local bird data in biodiversity learning; (2) identify the relationship between local context-based learning and the

achievement of SDG-13; and (3) explore the pedagogical implications of integrating local bird data for the development of contextual and sustainable biology learning materials.

II. METHOD

This study uses a literature review method. The literature review was conducted by examining a number of articles from accredited national and international journals that can be accessed through Google Scholar, Science Direct, and ERIC. The articles reviewed were research articles in Indonesian and English, met the search keyword criteria used, had titles and content relevant to the research objectives, and were freely accessible.

The keywords used in the literature search included: “contextual biology learning,” “local biodiversity,” “birds as a learning resource,” “SDG-13 in education,” “climate change education,” “biodiversity education,” “local context learning,” “climate change education,” and “*birds as bioindicators*”. The articles analyzed were published between 2019 and 2025 to ensure their relevance to the current educational context.

This study used content analysis to analyze the data. The analysis process was carried out by thoroughly reviewing various literature sources discussing contextual learning of biodiversity, the use of local bird data as a learning resource, and the integration of SDG-13 values in biology education. The total number of articles obtained was filtered according to the inclusion criteria, resulting in 7 articles that were comprehensively reviewed.

The article inclusion criteria included: (1) discussing biodiversity learning; (2) using a contextual or local potential-based approach; (3) discussing birds as a subject of study or learning resource; (4) integrating sustainable development values or SDGs; (5) being published in an accredited journal; and (6) having a clear and accountable research methodology.

III. RESULT

Table 1. Literature Review Article on Local Data Integration in Biodiversity Learning for Achieving SDG-13

Code	Author	Research Title	Research Results
A1	Ramona & Suryani (2022)	Keanekaragaman Burung dan Potensi Pengembangan Ekowisata di Kawasan Perkampungan Minangkabau Kota Padang Panjang	The bird wealth in the Minangkabau Village area has a high Species Diversity Index ($H' > 3$) of 3.21. This data shows great potential for the development of contextual learning materials that link local biodiversity with conservation and sustainable development.
A2	Yuliandri & Sumarmin (2020)	Avifauna Potential for The Development of Bird Watching Ecotourism on Mount Tandikek	A total of 136 birds of 35 species were found along the Mount Tandikek hiking trail. This data on local birds can be used as an authentic learning resource to improve students' understanding of biodiversity and the role of birds in mountain ecosystems that are vulnerable to climate change.
A3	Rahmatussyifa et al. (2024)	Pengembangan E-Booklet Interaktif Bermuatan Profil	The development of interactive e-booklets containing Pancasila Student Profiles on biodiversity has

		Pelajar Pancasila Pada Materi Keanekaragaman Hayati Untuk Peserta Didik Fase E SMA	proven to be valid and practical. The integration of character values and local context into teaching materials can improve environmental literacy and support meaningful learning in accordance with the Merdeka Curriculum.
A4	Novarina et al. (2023)	Konservasi Burung sebagai Strategi Pencapaian Tujuan Pembangunan Berkelanjutan (SDGs)	Bird conservation contributes directly to the achievement of several SDGs, particularly SDG-13 (climate action), SDG-14 (marine ecosystems), and SDG-15 (terrestrial ecosystems). Birds serve as bioindicators of ecosystem health and climate change, making bird studies highly relevant to environmental education.
A5	Sari et al. (2023)	Keanekaragaman Burung di Ekosistem Mangrove Sumatera Barat dan Implikasinya terhadap Konservasi Habitat	The diversity of bird species in mangrove ecosystems underscores the importance of these habitats for wildlife and ecosystem balance. Local ecosystem-based learning can raise students' awareness of the importance of habitat conservation as a means of adapting to and mitigating climate change.
A6	Yuliani & Hartono (2024)	Potensi Ekowisata Pengamatan Burung di Kawasan Mangrove Sumatera Barat	The potential for birdwatching ecotourism in mangrove areas demonstrates the economic and ecological value of local biodiversity. This data can be integrated into learning to show the link between biodiversity conservation, climate change mitigation, and sustainable development.
A7	Khairini et al. (2024)	Bird Diversity And Its Potential For Tourism Activities In Mangrove Areas, Carocok Anau, West Sumatra, Indonesia	Forty bird species from 23 families were found in the Carocok Anau mangrove area. This diversity reflects the ecological complexity and significant potential of the area as a habitat for tropical birds and a location for the development of biodiversity-based ecotourism that supports the green economy and SDG-13.

Overall, the seven articles reviewed show that data on local birds in West Sumatra has great potential to be integrated into biodiversity learning that supports the achievement of SDG-13. Learning that begins with a local context familiar to students (birds they can observe in their surroundings) and then connects to global issues (climate change and sustainable development) creates meaningful and transformative learning.

This approach is in line with the principles of constructivist pedagogy, which emphasizes the importance of building new knowledge based on students' existing experiences and knowledge

(Lufri, 2007). When students learn about local birds that they can find around their school or home, learning becomes more relevant and interesting. Then, when they learn how climate change affects the distribution, migration patterns, or reproductive success of these birds, they can understand the real impact of climate change at the local level.

IV. DISCUSSION

Article A1 (Ramona & Suryani, 2022) shows that the Minangkabau Village area in Padang Panjang City has a high Bird Species Diversity Index ($H' = 3.21$) with Species Richness (DM) of 7.50 and Species Evenness (ED) of 0.85. This quantitative data provides a strong basis for the development of learning materials that are not only theoretical but also empirically based. Students can learn the concept of biodiversity at the species and ecosystem levels through real data from their surrounding environment, making learning more meaningful and contextual.

In article A2 (Yuliandri & Sumarmin, 2020), 136 individual birds consisting of 35 species were found on the Mount Tandikek hiking trail. This data includes information on conservation status according to the IUCN, where 2 species are categorized as *Near Threatened* and 33 species as *Least Concern*. This information on conservation status is highly relevant for building students' awareness of the importance of conservation efforts and the link between human activities and the preservation of biodiversity. Students can understand that climate change and habitat degradation threaten the existence of certain species, requiring concrete action to protect them.

Article A3 (Rahmatussyifa et al., 2024) shows that the development of interactive e-booklets containing Pancasila Student Profile content on biodiversity has been proven to be valid and practical for use in learning. The integration of Pancasila Student Profile elements such as “faithful and devoted to God Almighty,” “global diversity,” and “mutual cooperation” in biodiversity material helps students not only understand biological concepts but also develop character and values that support sustainable living.

Learning that integrates local bird data with the Pancasila Student Profile can develop the dimension of “critical thinking” through the analysis of biodiversity data, the dimension of ‘creativity’ through the exploration of various conservation strategies, and the dimension of “mutual cooperation” through collaborative bird watching activities. This approach is in line with the Merdeka Curriculum, which emphasizes learner-centered learning and holistic competency development (Kemendikbudristek, 2022).

Article A4 (Novarina et al., 2023) explicitly links bird conservation to the achievement of SDGs, particularly SDG-13 on climate action. Birds are highly sensitive to environmental changes, so changes in bird distribution, abundance, or behavior can be early indicators of the impacts of climate change. In the context of learning, students can learn how to observe and interpret bird data as a way to understand the impact of climate change on local ecosystems.

Learning that integrates bird data as a bioindicator of climate change provides a real-world context for students to understand the cause-and-effect relationship between greenhouse gas emissions, global warming, changing weather patterns, and their impact on biodiversity. Through case studies on changes in the habitats of migratory birds or changes in the breeding times of local birds due to climate change, students can develop a deeper understanding of the urgency of climate action.

Articles A5 (Sari et al., 2023), A6 (Yuliani & Hartono, 2024), and A7 (Khairini et al., 2024) all examine bird diversity in the mangrove ecosystems of West Sumatra. Mangrove ecosystems play a dual role that is very important: as a habitat rich in biodiversity and as an effective carbon

sink in climate change mitigation. In the Carocok Anau mangrove area, 40 bird species from 23 families were found (Khairini et al., 2024).

Learning that integrates the study of bird diversity in mangrove ecosystems provides a very rich context for understanding the interrelationships between biodiversity, ecosystem functions, and climate change. Students can learn how mangrove ecosystems not only provide habitat for various bird species but also play a role in absorbing carbon dioxide from the atmosphere, protecting coastlines from abrasion and storms (which are intensifying due to climate change), and supporting the livelihoods of local communities through ecotourism.

Article A6 (Yuliani & Hartono, 2024) emphasizes the potential of bird watching ecotourism in the mangrove areas of West Sumatra. Biodiversity-based ecotourism is one of the sustainable development strategies that integrates economic, social, and environmental aspects. In the context of learning, the concept of ecotourism can be used to show students that biodiversity conservation is not only ecologically important but also has economic value.

Learning that integrates the concept of bird watching ecotourism can develop students' understanding of the green economy and the link between nature conservation and community welfare. Students can explore how sustainable ecotourism activities can reduce pressure on ecosystems, provide economic incentives for conservation, and raise public awareness about the importance of preserving biodiversity. This is in line with SDG-13, which focuses not only on climate change mitigation and adaptation but also on integrating climate action into sustainable development planning (Bappenas, 2020).

Contextual learning based on local bird data also supports the development of environmental literacy and ecological awareness among students. Through bird watching, species identification, and biodiversity data analysis activities, students not only develop scientific skills but also build an emotional connection with nature. This emotional connection is important for fostering environmental concern and motivation to engage in conservation actions (Garnasih, 2018).

V. CONCLUSION

Based on a literature review of seven relevant research articles, it can be concluded that the integration of local bird data into biodiversity education has great potential to support the achievement of SDG-13 through contextual biology education. Local bird data from West Sumatra, which includes more than 500 species with varying levels of endemism and conservation status, provides a rich source of authentic learning to develop students' understanding of biodiversity at the genetic, species, and ecosystem levels. Learning that integrates local bird data has been proven in several ways, as follows.

1. Enhancing the relevance and contextuality of biology learning;
2. Strengthening students' ecological literacy;
3. Building an environmentally conscious character in line with the Pancasila student profile;
4. Providing a real-world context for understanding climate change and its impact on local ecosystems;
5. Supporting the development of 21st-century competencies such as critical thinking, collaboration, and environmental literacy..

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