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Development of Biodiversity Booklet in Demak Regency as a Supplement of Teaching Material

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Abstract

Biology is a subject that is closely related to living things and their environment. Biology learning especially on biodiversity material, must be relevant to the lives of students, therefore it is needed to develop teaching materials based on the local potential to maximize learning processes and learning outcomes. This research aims to analyze biodiversity in Demak Regency, analyze feasibility and readability, and measure the increase of student learning outcomes when using biodiversity booklet in Demak Regency as a supplement of teaching material. This research was conducted at SMA Negeri 3 Demak in the odd semester of 2022/2023. The research uses Research and Development (RnD) type. To analyze the increase in cognitive learning outcomes using the One-Group-Pretest-Posttest-Design, to analyze psychomotor and affective learning outcomes using the One-Shot Case Study. The subjects to collect readability data are 15 students of class X-10 taken by purposive sampling technique and the subjects to collect learning outcomes data are students of class X-8. The results showed that gene-level diversity was found in water apple or *Syzygium aqueum* (Burm. f.) Alston and starfruit or *Averrhoa carambola* L. varieties, species diversity of mangrove that was found are 20 mangrove species, and have been found 9 types of ecosystem-level diversity. Booklet validity based on material expert's judgment was 83,33%, 85,42% from media experts, and 88,88% from biology teacher, with "very feasible" category. The readability booklet by students got a percentage of 98,21% with "very good" criteria. The result of cognitive learning outcomes shows that the classical completeness reached 100% and based on the N-gain test, 94,44% of students got "medium to high" criteria. Psychomotor learning outcomes were obtained from exploration activities, 88,89% of students got "good to excellent" criteria and 11,11% of students got "sufficient" criteria. Affective learning outcomes were obtained from a questionnaire of conservation attitudes, 36,11% of students got "good to excellent" criteria, 47,22% of students got "sufficient" criteria, and 16,67% of students got "poor" criteria. The conclusion of this research is the development of biodiversity booklet in Demak Regency as a supplement of teaching materials is proven to be feasible to use, well readable, and effective to increase learning outcomes of students in class X Senior High School on biodiversity material.

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INTRODUCTION

Biology is a branch of science that studies living things and their environment (Pantiwati, 2016). One of the materials contained in biology subjects is biodiversity. On Merdeka Curriculum, biodiversity material is taught in class X in odd semesters. This material is one of the materials contained in phase E. Learning in the Merdeka Curriculum requires the active role of teachers and students, as well as appropriate learning resources so that learning outcomes are fulfilled. Learning resources originating from local issues have not been widely applied to formal learning environments (Opel & Bogner, 2020). The dominance of biology teachers at the senior high school level only uses ordinary biology textbooks. Based on the results of interviews with biology subject teachers at SMA Negeri 3 Demak, learning biology at school only use learning resources that are limited to worksheets and textbooks provided by the school.

The use of learning resources that are only focused on LKS and package book that are only provided by schools indicates that the method of introducing and applying the knowledge is not compatible. This is because the acquisition of knowledge is not connected with the reality around students so students are less able to form an understanding content of learning biology (Lancor, 2015). The limited learning resources cause students to be prone to misconceptions (Soeharto & Csapo, 2021). The learning process of students that take place is not maximal and impacts on low student learning outcomes. Learning outcomes cannot be separated from the world of education. Attaining a level of success in the world of education is centered on student learning outcomes because it relates to issues such as student competency skills as well as improving students' abilities and sustainable mindsets (Goss, 2022).

Indonesia is one of the centers of biodiversity in the world known as a mega-biodiversity country (Dwivany *et al.*, 2016). Based on the Directorate of Biodiversity Conservation Strategic Plan for 2020-2024, the strategic goal to be achieved by the Directorate of Biodiversity Conservation is for biodiversity to be maintained and protected and utilized to support the improvement of community welfare and the quality of human life. In this regard, it is highly recommended that the biodiversity in Indonesia be utilized in all fields, one of which is for the world of education, namely as a source of learning in schools.

As an effort to overcome the problem of the lack of biology learning resources that contain local potential and learning processes that are less than optimal, it can be overcome by developing supplements of teaching material based on potential of the area being explored to be used as a complement to existing biodiversity material learning resources. Demak Regency has an area of 89,743 Ha. Demak Regency is one of the regions in Indonesia which is located in a coastal area (Akbaruddin *et al.*, 2020) besides the coastal area, Demak also has areas in the form of paddy fields, gardens, buildings or settlements, and ponds. Therefore, Demak Regency is a potential place for learning about biodiversity.

According to Budiyono (2020), learning resources and learning media that concretely make use of the environment can implement learning more effectively and efficiently so that it can optimize students' understanding. Booklets can be used as an alternative learning resource, namely as a supplement to teaching materials, the content contained in booklets can support or complement material from existing teaching materials. Booklets have a simple, attractive form, use lots of pictures, and provide accurate data so that they can help students to understand material concepts (Imtihana *et al.,* 2014), with these characteristics booklets are deemed suitable for use in learning activities on biodiversity material. The purpose of this research was to analyze biodiversity in Demak Regency, analyze feasibility and readability, and measure the increase of student learning outcomes when using biodiversity booklet in Demak Regency as a supplement of teaching material.

Based on the background description that has been presented, it is hoped that by using the biodiversity booklet in Demak Regency as a supplement to teaching materials in learning activities, students can gain concrete knowledge about biodiversity. Thus, students better understand biodiversity material based on facts in the surrounding environment, so there is an increase in learning outcomes in achieving phase E of the Merdeka Curriculum, especially on biodiversity material.

RESEARCH METHOD

This research is an R&D (Research and Development) adaptation of Sugiyono (2016). The research procedure includes eight steps are; identification of potentials and problems, data collection, product design, design validation, design revision, small-scale testing, product revision, and large-scale testing. The research was conducted at SMA Negeri 3 Demak in the odd semester of 2022/2023. Subjects used in this study included material experts, media experts, and biology teachers to get booklet feasibility assessment, students in class X-10 with a total of 15 students to obtain a booklet readability assessment. Sampling is done by purposive sampling technique. The research data is in the form of a student readability questionnaire. Subjects for obtaining data on learning outcomes were students in class X-8 with a total of 36 students. Increase in learning outcomes was tested using the one-group-pretest-posttest-design method to measure cognitive ability and the one-shot-case-study method to measure psychomotor and affective abilities.

Data collection methods that are used are interviews, exploration, documentation, questionnaires, and tests. Identification of potentials and problems is obtained from the results of interviews with biology teachers who were analyzed descriptively, biodiversity in Demak Regency was identified utilizing exploration, the feasibility of the booklet was analyzed descriptively quantitatively, the readability of the booklet is analyzed at small-scale product trials which was analyzed descriptively quantitatively. Cognitive learning outcomes are obtained by providing pretest, posttest, and exploratory sheets whose results are analyzed descriptively quantitatively using the classical completeness percentage and N-gain formula. Psychomotor learning outcomes are obtained from the results of researchers' observations of students' psychomotor abilities using non-test instruments in the form of students' psychomotor assessment sheets, while affective learning outcomes were obtained by providing a conservation attitude assessment questionnaire.

RESULT AND DISCUSSION

Biodiversity in Demak Regency

In making the booklet, the results of research on biodiversity in Demak Regency were used to support material on biodiversity in general. The results of the exploration of biodiversity in Demak Regency covering three levels, there is the gene, species, and ecosystem level, have been found for each level. Gene-level diversity found in Demak Regency was in varieties of water apple (*Syzygium aqueum* (Burm. f.) Alston) and star fruit (*Averrhoa carambola* L.) (Table 1). *Syzygium aqueum* (Burm. f.) Alston and *Averrhoa carambola* L. is very suitable for planting in Demak Regency because of the suitability of the climate, topography, and chemical properties of the soil in Demak which makes these plants produce well. Demak Regency is known as a center for producing water apple and star fruit so they are mainstay fruit commodities or become a trademark of Demak Regency. Many people think that water apple and starfruit in Demak have different taste characteristics from others (Setiarini, 2015; Sari, 2018).

Based on research by Kardoyo & Nurkhin (2016), the origin of the very rapid cultivation of *Syzygium aqueum* (Burm. f.) Alston in Demak was pioneered by one of the farmers in Demak in the 1990s by developing seeds that were planted based on knowledge and skills cultivating from their creations. The development of this knowledge was then shared with the surrounding community so that many people cultivated *Syzygium aqueum* (Burm. f.) Alston. Meanwhile, *Averrhoa carambola* L. has been a favorite plant and fruit grown in Demak since the glory of the Demak Bintoro Kingdom. The expansion of the cultivation of these two plants is carried out by farmers utilizing seedlings and grafting.

Table 1 Gene Level Diversity in Demak Regency

No	Finding	Location
1	*Syzygium aqueum* var. *delima*	Found in every district in Demak
	Syzygium aqueum var. *citra*	Found in every district in Demak
	Syzygium aqueum var. deli hijau	Guntur district
	Syzygium aqueum var. cincalo hijau	Demak dan Karangtengah districts
	Syzygium aqueum var. pink rose	Guntur district
2	*Averrhoa carambola* var. *demak kapur*	Demak district
	Averrhoa carambola var. *demak kunir*	Demak district
	Averrhoa carambola var. *demak jingga*	Demak district
	Averrhoa carambola var. *madu*	Demak district

The species-level biodiversity that was found in Demak Regency is mangroves. The results of the identification of mangroves include 3 districts; Bonang, Karangtengah, and Sayung Districts. The identification results recorded 12 true mangrove species consisting of 5 families and 8 associated mangrove species consisting of 7 families (Table 2).

Tabel 2 Mangrove Species Diversity in Demak Regency

No	Name of Species	Family	Type	Location		
				Bonang	Karangtengah	Sayung
1	*Acanthus ebracteatus*	Acanthaceae	True mangroves	√	√	√
2	*Acanthus illicifolius*	Acanthaceae	True mangroves	√	√	√
3	*Exoecaria agallocha*	Euphorbiaceae	True mangroves	√	√	√
4	*Avicennia alba*	Avicenniaceae	True mangroves	√	-	-
5	*Avicennia marina*	Avicenniaceae	True mangroves	√	√	√
6	*Avicennia officinalis*	Avicenniaceae	True mangroves	-	-	√
7	*Sonneratia alba*	Sonneratiaceae	True mangroves	√	-	-
8	*Sonneratia caseolaris*	Sonneratiaceae	True mangroves	√	-	-
9	*Rhizophora mucronata*	Rhizoporaceae	True mangroves	√	√	√
10	*Rhizophora stylosa*	Rhizoporaceae	True mangroves	-	√	-
11	*Bruguiera cylindrica*	Rhizoporaceae	True mangroves	-	√	-
12	*Bruguiera gymnorrhiza*	Rhizoporaceae	True mangroves	√	-	-
13	*Calotropis gigantea*	Asclepiadaceae	Mangrove Associates	√	√	√
14	*Casuarina equisetifolia*	Casuarinaceae	Mangrove Associates	-	-	√
15	*Fimbristylis polytrichoides*	Cyperaceae	Mangrove Associates	√	√	√
16	*Scirpus littoralis*	Cyperaceae	Mangrove Associates	√	-	-
17	*Pluchea indica*	Asteraceae	Mangrove Associates	-	√	-
18	*Ipomoea pes-caprae*	Convolvulaceae	Mangrove Associates	√	-	-
19	*Hibiscus tiliaceus*	Malvaceae	Mangrove Associates	√	√	√
20	*Sesuvium portulacastrum*	Aizoaceae	Mangrove Associates	√	-	-

The richness of mangrove species in Demak Regency consists of Bonang, Karangtengah, and Sayung districts consecutive from highest to lowest are; Bonang district with 15 mangrove species, Karangtengah district with 11 mangrove species, and Sayung district with ten mangrove species (Figure 1).

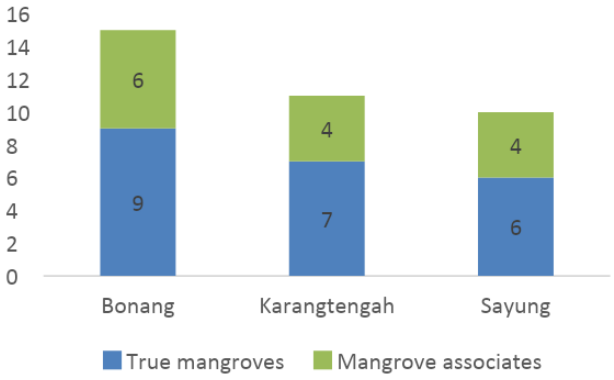


Figure 1 Number of Mangrove Types Found in Each District

There are 9 types of ecosystem-level biodiversity found in Demak Regency, there is marine ecosystems, mangrove ecosystems, coastal ecosystems, and artificial ecosystems consisting of dam ecosystems, teak forests, gardens, rice fields, ponds, and river ecosystems. Marine and pond ecosystems in Demak Regency are found in 4 districts, there is Bonang, Wedung, Karangtengah, and Sayung districts. Mangrove ecosystems are found in 3 districts, there is Bonang, Karangtengah, and Sayung districts. The teak forest ecosystem in Demak is found in Jragung village, Karangawen district, namely "Jati Park". The garden ecosystem in Demak Regency is dominated by water apple, star fruit, banana, mango, and tobacco gardens. The paddy field ecosystem is spread evenly in all districts in Demak, most of the Demak Regency area is rice fields which have an area of 51,799 ha from the total area of Demak Regency which is 89,743 ha. Rice fields have a percentage of 57,72% from the total area of Demak Regency (BPS, 2021). The dam ecosystem in

Demak can be found in Jragung village, Karangawen district, and in Wilalung village, Gajah district. Many areas in Demak Regency are traversed by rivers. Demak is included in the Pantura area which has many rivers, several major rivers in Demak Regency, including the Buyaran, Tuntang, Wulan, and Jajar rivers.

Feasibility of Biodiversity Booklet in Demak Regency

The development of biodiversity booklet in Demak Regency as a supplement of teaching materials has the concept of combining basic biodiversity material with research results in the form of biodiversity at the gene, species, and ecosystem levels in Demak Regency. The booklet contains a cover (Figure 2), preface, table of contents, instructions for use, learning purpose, concept map, general description of the research location, there is Demak Regency, the material on biodiversity, summary, glossary, bibliography, and author's biodata. The sub-material in the booklet consists of 5 units, starting from the definition and level of biodiversity which also includes research results, biodiversity in Indonesia, benefits, threats of extinction, and efforts to preserve biodiversity.

Figure 2 Front and Back Cover Design of the Booklet

The biodiversity booklet in Demak Regency that was developed was assessed for its feasibility by 3 validators, there is material expert, media expert, and biology teacher. The results of the material expert validation for the material biodiversity booklet in Demak Regency as a whole obtained an average of 83,33% in the very feasible category, the validation results from media experts were 85,42% in the very feasible category, and biology teachers were 88,88% with very decent category. Analysis of the final feasibility results of the booklet by material experts, media experts, and biology teachers is presented in Table 3 below.

Table 3 Final Result Analysis of Booklet Feasibility

Validator	Assessed Components	Percentage (%)	Feasibility Category
Material Expert	Knowledge Dimension	75	Feasible
	Language	100	Very feasible
	Presentation Technique	75	Feasible
	Presentation Equipment	75	Feasible
	Average	83.33	Very feasible
Media Expert	Booklet Size	75	Feasible
	Cover Design	95	Very feasible
	Booklet Content Design	79.16	Feasible
	Average	85.42	Very feasible
Biology Teacher	Graphics	83.33	Very feasible
	Material	91.67	Very feasible
	Language	91.67	Very feasible
	Average	88.88	Very feasible

The developed biodiversity booklet in Demak Regency can be said to be suitable for use in the teaching and learning process in the classroom if it meets the feasibility percentage based on the results of expert assessment and all experts who assess the product declare it feasible. The results of all validators showed that the developed booklet met the feasibility percentage, there is > 62,50%, and was categorized as very feasible to use as a supplement of teaching material on biodiversity.

In the material feasibility component, the material is completely presented, by the learning objectives, and systematically arranged, there is coherently starting from easy to difficult material. Teaching materials that are arranged systematically make it easy for students to learn and enjoy participating in learning (Apriyeni *et al.*, 2021). In the media feasibility component, the booklet has an attractive appearance with lots of pictures that can make students focus on understanding the contents of the booklet. The language feasibility component is declared feasible because the booklet uses language that is communicative, effective, by Indonesian language rules, follows the cognitive development of students, and can motivate. The booklet presents motivational sentences from famous figures which are found at the beginning of each material unit. According to Khoirotunnisa *et al.* (2018), the use of motivational sentences in teaching materials increases the enthusiasm of students to study the following pages to completion, so can maximize students' knowledge acquisition.

Based on suggestions from material expert validators and biology teachers regarding the material for biodiversity booklet in Demak Regency, need to provide affirmation of learning purpose in the prefix part of the material unit. Learning purposes that were originally made into separate pages are included at the beginning of each material unit. Besides that, the research material was made into a separate material unit to make it easier for students to understand it. Meanwhile, suggestions from the media expert validator included forewords being replaced with prefaces, concept maps being replaced with material maps, the narration in the booklet being more concise, and focusing more on research results.

Readibility of Biodiversity Booklet in Demak Regency

Small-scale product trials were carried out at SMA Negeri 3 Demak by distributing readability test questionnaires. The subjects needed to fill out the readability test questionnaire were students of class X with a total of 15 students from class X-10. The results of the students' readability questionnaire obtained an average percentage of 98.21% with very good criteria. Students get convenience in studying biodiversity material with the booklet developed by researchers. Based on the percentage results and students' positive responses, shows that the booklet developed by researcher can be used at the trial stage of large-scale use. This is supported by research from Khotim *et al.* (2015), that if in small-scale trials have results with good to very good criteria and received positive responses from students, the product can be used in the next stage, there are large-scale trials.

Student Learning Outcomes

Booklet that has been developed is tested to measure student learning outcomes. In the cognitive domain, it was tested using pretest and posttest questions, each consisting of 25 multiple-choice items, and exploratory sheets. After getting the results of the students' pretest, posttest, and exploration scores, then the percentage of classical completeness and the N-Gain were analyzed with Microsoft Excel 2013 application.

Calculation of the final score for the classical completeness data is obtained from the posttest scores and the average value of the exploration sheet work. On average, it was found that 36 students completed with a score of ≥ 75, so the percentage of classical completeness of the student's learning outcomes was 100%. This indicates that the developed booklet meets the classical completeness indicators, there was ≥ 75% of the number of students in the class so it can be said that the use of booklet can have a positive impact on student learning outcomes. Based on the results of the analysis and calculations with the N-Gain, the average N-Gain is 0.71 in the high category. The results of the percentage of students' N-Gain scores are presented in Figure 3 below.

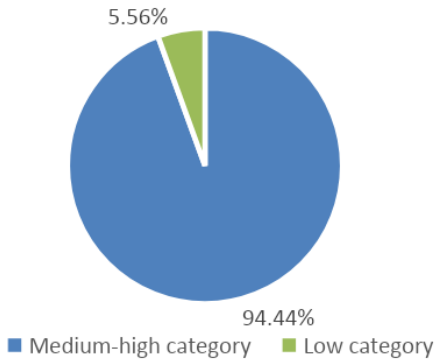


Figure 3 Percentage of N-gain Score

According to Destiara (2020), students who have N-Gain scores in the medium to high category after learning by using products developed, show an excellent increase in understanding of concepts. Based on the research results, the percentage of students with medium to high N-Gain scores was 94,44%, while the percentage of students with low N-Gain scores was 5,56% as shown in Figure 3. This proves that the ability of students in the cognitive domain has increased, there is a percentage of students who get an N-Gain score of medium to high criteria ≥ 75%. Thus, students have fulfilled the learning outcomes of the phase E Merdeka Curriculum, understanding biology elements, especially on biodiversity material.

Increasing learning outcomes in the psychomotor domain were getting from the results of the students' psychomotor assessment sheets which included assessing student activities starting from preparatory activities to the presentation of exploration results. Students are asked to carry out biodiversity exploration activities in the school environment and if necessary along with the environment around their homes according to the steps presented in the exploration sheet that the researchers have provided.

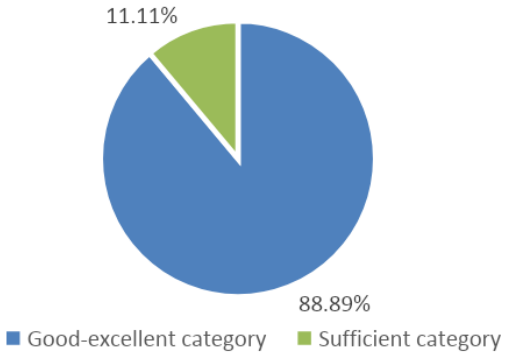


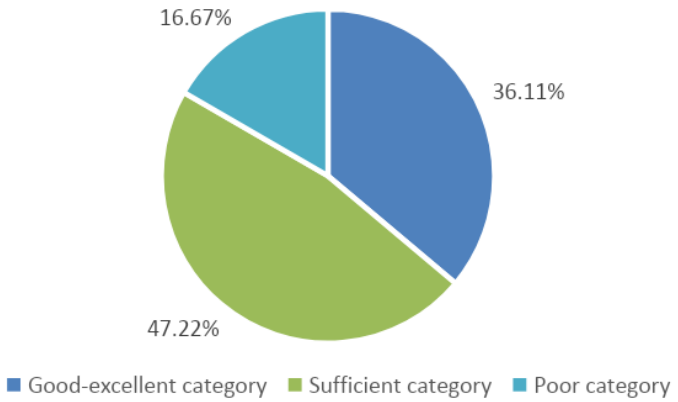
Figure 4 Percentage of Student's Psychomotor Assessment Results

The percentage of the results of the assessment of students' exploratory activities who got good to excellent categories was 88,89% while the sufficient category obtained 11,11% as shown in Figure 4, it can be concluded that students can use their motor or physical skills, and find the material concept of biodiversity by exploring the surrounding environment. According to Widiantono's research (2017) through exploratory activities, students are involved more deeply with the topic being studied. Thus students are stimulated to increase learning activities so they can use their skills properly and optimally. Based on the analysis results, students have fulfilled the learning outcomes of the phase E Merdeka Curriculum of process skills elements, including the ability to observe, question, predict, plan and carry out investigations, analyze data, evaluate, and communicate the results of biodiversity exploration activities in the surrounding environment.

The affective domain is a domain related to several aspects including attitudes, interests, self-concept, morals, and values (Gusti *et al.*, 2020). In the Merdeka Curriculum, the affective domain is integrated into

the profile of Pancasila students. The Pancasila student profile consists of 5 dimensions, including: 1) faith, piety to God Almighty and noble character, 2) global diversity, 3) mutual cooperation, 4) independent, and 5) critical reasoning. The affective aspect that the researchers collected were aspects that were closely related to the subject of biodiversity, namely conservation attitudes. According to Ngabekti *et al.* (2022) a conservation attitude is the attitude of someone who has conservation values as an effort or concrete action to wisely save, protect, and preserve the surrounding environment.

Referring to the Ministry of Education and Culture's 2023 about Merdeka Curriculum on merdeka learning platform, conservation attitudes are included in the Pancasila Student Profile of the dimension "faithful, devoted to God Almighty and noble" because it relates to morality towards nature. Affective assessment is carried out after learning activities that use supplements of teaching material, that was biodiversity booklet in Demak Regency. By filling out a conservation attitude assessment questionnaire distributed to students via Google form, student learning outcomes are obtained in the affective domain (Figure 5).



Fiigure 5 Percentage of Student Conservation Attitude Assessment Results

The percentage of the conservation attitude of students who get good to excellent categories is 36,11%, the sufficient category is 47,22%, while the less category is 16,67%. Based on the data and interviews with biology teachers, shows that the use of biodiversity booklet in Demak Regency in learning activities has a positive impact on the students' conservation attitudes establishment. There was an increase in the number of students who had a good category in conservation attitudes, from 15% to 36,11% of students with good conservation attitudes.

Based on the learning outcomes data that was analyzed, it can be concluded that the use of biodiversity booklet in Demak Regency which the researchers developed as supplement of teaching material in learning activities can increase student learning outcomes in the cognitive, psychomotor, and affective domains. Therefore, the learning purposes have been achieved and can fulfill the learning achievement of the phase E Merdeka Curriculum on biology material, especially biodiversity.

CONCLUSION

Based on the results, biodiversity in Demak Regency includes diversity at the gene, species, and ecosystem levels. The results of the research on gene-level diversity were found in varieties of water apple (*Syzygium aqueum* (Burm. f.) Alston) and star fruit (*Averrhoa carambola* L.), species-level diversity was found in 20 mangrove species, and ecosystem-level diversity was found in 9 ecosystem types. Biodiversity booklet in Demak Regency that developed got very feasible criteria, there is 83,33% from material experts, 85,42% from media experts, and 88,88% from biology teachers, the readability of biodiversity booklet in Demak Regency by students obtained a percentage of 98,21% with very good criteria, and the use of booklet in learning activities effective can increase student learning outcomes so that they fulfill the achievements of phase E biology learning, especially the material for biodiversity in the Merdeka Curriculum.

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