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Development of Biodiversity Booklet in Mangunharjo Area

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Abstract

Mangunharjo area is one of the areas in the coastal area of Semarang City that has biodiversity and can be used as an environment-based learning resource. The purpose of the study was to identified biodiversity and then analyzed the feasibility and readability of biodiversity booklet in the Mangunharjo area as a supplement of biological material. The research design was Research and Development (R&D). Small-scale trial was conducted at SMA Negeri 8 Semarang, class X MIPA 3 in the even semester of the 2019/2020 school year. The validation results showed that the booklet is very suitable for use in learning by getting a percentage of 98% media expert, 88% material expert, and 94% biology teacher. The results of small-scale trial with student response questionnaires obtained an average score of 88% in the excellent category, and readability booklet by students obtained a score of 94% in the high category.

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INTRODUCTION

The coastal is a dynamic ecosystem and has a wealth of species both on land and at sea, as well as interacting with each other between these habitats. The mangrove area is one of the ecosystems in the coastal area that has ecological and economic functions that are very beneficial to humanity. Semarang City as one of the coastal areas in Jawa Tengah has a coastline of around 36.6 km (Hakim, 2016). Mangrove forests have a high level of biodiversity and genetic pool also play an important role as a life support system (Hutchings & Saenger, 1987).

The mangrove ecosystems has become a breeding ground for various aquatic animal such as fish, crutaceans, crabs, and mollusks. In addition, mangroves become a place to find a number of wild animals such as reptiles, birds, and mammals. Mangrove forests are a paradise for water birds and other migratory birds. There are at least 200 species of birds that depend on mangrove ecosystems, or about 13% of all birds in Indonesia (Mulyono *et al.*, 2018). In addition, birds as one of the animals that have unique characteristics, thus meeting the criteria as a natural indicator of biodiversity in an area.

Many potential natural resources around can be used as a supplement to learning resources, but there are still many that have not been utilized to support the learning process in school. Utilization of the environment as an effective learning resource in improving learning outcomes by 97.43% and students concern for the environment by 86.49% (Yuliati & Martuti, 2014). Learning through an environmental approach can provide good opportunities for students to observe the actual state of the environment so that they are able to build awareness of the importance of protecting the environment, stimulating participation, and developing students' investigations (Alexandar & Poyyamoli, 2014).

The potential of natural resources in the surrounding environment provides a variety of real information about daily life that can be used as learning resources. The existence of this information must be utilized as much as possible to support the learning process. Examples of the use of the coastal environment in the city of Semarang that can be used as a source of learning include the Mangunharjo area. The area is located quite close to SMA Negeri 8 Semarang, which in the learning process the teachers have not used mangroves as a source of learning for biodiversity material and their learning resources are still limited to worksheets, modules, and handbooks.

The results of interviews with biology teachers and students indicate that other learning resources are needed that utilize the potential of environment-based local material for biodiversity. Therefore, learning resources that utilize the local potentials need to be developed as supplementary materials for a solution to the problem of outdoor learning, such as limited time, costs, and school licensing for learning that requires activites outside the classroom. In this case the local potential is research on biodiversity in the Mangunharjo area. Therefore, the results of research on biodiversity in the Mangunharjo area are expected to be used as a source of biology high school biology learning material in the form of booklet.

RESEARCH METHOD

The method used in this research is the Research and Development (R&D) adaptation of Sugiyono (2015) with modifications: preliminary study, data collection (primary and secondary data), product design, product validation, revision of product validation results, small-scale trial, revision of results small-sacle trial, final product. Retrieval of field data in the form of biodiversity in the Mangunharjo area, Tugu district, Semarang City. The Mangunharjo areas which are sampled are the area of residential and yards, rice fields, ponds, mangroves, and beaches. Preparation booklet and validation by experts was carried out at Semarang State University. A small-scale product trial in the form of a booklet of research results was conducted at SMA Negeri 8 Semarang, X MIPA 3 in the even semester of the 2019/2020 school year. Field data collection up to small-scale trial products in the school carried out in July 2019 – January 2020. The results of the study were analyzed descriptively quantitative.

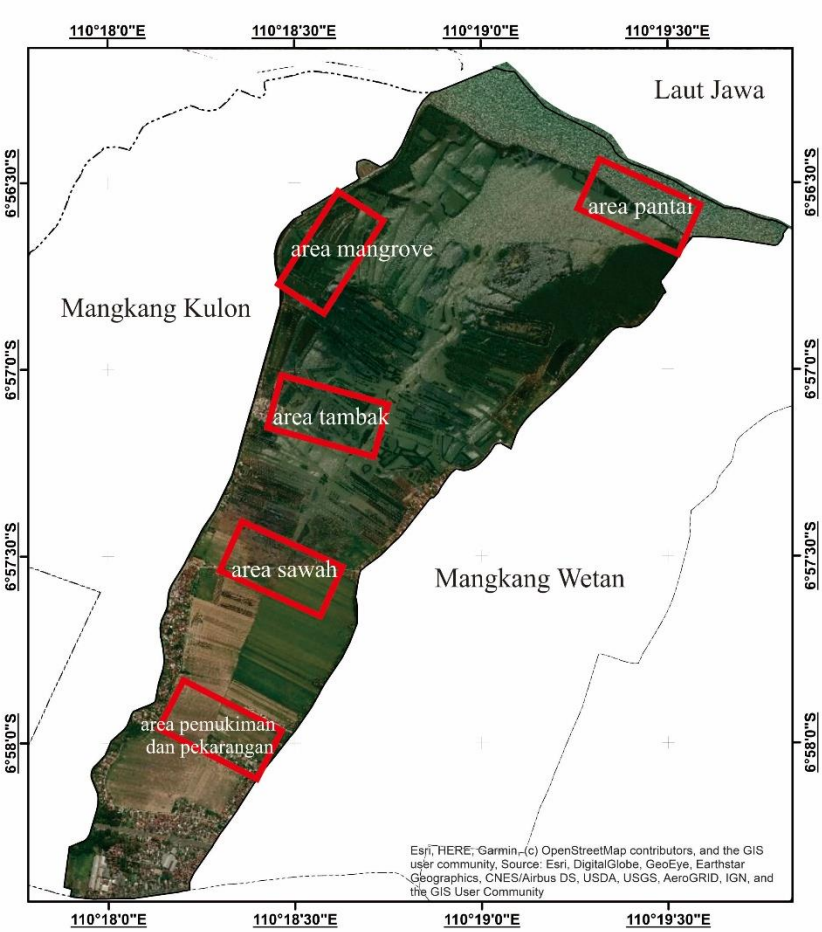

Figure 1 Map of location data collection; residential and yards, rice fields, pond, mangrove, and beach areas

RESULTS AND DISCUSSION

Biodiversity in the Mangunharjo Area

Based on the results of biodiversity research in the Mangunharjo area which includes the level of genes, types, and ecosystems, samples were found for each of the three levels of biodiversity. Diversity of gene levels found in the sample are Tembelekan plants (*Lantana camara*) with flower color varations are found in the yard near the residential areas and around the paddy fields and mangroves.

The diversity of species found in the Mangunharjo area which represent examples of animals are birds and those that represent examples of plants are mangroves. The results of bird identification found in the Mangunharjo area include mangrove areas, ponds, and beaches recorded 65 species of birds consiting of 31 families.

The results showed that of the 65 bird species found, there were 8 types of migratory birds from the Charadriiformes order, namely Cerek Kalung Kecil (*Charadrius dubius*), Cerek Kernyut (*Pluvialis fulva*), Gagang Bayam Timur (*Himantopus leucocephalus*), Kedidi Jari Panjang (*Calidris subminuta*), Trinil Pantai (*Actitis hypoleucos*), Trinil Semak (*Tringa glareola*), Gajahan Kecil (*Numenius minutus*), and Gajahan Penggala (*Numenius phaeopus*). There are also bird species whose conservation status is in the Vulnerable (VU) category according to the IUCN (International Union for Conservation of Nature), namely Bangau Bluwok (*Mycteria cinerea*), while the rest are in the Least Concern (LC) category or low risk. Then there are bird species which according to CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) are included in the Appendix II category in their trading status, namely Serak Jawa (*Tyto alba*). Meanwhile, there are 6 protected bird species according to P.106/2018, namely Gajahan Kecil (*Numenius minutus*),

Gajahan Penggala (*Numenius phaeopus*), Cangak Besar (*Egretta alba*), Cangak Laut (*Ardea sumatrana*), Ibis roko-roko (*Plegadis falcinellus*), Bangau Bluwok (*Mycteria cinerea*), Kipasan Belang (*Rhipidura javanica*), and Kacamata Jawa (*Zozterops flavus*) (Table 1).

Table 1 Some bird species in the Mangunharjo area

No	Family	Indonesian Name	Scientific Name	Information
1	Charadriidae	Cerek Kalung Kecil	*Charadrius dubius*	Migrant
		Cerek Kernyut	*Pluvialis fulva*	Migrant
2	Recurvirostridae	Gagang Bayam Timur	*Himantopus leucocephalus*	Migrant
3	Scolopacidae	Kedidi Jari Panjang	*Calidris subminuta*	Migrant
		Trinil Pantai	*Actitis hyploleucos*	Migrant
		Trinil Semak	*Tringa glareola*	Migrant
		Gajahan Kecil	*Numenius minutus*	Migrant
				Protected by P.106/ 2018
		Gajahan Penggala	*Numenius phaeopus*	Migrant
				Protected by P.106/ 2018
4	Ciconiidae	Bangau Bluwok	*Mycteria cinerea*	IUCN Vulnerable
5	Titonidae	Serak Jawa	*Tyto alba*	CITES Appendix II

The richness of bird species in the Mangunharjo area which includes ponds, mangroves, and beaches, respectively from highest to lowest, is the pond area with 49 species, mangrove area with 30 species, and beach area with 24 species (Figure 2).

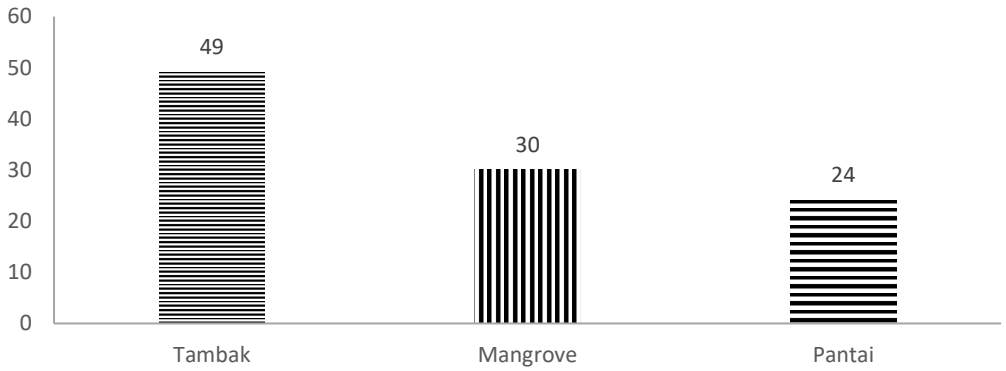

Figure 2 The richness of bird species in each area of Mangunharjo area

The pond and mangrove areas are the places with the highest species richness. This is because the types of ponds and mangrove habitats have a source of feed that supports many bird species. The mangrove forests and ponds are places used by birds to forage for food. In addition, in this area, mudflat is found which are favored by scaffolding birds such as the plover and sandpiper species. In addition, mudflat allows migratory birds to rest. This is in accordance with the research of Jumilawaty *et al.* (2011) stated that the presence of many waterbirds in mudflat is due to the abundance of food sources from the macrozoobenthic species which are the main food for waterbirds, especially shorebirds.

The beach area has the lowest species richness compared to the other two areas. This is because the coastal area has a type of coastal forest vegetation. According to MacKinnon *et al.* (2010), this type of stand has the lowest species richness compared to other stand types with several coomon types dominating. Some types of birds that are commonly found include Kuntul Kecil (*Egretta garzetta*), Cangak Besar (*Ardea alba*), Blekok Sawah (*Ardeola speciosa*), Cangak Abu (*Ardea cinerea*), Walet Linci (*Collocalia linchi*), Kokokan Laut (*Butorides striata*), Remetuk Laut (*Gerygone sulphurea*), Pecuk Ular Asia (*Anhinga melanogaster*), Pecuk Padi Hitam (*Phalacrocorax sulcirostris*), Cekakak Australia (*Todiramphus sanctus*), Raja Udang Biru (*Alcedo*

coerulescens), Tekukur Biasa (*Spilopelia chinensis*), and Cucak Kutilang (*Pycnonotus aurigaster*). This type of bird can be said to be common because it is found in all three areas of observation, namely the area of ponds, mangroves, and beaches.

Based on the results of research on bird species diversity in the Mangunharjo area, the family that has the most members is the Ardeidae family with 10 species or 20% of the total bird species found. This indicates that the habitat is able to provide the components needed by the Ardeidae family. The Ardeidae family also has good adaptability to the mangrove ecosystem in the observation area. It is known from the observations in all areas that the species of Rhizophora mangroves are often used as perches by the Ardeidae family. This is in accordance with the research of Widodo *et al.* (1996) stated that the Ardeidae family is very adaptive to the mangrove ecosystem, namely a type of bird that uses mudflat, ponds and rivers as a place to find food (foraging) and mangrove vegetation for perching and nesting.

Rhizophora mangrove canopies are often used as nesting sites and breed by these Ardeidae family birds. This is supported by Paramita *et al.* (2015), that Blekok Sawah birds that are members of the Ardeidae family utilize *Rhizophora mucronata* as nesting sites. Graph composition of the number of family members of birds found in the Mangunharjo area can be seen in Figure 3.

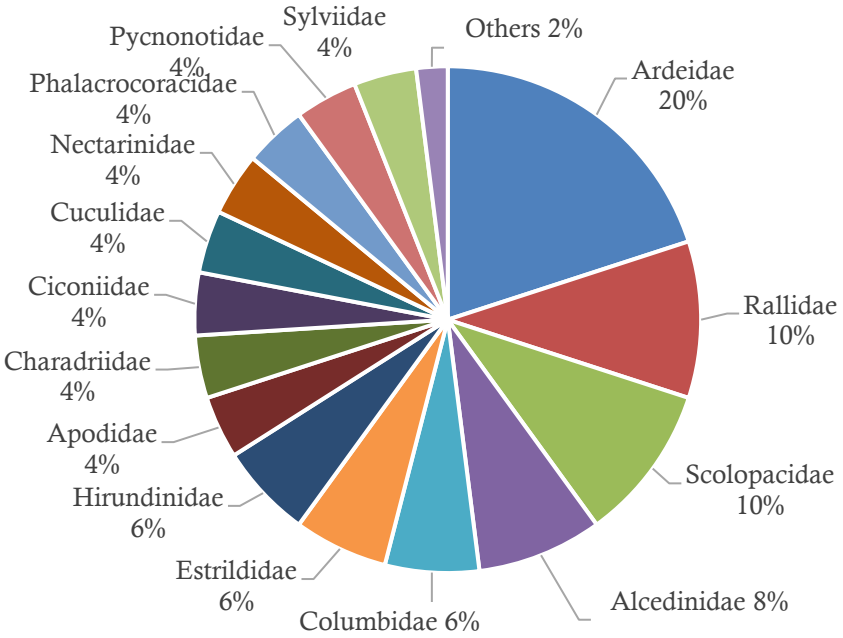

Figure 3 Composition of bird family members in the Mangunharjo area

The diversity of species that represent examples of plants is the diversity of mangrove species. The results of the analysis for mangrove species diversity were based on research by Tefarani *et al.* (2019) found 15 types of mangroves in the Mangunharjo area. The diversity index of mangrove species found in the coastal area of Mangunharjo Village, Tugu District, Semarang City is low to moderate with a diversity index (H') of 0.72-1.32. List of mangrove species that can be found in Mangunharjo can be seen in Table 2.

Table 2 List of mangrove species in the Mangunharjo area

No	Species Name	Information
1	*Avicennia alba*	Mangrove mayor
2	*Avicennia marina*	Mangrove mayor
3	*Rhizophora apiculata*	Mangrove mayor
4	*Rhizophora mucronata*	Mangrove mayor
5	*Rhizophora stylosa*	Mangrove mayor
6	*Xylocarpus granatum*	Mangrove minor
7	*Ipomoea press-capree*	Mangrove asosiasi
8	*Widelia bifolia*	Mangrove asosiasi
9	*Vitex ovata*	Mangrove asosiasi
10	*Cynedon dactylon*	Mangrove asosiasi
11	*Aferatum eonyzoides*	Mangrove asosiasi
12	*Casuarina equisetifolia*	Mangrove asosiasi
13	*Albizia chinesis*	Mangrove asosiasi
14	*Portulaca leavis Wall*	Mangrove asosiasi
15	*Terminalia catappa*	Mangrove asosiasi

Source: (Tefarani *et al.*, 2019)

The diversity of ecosystem levels found in the Mangunharjo area, there are five types of ecosystems, namely residential area and yards, rice fields, ponds, mangroves, and beaches. Zaky *et al.* (2012) stated that the condition of mangrove land in Mangunharjo village is mostly a pond area. Pond development has an influence on the loss of mangroves. According to Noor *et al.* (2006) although data is lacking, it appears that factors contributing to the loss of mangroves, in addition to conversion to ponds, are conversion to agricultural land and commercial logging on a smaller scale, and over-exploitation by local communities.

Feasibility of Booklet Biodiversity in the Mangunharjo Area

Booklet Biodiversity in the Mangunharjo Area that was developed has been validated by material expert, media expert, and biology teacher (Picture 4). Dr. Partaya, M. Si. as a material expert, Dr. Sigit Saptono, M. Pd. as a media expert, dan Ely Murniati, S. Pd. as a biology teacher at SMA Negeri 8 Semarang.

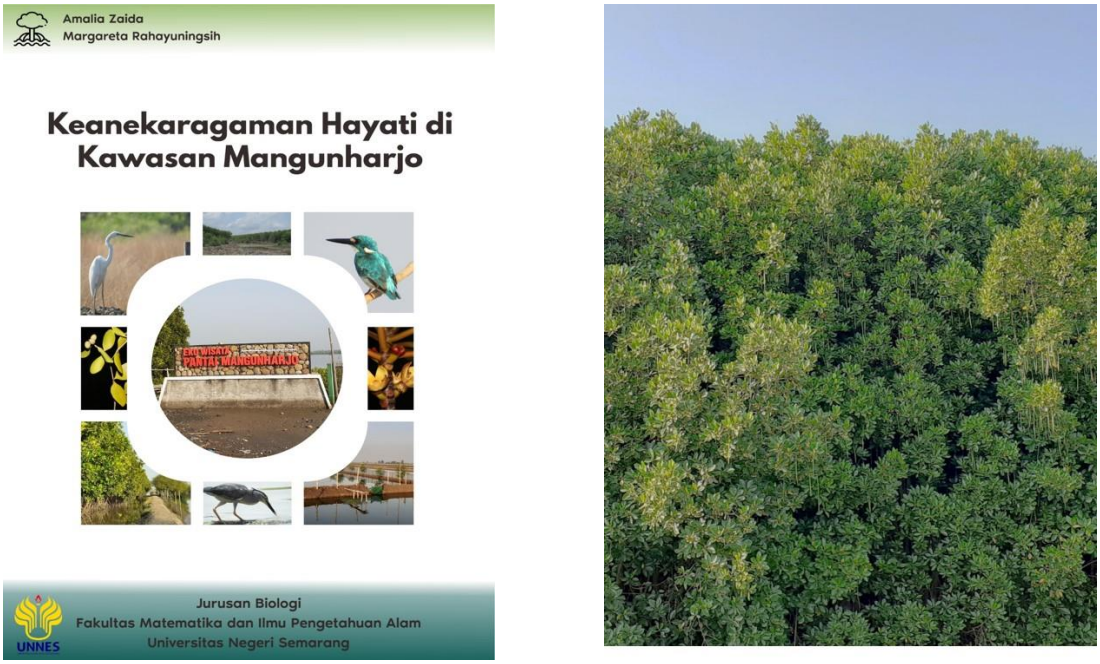

Figure 4 The view of the booklet's front and back covers

The results of the material expert validation of the material booklet consisting of four feasibility components obtained percentage results, namely the knowledge dimension 87.5%, linguistics 87.5%, 100% presentation technique, and completeness of 93.75% presentation. Overall, the results of material validation obtained an average percentage of 87.5% with a very feasible category and do not need to be revised.

The results of the media expert's validation of the media booklet consisting of six components of eligibility obtained a percentage result, namely the size of the booklet 100%, the design of the cover booklet 100%, and the design of the content booklet 95.38%. Overall results of media validation obtained an average percentage of 97.91% with a very feasible category and did not need to be revised.

The results of teacher responses include the three components of eligibility to obtain percentage results, namely the aspect of graphic at 100%, the material aspect at 100%, and the language aspect at 100%. Overall the teacher's response to the booklet obtained an average percentage of 98% in the very feasible category and did not need to be revised.

Tabel 3 Validation results booklet Biodiversity in Mangunharjo Area

No	Validator	Percentage	Category
1	Material	87,5%	Very feasible and didn't need to be revised
2	Media	97,91%	Very feasible and didn't need to be revised
3	Biology teacher	94,44%	Very feasible and didn't need to be revised
	Average of percentage	93,28%	Very feasible and didn't need to be revised

The cloze test is conducted after being assessed and declared to be feasible by the validator. Cloze test to find out the level of readability booklet. Overall, the results of the overlap test for readability booklet obtained an average percentage of 94% with a high category.

Table 4 The results of cloze test to measure the readability level of the booklet

No	Students	Number	Percentage	Category
1	High ability level	3	98%	High
2	Medium ability level	4	93%	High
3	Low ability level	3	91%	High
	Average of percentage		94%	High

Students feel happy and was enthusiastic when reading the booklet Biodiversity in the Mangunharjo Area which was proven by the lowest percentage results of 70% and the highest percentage of 98%. The results of the questionnaire responses of students obtained an average score of 88% with a very good category.

Table 5 Student responses to booklet

No	Pernyataan	Score	Percentage	Category
1	The appearance of cover booklet is interesting	123	85%	Very good
2	This makes me more enthusiastic in studying Biology	123	85%	Very good
3	The pictures/photos is interesting that makes me excited to study	133	92%	Very good
4	Presentation of material in booklet is systematically presented	127	88%	Very good
5	Submission of material in booklet is related to daily	112	78%	Very good
6	This booklet equipped with photos/pictures supporting material	138	96%	Very good
7	This booklet equipped with a glossary that helps me understand the contents	136	94%	Very good
8	The language used in booklet makes ot easier for me to understand	126	88%	Very good
9	This booklet not found in typos or mistypes	122	85%	Very good
10	The letters used are clear and easy to read	133	92%	Very good
	Average of percentage		**88%**	
	Category		**Very good**	

Note: the maximum score is 144 (max score 4 x 36 students)

Overall, the booklet that was developed has advantages including size of the booklet the smalls of that simple are used when learning, the design of the booklet is interesting, and uses language that is easy to understand so as to arouse students' interest in understanding learning material. In addition, this booklet also has its own advantages compared to booklets other, namely this booklet presents biodiversity in the Mangunharjo area. Thus, the booklet has reached the standard of teaching material eligibility according to the 2014 BSNP which includes four components, namely the component of content eligibility, language, presentation, and graphic. This is also supported by the results of Gemilang & Christiana's research (2016: 8), namely research on developing media booklets as hedonism lifestyle learning materials, obtaining material and media feasibility assessments respectively by 87.3% and 84.4% with very feasible criteria and does not need to be revised.

A small-scale trial was conducted on 36 students of Class X MIPA 3 of SMA Negeri 8 Semarang. Small-scale trials aim to determine the level of readability of the booklet. Students are asked to fill in the mortar test which serves as a measure of the readability of the booklet that has been developed. The overlap

test obtained an average percentage of 94% with high criteria. The readability criteria for the booklet Biodiversity in the Mangunharjo Area is relatively high and can be used by students with high to low levels of ability. This is evidenced by the acquisition of the percentage of students with low ability levels of more than 60%.

Students are also asked to fill in questionnaires for responses regarding the booklet that was developed. The filling out of the questionnaire aims to find out the compatibility of the booklet developed with students. The average value of the percentage obtained from the questionnaire responses of small-scale students by 88% with very good criteria. Excellent criteria by students shows that the booklet developed is suitable to be used as a supplement to learning resources.

The Booklet Biodiversity in the Mangunharjo Area is interesting to study. This is evident from the acquisition of a high percentage of interest in the booklet cover and there are good quality photos. Pictures or photos in the booklet give students motivation to learn the material in the booklet. The use of image media in the form of color photographs in delivering material makes it easy for students to understand the material. This is consistent with the opinion of Pralisaputri *et al*. (2016) that the development of the booklet SETS-based as a learning medium has advantages including an attractive colorful display with illustrations of images, material and photos that are clearer, shorter, and denser than the books that teachers normally use. Then this was also supported by the opinion of Irwan *et al*. (2018) that media booklet can be used as an alternative to overcome the limitations of textbooks. Media booklet is one of the visual media that is able to display interesting pictures and writings that will help the delivery of material during pre-learning activities and increase students' understanding so that learning takes place effectively and learning outcomes will be in line with expectations.

Student activity sheets were also given during small scale trials. This sheets filling is given to analyze the activities of students during small-scale trials in order to fulfill KD 3.2 Analyzing data from observations about various levels of biodiversity (genes, types and ecosystems) in Indonesia as well as threats and their preservation. In the sheets, a table of precautionary figures is presented and students are asked to analyze the precautionary level along with its description and characteristics. The results of the sttudent activity sheet showed that the class average score was 89, meaning that students were able to answer most of the questions presented at the sheets. In the table of precautionary figures in the sheets, all students are able to answer correctly by distinguishing each type of biodiversity level, namely the level of genes, species, and ecosystem. This shows that during the small-scale trial students not only read the booklet but also understood the concept of prudence which was presented in the booklet.

The booklet also presents a sheet of proposals for efforts to conserve the Mangunharjo mangrove area. Students are asked to fill out the sheet with suggestions for preservation efforts according to the thoughts and opinions of each student. The proposal sheet is in accordance with KD 4.2 presenting the results of observations of various levels of biodiversity (genes, species, and ecosystems) in Indonesia and proposals for efforts to conserve Indonesian biodiversity based on the results of data analysis on threats to the sustainability of various Indonesian animals and plants in various forms of information media. The results on the proposal sheet showed that 100% of students were able to provide answers to preservation efforts, meaning that there were no students who did not provide suggestions. This shows that students care about the environment and think about preserving the surrounding environment. Some of the alternative proposals given by the students include planting mangroves, conservation education for the community, and beach cleaning activities as an effort to conserve mangrove areas in Mangunharjo.

The presentation of the biodiversity booklet in the Mangunharjo area provides awareness to students that there is biodiversity around the students' environment, especially in the coastal environment that they must protect and preserve. The existence of this awareness is expected to encourage students to increase environmental care and participate in taking real action for efforts to conserve biodiversity around their environment. This is in accordance with research by Yuliati & Martuti (2014), which states that the use of the environment as a learning resource is effective in increasing learning outcomes by 97.43% and students' concern for the environment by 86.49%.

CONCLUSION

Based on the results of study found each of the three levels of biodiversity, namely the diversity of genes, species, and ecosystems in the Mangunharjo area. The results of the research on gene diversity found variations in flower color in the Tembelekan plant (*Lantana camara*). The results of the research on bird species diversity found 65 bird species from 31 families, while for mangrove species diversity there were 15 species. The results of the research on ecosystems diversity there were 5 kind of ecosystems, namely yard ecosystem, paddy field ecosystem, pond ecosystem, mangrove ecosystem, and beach ecosystem. Booklet "Biodiversity in the Mangunharjo Area" which has been developed, obtained very suitable criteria to be used as a supplement to biology learning resources especially for biodiversity material of senior high school class X, and has received an assessment from the material validator 88%, media validator 98%, biology teacher responses 88%, and booklet readability by students 94%.

REFERENCES

Alexander, R., & Poyyamoli, G. 2014. The effectiveness of environmental education for sustainable development based on active teaching and learning at high school level-a case study from Puducherry and Cuddalore regions, India. *Journal of Sustainability Education*, 7, 1-20.

Gemilang, R. 2016. Pengembangan Booklet sebagai Media Layanan Informasi untuk Pemahaman Gaya Hidup Hedonisme Siswa kelas XI di SMAN 3 Sidoarjo. *Jurnal BK UNESA*, 6(3).

Hakim, B. A. 2016. Potensi Ekowisata Pesisir Tugu, Semarang, Jawa Tengah. Suara Merdeka. Tersedia di http://suaramerdeka.com/vl/indexphp. [diakses 29 Januari 2020].

Hutchings and Saenger. 1987. *Ecology of Mangrove*. University of Queensland Press. Queensland.

Irwan., Asrori, M., & Mering, A. 2018. Pengembangan Media Booklet Dalam Pembelajaran Ikatan Kimia Pada Mata Pelajaran Kimia Sekolah Menengah Atas. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa,* 6 (12).

Jumilawaty, E., Mardiastuti, A., Prasetyo, L. B., & Mulyani, Y. A. 2011. Keanekaragaman Burung Air di Bagan Percut, Deli Serdang Sumatera Utara. *Media Konservasi*, 16(3).

MacKinnon, J., Karen P. & Bas V. B. 2010. *Burung-Burung di Sumatera, Jawa dan Bali*. Bogor: Puslitbang Biologi LIPI & Burung Indonesia.

Mulyono, M., R. Firdaus, C. M. N. Alka, H. Anda. 2018. *Sumberdaya Hayati Laut Indonesia*. Jakarta: STP Press.

Noor, R, Yus., Khazali, M., Suryadiputra I.N.N. 2006. *Panduan pengenalan mangrove di Indonesia*. Bogor: PHKA/WIIP.

Paramita, E. C., Sunu K., & Reni A. 2015. Keanekaragaman dan Kelimpahan Jenis Burung di Kawasan Mangrove Center Tuban. *LenteraBio*, 4(3): 161-167.

Pralisaputri, K. R. 2016. Pengembangan Media Booklet Berbasis SETS Pada Materi. *Jurnal GeoEco*, 2 (2): 147-154.

Sugiyono, 2015. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Tefarani, R., Martuti, N. K. T., & Ngabekti, S. 2019. Keanekaragaman Spesies Mangrove dan Zonasi di Wilayah Kelurahan Mangunharjo Kecamatan Tugu Kota Semarang. *Life Science*, *8*(1), 41-53.

Widodo, W., Noor Y. R. & Wiroadmodjo S. 1996. Pengamatan Burung-Burung Air di Pantai Indramayu-Cirebon, Jawa Barat. *Jurnal Media Konservasi*, 5: 11-15.

Yuliati, T., & Martuti, N. K. T. 2014. Efektivitas penerapan metode field trip untuk meningkatkan hasil belajar dan kepedulian siswa terhadap lingkungan. *Jurnal Pendidikan Matematika dan Sains*, 2(2), 178-186.

Zaky, A. R, Chrisna A. S & Rudi P. 2012. Kajian kondisi lahan mangrove Di Desa Bedono, Kecamatan Sayung, Kabupaten Demak dan Kelurahan Mangunharjo, Kecamatan Tugu, Kota Semarang. *Journal of Marine Research*, 1(2): 88-97.