

Plant biodiversity and people's behavior on environmental conservation in Pabelan Islamic Boarding School, Magelang, Central Java, Indonesia

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Abstract. Nazar IA, Sutarno, Mudofir, Sunarto. 2024. Plant biodiversity and people's behavior on environmental conservation in Pabelan Islamic Boarding School, Magelang, Central Java, Indonesia. *Biodiversitas* 25: 232-239. Pabelan Islamic Boarding School is a modern educational institution committed to religious-based environmental education. The landscape of this Islamic boarding school is designed to contribute to the preservation of the surrounding environment. This study aims to determine plant diversity and behavioral patterns in environmental conservation in Pabelan Islamic Boarding School, Magelang District, Central Java, Indonesia. Vegetation analysis was conducted by inventory of tree species planted in the area of the school. Analysis of the behavior patterns was carried out using observation, interviews with the clerics (*kiai*), teacher (*ustaz*) and staff, and questionnaires to students. The result of vegetation analysis showed that Pabelan Islamic boarding school has a moderate level of flora diversity with a Shannon-Wiener index (H' : 2.597). This is because the management of the school has a unique way of maintaining flora biodiversity by requiring every new student to bring unique or rare plant seeds from their hometown. The *Kiai* and teacher at the school have progressive thoughts about the human's relationship with God and nature. Human is God's representative who is obliged to maintain the environment and natural elements including biodiversity. The students generally have adequate awareness and concern for the environment and sustainability which is largely influenced by the figure of the *Kiai*. The findings of this study imply that Islamic boarding school (*pesantren*) can play essential role in practicing and raising awareness of sustainable environmental management and biodiversity conservation.

Keywords: Biodiversity, environmental conservation, Pabelan Islamic Boarding School, sustainable

INTRODUCTION

Modern humans conduct large-scale exploration and exploitation of natural resources for economic interests, often causing damage to the environment and ecosystem (Azra 2010; Kattumuri 2018). In modern society which is generally built upon capitalism and secularism, discussions on religion and the environment are counter hegemony. The problem is, capitalism, which believes in secular principles, has become the dominant and hegemonic mode of production in modern society. Capitalists who are supported by strong industry generally have an anthropocentric view, which views nature with its various species, herds of animals and plants, water and minerals, as entities to be exploited by humans and as having no inherent value (Green and Citrin 2000). As the consequences, various ecological functions have been degraded including the capacity of ecosystem in maintaining climate, regulating water and conserving soils. Anthropogenic activities have also been the major threats to biodiversity with biodiversity loss caused by habitat changes, over-exploitation, invasive alien species and climate changes. Therefore, efforts to mitigate such impacts are necessary to sustain ecosystem services and protect biodiversity.

It is necessary to implement religious concepts regarding the environment in a measurable manner so that religious communities are able to manage natural resources sustainably (Azizi et al. 2023). Indonesia is the country with the largest Muslim population in the world with 240.62 million people being Muslim, or equivalent to 87.02% of the total population of the country (Ministry of Internal Affairs 2023). Religious value plays an essential role in building the interaction between humans and nature to achieve a sustainable balance (Hefner 2013). The integration of religion might serve as important pillars in environmental management and biodiversity conservation since major world religions have non-destructive values in their principles. The religious beliefs and practices can strengthen human awareness to implement environmental conservation (Tucker and Grimm 2007).

Islamic boarding schools (*pesantren*) are important religious institutions which have the potential to serve as agents of change towards community behavior and attitudes for sustainable natural resources management and environmental conservation. Therefore, *pesantren* can be an example of their innovation and participation in achieving Sustainable Development Goals (SDGs) targets and goals, especially those related to human resource and

environmental resource management (Isbah 2020). Islamic boarding schools are the oldest educational institutions in Indonesia which existed before the emergence of modern education system (Abdillah 2002). In addition, *pesantren* have become the attention of the global community because they might serve as a node of cultural assimilation and intermediaries (brokers) between modern culture and traditional societies (Wahid 2006). In recent decades, Islamic boarding schools have experienced tremendous development in rural, suburban, and urban areas. The number of Islamic boarding schools as of January 2022 is 26,975, with 1,444,468 residing/boarding students (*mukim*) and 1,202,598 non-residing students (*non-mukim*) (<https://ditpdponren.kemenag.go.id/pdpp/statistik>).

Nowadays, Islamic boarding schools are no longer only limited to serve as religious educational institutions but also as community development institutions. Islamic boarding schools continue to evolve and involve along with the progression of civilization and global development including the emerging issues on environment and biodiversity. Thus, the role of *pesantren* is not only as an educational institution but also as a *da'wah* institution, as a social institution of the community, and as an agent of environmental change in society. According to Munawwir (1997) in the Al-Munawwir Arabic-Indonesian Dictionary, *da'wah* comes from the word *da'a* which means: calling, inviting, exhorting, and serving. In this respect, the role of *da'wah* in *pesantren* can be expanded to raise the awareness of environmental conservation.

How the environment and biodiversity are managed in Islamic boarding schools becomes an interesting topic to study. This institution has proven to be involved and active in various environment related activities, from pioneering to becoming a role model in environmental management. For example, there have been 10 *Kalpataru*, a prestigious award in the field of environment, awarded to several Islamic boarding schools throughout Indonesia to acknowledge their contribution to environmental conservation (KLH 2011). Their activities include innovations and initiatives in afforestation, land improvement, organic farming, environmental sanitation, and aquatic technology. Specifically, to garner wider involvement of Islamic boarding schools in Indonesia, The Ministry of Environment (KLH) launched the *Ecopesantren* Program in 2008. This program was created to encourage increased knowledge, obedience, and awareness of Islamic boarding schools in environmental conservation (KLH 2010). This program is considered as the embryo of a formally recognized environmental education program in *pesantren*.

This study aims to determine plant diversity and behavioral patterns in environmental conservation in Pabelan Islamic Boarding School, Magelang District, Central Java, Indonesia. This research is part of the implementation of the *ecopesantren* program and as a medium for evaluating the contribution of Islamic boarding schools in environmental conservation while providing data on plant diversity. The results of this study might provide an example of the role of religious educational institutions, particularly *pesantren*,

in biodiversity conservation and environmental protection which can be referred by other institutions

MATERIALS AND METHODS

Study area and period

The research was conducted at Pabelan Islamic Boarding School in Pabelan Village, Mungkid Sub-district, Magelang District, Central Java Province, Indonesia (Figure 1). The study was conducted from January to May 2023. Pabelan Islamic Boarding School has an area of around 5.5 ha. Even though this is categorized as modern, the Islamic boarding school management maintains a traditional building pattern that has a strong rural atmosphere. More than half of the Islamic boarding school's land consists of green open space with various kinds of plants (personal interview with Ustadz Ahmad Muzakir, 23 June 2023). Pabelan Islamic Boarding School is located in a beautiful and natural environment with numerous rare tree species with large sizes. It is positioned on 1.5 km from the Jogja-Semarang highway and 1 km from the Muntilan-Borobudur highway, yet the situation is relatively quiet.

One of the missions of Pabelan Islamic Boarding School is to educate the students to be able to recognize their identity and aware to the surrounding environment, as well as to prepare students to become independent humans and serve the community and nation. This mission is then implemented in various activities. For example, the spatial layout of the school resembles the path of the sun as a typical Islamic architecture (Pamungkas et al. 2020). This depicts the journey of human's life as a symbol of Islamic values derived from the Quran and Hadith. The Islamic values can also be observed from the building and open spaces, including green spaces.

In 1982, Pabelan Islamic Boarding School received the *Kalpataru* Award. The Indonesian government gave this award because of the success of the school in maintaining and preserving the environment by motivating students to plant trees. Kiai Hamam, the founder of the school, is also very inspiring in environmental governance, besides being discerning in religion. When Kiai Hamam led the school, the students came from all parts of Indonesia, and even from other countries such as Thailand. When entering the school, Kiai Hamam obliged his students to bring seeds from where they live and plant them around the cottage and the surrounding green open spaces. Nowadays, many plant species originating from various areas in Indonesia, such as karet kebo (Aceh) and matoa (Papua) still exist and are well maintained. The obligation of students to bring seeds continues until now as the tradition of the school.

Data collection procedures

Vegetation data was collected using census method carried out in the entire Pabelan Islamic Boarding School area. Tree species identification was done using primary observation and also the Identification Guidelines.

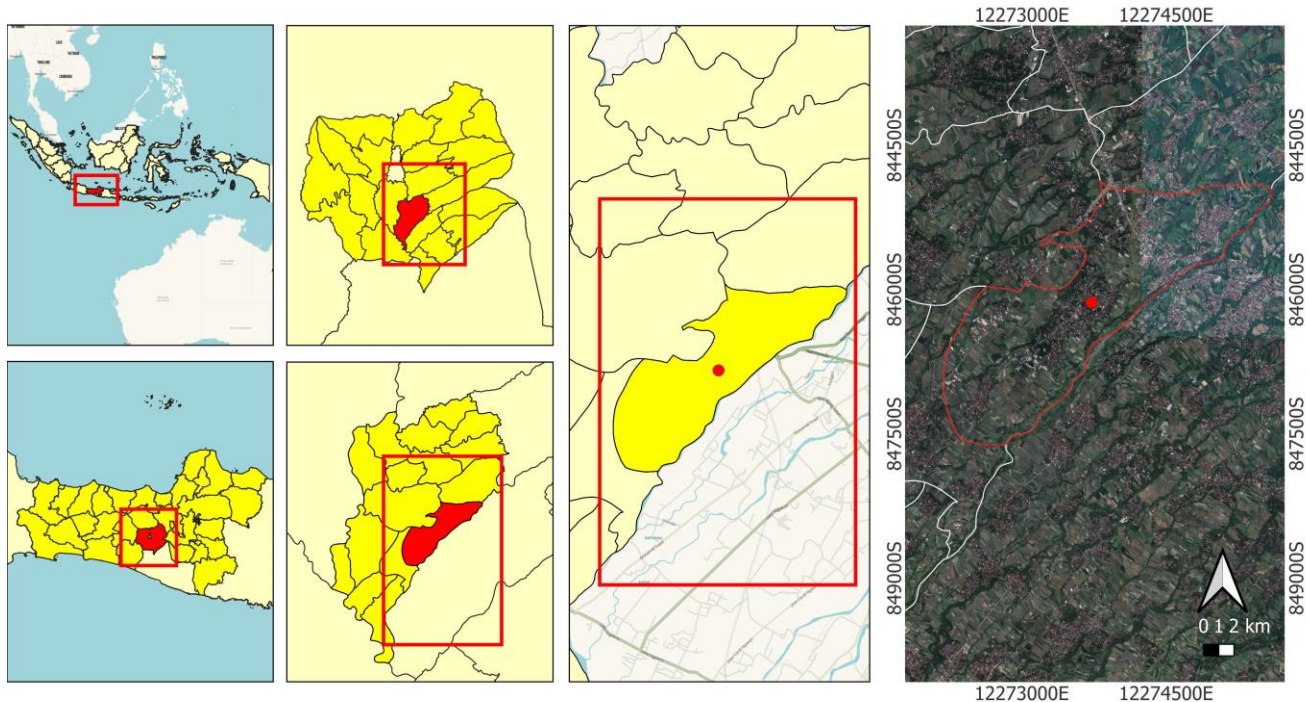


Figure 1. The location of Pabelan Islamic boarding school in Pabelan Village, Mungkid Sub-district, Magelang District, Central Java Province, Indonesia

Qualitative data regarding ecological functions in Pabelan Islamic Boarding School was conducted using in-depth interviews (Bungin 2007; Arikunto 2010) to school staff including the clerics (*kiai*), headmaster, and teacher (*ustaz*). Qualitative data was also collected by distributing questionnaires to students of class XII at school with total respondents of 52 students, representing 25 percent of the total students. The perception of the respondents was classified following Likert scale (Siegel 2011) with five levels, namely: strongly agree, agree, undecided, disagree, strongly disagree.

Data analysis

Vegetation data was analyzed to see its diversity and distribution. Index of diversity was calculated using the Shannon Weiner formula as follow:

$$H' = - \sum \frac{n_i}{N} \ln \frac{n_i}{N}$$

Where:

- H' : the diversity index of Shannon Weiner
- n_i : the number of a given species (i)
- N : total of individuals observed

The diversity index was used in determining the biodiversity level in the research area. According to Michael (1995) in Setyono and Himawan (2018), the value of H' < 1.5 indicates low diversity, 1.5 ≤ H' ≤ 3.5 indicates moderate diversity, and H' > 3.5 indicates high diversity.

The Evenness index shows the distribution of each individual in proportion to the area of the study. Odum (1996) in Hartoyo et al. (2021) categorizes Evenness index into several classes, namely: E < 0.5 shows uneven

distribution patterns, 0.5 < E < 0.75 shows moderately even distribution pattern and E > 0.75 shows an even distribution pattern. The Evenness (E) index was calculated as follows:

$$E = \frac{H'}{H_{max}} \text{ atau } E = \frac{-\sum p_i (\ln p_i)}{\ln S}$$

Where:

- E : evenness Index
- S : number of species
- H' : Shannon Weiner diversity index
- H_{max} : Shannon Weiner diversity index (Daget 1976; Solahudin 2003)

Data related to behavior patterns in environmental conservation at the Pabelan Islamic Boarding School resulted from the interviews with school staff were analyzed qualitatively in the form of descriptions of their ideas about ecotheology and sustainable environmental management. Ecotheology is an environmental epistemology based on theology that focuses on studying the relationship between religion and the environment. In particular, this epistemology shows religious concern for the universe through the interaction between theological values and human cosmic awareness which produces a reflection and harmonious human action towards the environment (Jacobus 2004; Wardani 2013).

Meanwhile, data resulted from questionnaires to students were analyzed quantitatively in the form of descriptions of measures of awareness and the concept of sustainability among students. Spearman correlation analysis was conducted to see the strength of the relationship between the level of action carried out by students with the knowledge and environmental values they obtained in the school. Statistical analysis was conducted using SPSS software Version 26.

RESULTS AND DISCUSSIONS

Plant diversity in Pabelan Islamic Boarding School

In total, there were 15 species of trees and 44 individuals recorded in Pabelan Islamic boarding school (Table 1). The result of analysis showed that plant community in the school had moderate diversity with Shannon-Wiener index (H') of 2.597. Pabelan Islamic Boarding School assigns new students to bring plants with a distinctive value to the area of origin, for example *matoa* (*Pometia pinnata*) from Papua. *Sawo beludru* (*Chrysophyllum cainito*) had the largest number of individuals and is recognized as endemic to the northern Central Java region of Karimunjawa. The second highest number of individuals is Norfolk cypress (*Araucaria heterophylla*) an introduced plant species.

The analysis of Evenness (E) index resulted in the value of 0.686, indicating moderately even distribution of species. This is reasonable because Pabelan Islamic Boarding School is located in the urban fringe area of Magelang City surrounded with fairly dense settlement in Pabelan Village. In addition, the school is also located adjacent to the Borobudur tourist area, adding the pressures on environmental conditions of the area. Environmental change follows anthropogenic preferences and utilization as indicated with the moderate Evenness index. In Pabelan Islamic Boarding School, a greater number of plants were cultivated in an area behind the mosque.

Based on conservation status, there are two species with conservation concern under the IUCN Red List namely *sonokeling* (*D. latifolia*) and Norfolk fir (*A. heterophylla*), both with Vulnerable status. *Sonokeling* is a type of wood of high economic value that is widely traded, triggering a decrease in individuals due to logging. The other species have least concern and not evaluated status (Figure 2).

Various plant species in Pabelan Islamic Boarding School provide various ecosystem services. Most importantly, the presence of the trees can regulate microclimate by providing shade which makes the area surrounding the school cooler and comfortable. Some species including *Ficus benjamina*, *F. microcarpa* and *F. retusa* are potential for carbon sequestration while also conserving soil and

water. Most plants also serve as habitat of fauna, such as birds and insects. Other species have economic value, for example to produce wood (e.g. *D. latifolia*), fruits (e.g. *G. gnemon* and *P. pinnata*), and biopharmaceuticals (e.g. *F. elastica* and *W. religiosa*). However, a species in the school is considered as invasive namely *L. leucocephala* which might suppress the growth of other plants.

According to Islamic teachings, planting trees to conserve the diversity of flora is a positive deed, or known as *shaleh*. The Holy Prophet (peace be upon him) said *No muslim plants a tree, but what is eaten from it as alms to him, and what is stolen from that plant is alms to him and does not belong to him but becomes alms to him* (HR. Imam Muslim, Hadith No.1552). The appeal is also reflected by the encouragement to do good deeds, such as planting trees, even though doomsday has come. In a hadith narrated by Anas (r.a.), the Prophet (peace be upon him) said *If the Day of Judgment is about to happen, while in the hands of one of you, there is a seed, then if he can plant it before the end of the world then let him plant it* (HR. Imam Ahmad).

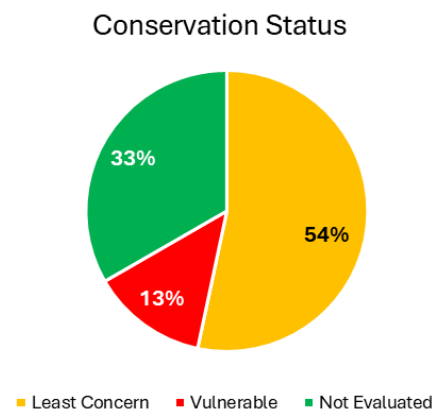


Figure 2. Conservation status of plant species in Pabelan Islamic Boarding School Magelang District, Central Java Province

Table 1. List of plant species in Pabelan Islamic Boarding School, Magelang District, Central Java Province

Scientific name	Local name	Number of individuals	pi	piLNpi
<i>Chrysophyllum cainito</i>	Sawo beludru	6	0.136364	0.271695
<i>Dalbergia latifolia</i>	Sonokeling	4	0.090909	0.21799
<i>Terminalia mantaly</i>	Ketapang kencana	1	0.022727	0.086004
<i>Gnetum gnemon</i>	Melinjo	2	0.045455	0.140502
<i>Terminalia catappa</i>	Ketapang	2	0.045455	0.140502
<i>Delonix regia</i>	Flamboyan	4	0.090909	0.21799
<i>Pometia pinnata</i>	Matoa	1	0.022727	0.086004
<i>Syzygium myrtifolium</i>	Pucuk merah	3	0.068182	0.183108
<i>Ficus elastica</i>	Karet kebo	2	0.045455	0.140502
<i>Ficus retusa</i>	Pohon bibis	2	0.045455	0.140502
<i>Ficus benjamina</i>	Beringin	3	0.068182	0.183108
<i>Araucaria heterophylla</i>	Cemara Norfolk	5	0.113636	0.247131
<i>Ficus microcarpa</i>	Beringin dolar	2	0.045455	0.140502
<i>Wrightia religiosa</i>	Anting putri	3	0.068182	0.183108
<i>Leucaena leucocephala</i>	Petai cina/Lamtoro	4	0.090909	0.21799
		44		2.596638

Perceived sustainable ecological functions by school staff

The Qur'an contains tremendous guidelines for caring the environment (Sardar 1985; Izzi and Mawil 1990; Nasr 1996; Khalid 2002; Qardhawi 2006; Mangunwijaya and McKay 2012; Wardani 2013). The Prophet, as the first interpreter of the Qur'an, conveyed some information through his hadiths on how a Muslim should behave towards the environment. The Holy Prophet (peace be upon him) said *Do not declare (cause harm) to yourself and others* (H.R. Ibn Majah). The word *dharar*, according to etymology, is the opposite of benefits; in other words, it can bring harm (*mudharat*) if done, impacting oneself or others. The word *dhirar*, according to etymology, is a deliberate recompense for the glory he receives. According to Deuraseh (2009), activities that cause damages, disturbances or destructions to life, public health, and other living things are *haram* (prohibited). The clerics (*Kiai*) in Islamic boarding schools, in addition to being guardians of Islamic treasures, also pay attention to the problems of contemporary society including issues about environmental management (Yafie 2006).

The universe must be seen as verses of the God (*Allah*) that guide humans to the truth. Nature was created by the God for humans, but it must be managed and maintained and used to understand the universe. This universe is the manifestation of God's willing, therefore, the basic principle of all Islamic teachings is *tawhid* (Kiai Ahmad Najib Amin, pers. comm.). These beliefs align with the Qur'an which reads *Verily Allah did not create his creatures in vain* (Q.S. Ali Imran/3:191). Every creature has value and meaning when created, as God says. In the surah, which reads *and we did not play games in creating the heavens and the earth and what is between them. We did not create both but with haqq (truth), but most of them did not know* (Q.S. Al-Dukhan/44:38-39). This is similar with the idea of Madjid (2000), which connects *tawhid* with the word tyrant (*taghut*). Madjid analysis can be used to relate the concept of monotheism to the environment. *Tawhid* towards the environment means viewing the universe as wholeness, beauty, and order, which is the opposite of tyranny or *taghut*. Being monotheistic towards the environment means humans must take care of the environment just as humans must surrender to God.

Humans should observe the greatness of God through the signs of nature (*kauniyah* verses). Therefore, bad deeds, such as irresponsible logging and throwing garbage into rivers, can cause disasters. The environment must be maintained and cared as the manifestation of love to God (Allah SWT). Islamic boarding students (*santri*) must learn about managing the environment, such as waste management. The principle is that nature is the mandate from God to humans, thus caring nature means obedience to God (Muhammad Mudzakir, Head of Pabelan Islamic Boarding School, perss. comm).

The above view is in line with the thinking of Nasr (2004) that nature, in the perspective of the Qur'an, can also be understood as a human means to enhance human theological consciousness. Surah Nasr says the Qur'an and the universe (cosmos) have a common form, i.e., the Qur'an

is a revelation on various written symbols and words collected and recorded, while nature is a revelation in cosmic form (*takwin*). This "primordial revelation" can be understood that the "Qur'an and nature" are the "holy books" of God.

Human is God's representative on the Earth, being entrusted to keep the Earth sustainable and comfortable using religion and science. Islamic boarding school (*pesantren*) is an educational institution to produce humans with environmentally conscious character. Humans must act trustfully and justly to the nature and environment (KH. Ahmad Najib Amin, pers. comm.). Therefore, *pesantren* can contribute to overcome environmental problems because it significantly shapes students' character with noble morals and high social awareness, as exemplified by the Prophet Muhammad.

Pabelan Islamic Boarding School aims to shape the character of its students responsible for *caliph fi al-ard* (representative on earth). The word *caliph* affirms the understanding that being a *caliph*/representation/representative of God is actually *a form of spiritual, individual, social and environmental responsibility of humans in managing and preserving the earth*. This understanding can reconcile the anthropocentric paradigm, which considers humans as the center of the universe, which actually needs nature as their source of life. Therefore, accepting this representation or trust means "serving." Therefore, humans need to use resources wisely and serve the earth by preserving it (Febriani 2014).

Humans must live in harmony with nature so that nature always gives good things to humans. Pabelan Islamic Boarding School teaches its students to always protect the natural environment by treating nature as a friend. For example, when practicing praying, the place and clothing for prayer as well as the body of the prayer must be clean/holy/pure from *hadas* (dirties). The Qur'an instructs humans to always mind all their actions when interacting with the environment to keep it balanced and to avoid ecological disasters (Febriani 2014).

Perceived sustainable ecological functions by students (*santri*)

The most important aspect in education is how education can influence humans to change individually and collectively. McKenzie-Mohr (1999) stated that to influence someone to change, the people who are invited to change understand the benefits or obstacles of change from their action/perspective. Therefore, someone must make choices through changes in their behavior. For example, recycling organic waste into compost means changing the habit of putting inorganic waste in the same bin into separate ones.

The results of the analysis to see the relationship between the level of environmental awareness and the level of action taken by students (N=52) showed the rho value of 0.492 (Table 2). This indicates a very significant positive relationship between the awareness of the students and their attitude and practices towards sustainable environment. In addition, the correlation between emotions/feels and care environmental sustainability also showed significant correlation with the rho value of 0.311. This result implies

that care to the environment is related to the emotions or feeling of the students (Table 2).

Interestingly, there is no correlation between environmental lessons in schools and caring for sustainability as shown by the low value of rho (0.024). This finding suggests that environmental lessons in the Pabelan Islamic Boarding School do not help students to carry out practices related to environmental sustainability. On the other hand, there is strong correlation between Islamic knowledge and care for environmental sustainability with rho of 0.137. This means that Islamic lessons garnered from the Pabelan Islamic Boarding School affect the attitude and practices towards sustainable environment (Table 2).

There were 30 questions in the questionnaires to determine students' perceptions of sustainability practices, attitudes, and values of Islamic teachings that they carry out in their daily lives. Table 3 shows the median value (mean), standard deviation (SD), and the total percentage of

strongly agree + agree (SA+A) given by students in each question.

The student's responses to the questions regarding awareness could be observed with the attitudes on their daily behavior and practices. These are reflected in the student's statements, who expressed an attitude of Strongly Agree (SA) and Agree (A). This data is then analyzed and sorted to explain an overview of their daily behavior on sustainability awareness, as categorized in Table 4.

In general, the students of Pabelan Islamic Boarding School have awareness and carry out sustainability practices, attitudes and behaviors, as well as emotions or feelings toward the environment. It turns out that Islam is the motivation for caring about environmental sustainability. However, there was no correlation between school lessons and sustainability practices (Table 2). This indicates that environmental lessons in *pesantren* are not effective to make students become more aware and concerned about the environment.

Table 2. The results of Spearman correlation test to see relationships between students' perceptions and attitude and practices towards sustainable environment

Aspects	Spearman Rho (p)	Conclusion
The awareness versus care for sustainability	0.492	Indicates a positive relationship
Emotion or feelings versus care for sustainability	0.311	Indicates a positive relationship
Environmental lessons versus care for sustainability	0.024	Indicate no relationship
Islamic lessons versus care for sustainability	0.137	Indicates a positive relationship

Table 3. Students' perception of practices, attitudes, and values of Islamic teachings related to environmental sustainability

Aspect being asked in the questionnaire	Mean	SD	Total (%) of SA+A
The <i>pesantren</i> curriculum includes lessons and understanding of the environment	4.08	0.74	85.54
The <i>pesantren</i> organizes environmental care activities regularly	4.30	0.65	87.15
The <i>pesantren</i> always reminds students to behave environmentally friendly	4.87	0.68	86.56
The <i>pesantren</i> provides adequate trash can facilities	3.76	0.73	75.45
The <i>pesantren</i> provides adequate green open space	3.67	0.69	53.70
The <i>pesantren</i> provides adequate infiltration wells and sanitation facilities	3.45	0.76	62.76
The student understands that human is God's representative on earth who has a mandate to care for the earth and prohibit to destruct it	4.20	0.64	90.12
The student cares about the environment because of Islam orders to care the environment and nature including water, soil, and air	4.58	0.62	90.38
The student always discusses the environment with friends	3.50	0.80	45.34
The student always takes the trash out of its place	4.32	0.76	85.23
The student reuses non-organic waste	3.43	0.91	26.50
The student composts the organic wastes, including food, to produce fertilizer	3.21	0.96	27.38
The student prefers to use natural products	3.10	0.87	28.76
The student limits the use of plastic to wrap things	2.89	0.99	19.83
The student passes on information about the environment to the family members	3.59	0.94	52.72
The student is involved in environmental activities at the <i>pesantren</i>	3.64	0.88	66.67
The student reads about environmental issues in the mass media	4.19	0.75	80.57
The issue of climate change is an essential modern human problem and is related to religion	3.89	0.59	82.70
The student tries to understand the issues about environmental degradation	3.42	0.69	79.70
The student appreciates the existence of biodiversity	4.32	0.72	93.27
The student concerns about the smoke and emissions emitted by motor vehicles	2.90	1.40	47.76
The student attempts to reduce the amount of waste by recycle it	3.78	0.93	52.81
The student saves the electricity use at home	3.86	0.91	56.59
The student saves water use	3.87	0.87	68.67
The overall level of sustainability, attitude, and wisdom in environmental awareness	3.86	0.85	

Note: SD: Standard Deviation; SA: Strongly Agree; A: Agree; Likert scale: 1.00-2.99 low; 3.00-3.99 medium; 4.00-5.00 high

Table 4. The categories of sustainability awareness by students

Category of awareness	Average response (%)	Note
Be aware and do sustainability actions	0 to 52%	Rarely done by students (<i>santri</i>)
Caring for environmental sustainability	53 to 62%	Students have a caring attitude between less and moderate
Emotion of concern	63 to 89%	Emotionally, students have a highly caring actions

Sustainability aspects asked in this study were related to environmental awareness and caring among the students which were then conveyed to the level of action. These actions, both individually and collectively, include (i) always discussing and conveying environmental concerns with friends around them; (ii) reusing non-organic waste; (iii) composting food scraps for fertilizer; (iv) using natural products; (v) avoiding plastic as wrapping to reduce waste, (vi) convey information about the environment to family members around them, and (vii) engage in environmental activity. These seven sustainability aspects are categorized as things students rarely do in their daily behavior (Table 3).

The study indicated that environmental teaching in *pesantren* did not correlate with the caring/awareness behavior of the students, even though the students admitted that they understood environmental education in their *pesantren* (85.54%) (Table 3). The caring behavior and attitudes of the students grow and develop due to the visionary figure of the *Kiai* and adherents of progressive theology in environmental management. Furthermore, the advantages possessed by these *kiai* are that the students still respect them, even though the students have a different perspective from them. In some cases, *Kiai* is the founder and the owner of *pesantren* (Siregar 2013). There are two factors behind the position of *Kiai* very authoritative and powerful, not only in internal, but also in external of the *pesantren*. Internally, a *kiai* in a *pesantren* usually has high self-confidence in Islamic knowledge, powerful authority, and management (Dhofier 2011).

Similarly, students generally agree that Islam teaches to care the environment and conserve the nature elements, including water, soil, and air (90.38%). Students realize that humans are God's representatives on earth who are mandated to care the earth and prohibited to destroying it (90.12%) (Table 3). Islam generally provides inherent guidance on environmental conservation (Anas, pers. comm.). Therefore, *santri* believes that religion strongly encourages activities and actions that care the Earth that positively impact life. This understanding can be used as a reference by the students in their activities which eventually lead as habits. The knowledge regarding the environment, as well as biodiversity, is important to carry out more focused environmental activities and making important contributions to conserving natural resources.

This research revealed five roles that can be explored and even improved in environmental sustainability, namely: (i) emotions can be a positive advantage to carry out environmental actions that lead to its sustainability; (ii) sustainability action certainly requires good, well-organized means or media so it would be real activities or actions on the environment; (iii) students need to improve their

understanding of sustainability measures related to the environment, because they could do positively in their sustainability efforts, individually or in groups, for example in making compost from food waste for fertilizer which is rarely done by students; (iv) sustainability measures can be encouraged to foster awareness by facilitating students in environment-themed discussions; (v) the student's knowledge and awareness on Islam that emphasizes the environment is part of its teachings, can be used as capital to increase awareness as well as concrete actions in *pesantren* and surrounding communities.

Emotions and concerns can be positive capital for carrying out sustainable environmental actions. But in its implementation, it requires good and well-organized facilities or media as well. To carry out activities or concrete actions on the environment, students must enrich their understanding of environmental sustainability. In this regard, Islamic boarding schools must have environmental projects that involve the students to develop a culture of sustainable environment.

In conclusion, Pabelan Islamic Boarding School has a great diversity and abundance of flora so this school can be categorized as a green *pesantren*. This is the result of the school policy that requires every new student to bring seeds of rare or unique plant species from their hometown to be planted in the *pesantren* area. It also implements religious commandments (*hadits*) that tell people to have planting habits. The staff at Pabelan Islamic Boarding School have progressive thinking and practices about *kauniyah* (observable) verses related to a sustainable environment. They translate theological verses of environment into technical and scientific means, such as environmental jurisprudence, disaster jurisprudence, and ecotheology, which have less attention. *Santri* of Pabelan Islamic Boarding School has moderate awareness and concern for sustainable environment. However, there is no significant relationship between the environmental lessons taught in the school and their environmental care behavior ($p = 0.024$). Instead, students' behavior towards the environment is more influenced by the Islamic values taught by the clerics (*kiai* and *ustaz*) of the Pabelan Islamic Boarding School. The findings of this study imply that Islamic boarding school (*pesantren*) can play essential role in practicing and raising awareness of sustainable environmental management and biodiversity conservation.

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