Artificial Intelligence and Ecotheology: A Tree Planting Movement Towards a Globally Competitive Indonesia

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Abstract

This study examines the integration of Artificial Intelligence (AI) and ecotheology in supporting tree-planting initiatives in Indonesia. Using a descriptive qualitative approach, data were collected through questionnaires from 40 respondents and analyzed descriptively. The findings reveal limited AI awareness, with 57.5% of respondents unaware of its application in identifying degraded land using satellite imagery and drones. However, 67.5% strongly associated environmental stewardship with tawhid, and 62.5% strongly supported conservation programs based on Islamic values. Integrating AI and ecotheology offers opportunities to strengthen digital and spiritual literacy, ecological responsibility, and environmental advocacy. Nevertheless, challenges include weak stakeholder collaboration, limited AI expertise, low educator awareness, and insufficient training. This integration may provide an alternative approach to advancing tree planting, environmental restoration, and sustainable development in Indonesia.
Keywords: Artificial intelligence, ecotheology, tree planting.

Introduction

Climate change and the global ecological crisis have become among the greatest challenges faced by humanity in the 21st century. The Intergovernmental Panel on Climate Change (IPCC, 2022) reported that global temperatures have risen by approximately 1.1°C compared to the pre-industrial era, leading to an increase in the frequency of hydrometeorological disasters such as floods, droughts, and forest fires (IPCC, 2022). In Indonesia, data from the Ministry of Environment and Forestry (KLHK, 2022) recorded that the country's deforestation rate during the 2019–2020 period reached 115.5 thousand hectares per year (KLHK, 2022). Moreover, Indonesia's Environmental Quality Index (IKLH) in 2022 stood at only 69, reflecting the persistently low quality of air, water, and land cover (KLHK, 2022). KLHK (2023) also reported that in 2022, more than 2.6 million hectares of degraded

land required rehabilitation (KLHK, 2023). These conditions indicate that environmental preservation is not only an ecological necessity but also a strategic imperative for the nation's sustainability.

Tree-planting movements have emerged as one of the most tangible initiatives for mitigating environmental degradation. For example, the *National Watershed Rehabilitation Movement* launched by the Ministry of Environment and Forestry targets the rehabilitation of millions of hectares of degraded land each year (KLHK, 2023). Nevertheless, various evaluations indicate that the effectiveness of tree-planting initiatives is often hindered by weak planning, insufficiently accurate data, and limited community engagement in post-planting maintenance (BPS, 2022). Many planted trees fail to survive due to inappropriate site selection, unsuitable species, or the absence of continuous monitoring. On the other hand, advances in digital technology, particularly Artificial Intelligence (AI), present significant opportunities to enhance the effectiveness of tree-planting initiatives. By leveraging AI, the identification of degraded land can be conducted more rapidly and accurately, while also enabling predictions of species suitability based on local soil and climate conditions (Kumar & Bhaduri, 2021). Moreover, AI technologies can be employed to monitor tree growth in real time through satellite imagery and drones, thereby ensuring greater sustainability of reforestation programs (Joppa, 2017).

Indonesia, as a country endowed with abundant natural resources and home to the world's largest Muslim population, occupies a strategic position in addressing these challenges. Nevertheless, the persistent rates of deforestation, environmental pollution, and ecosystem degradation indicate that environmental management in Indonesia requires a more integrative approach that is grounded not only in regulation but also in spirituality and technology (Rifkin, 2019). In other words, there is a need for an approach that integrates religious values with modern technology, such as the concept of ecotheology. Ecotheology emerges as a new paradigm that integrates spiritual, ethical, and ecological dimensions. It views nature as a divine trust (*amānah*) that must be preserved, thereby positioning tree-planting initiatives not merely as ecological acts but also as spiritual practices of worship (Al-Attas, 1993). These spiritual values can serve as a foundation for cultivating ecological awareness within society. Through the lens of ecotheology, environmental conservation is not solely the responsibility of the government but also a collective moral and spiritual movement that harnesses technological advancements (Haq, 2001).

Alongside technological advancements, Artificial Intelligence (AI) offers significant opportunities for monitoring and mitigating environmental problems. AI can be applied in early warning systems for forest fires, mapping disaster-prone areas, monitoring air quality, and accurately estimating carbon stocks (Kumar & Bhaduri, 2021). The integration of this technology with the values of ecotheology enables the development of a faith and data-based model of environmental management, which may serve as a significant contribution from Indonesia at the global level. Indonesia's strength lies not only in its geographical and demographic aspects but also in its robust religious social networks, such as Islamic boarding schools (*pesantren*), Islamic mass organizations, and Qurʾānic educational institutions. These institutions can be mobilized as pioneers of reforestation and environmental conservation. For example, mosque-based community tree-planting programs have proven to be more sustainable, as they are supported by collective awareness and spiritual values (UNEP, 2022).

In international forums such as the COP, G20, and the Islamic World Forum, Indonesia holds considerable opportunities to demonstrate leadership on environmental issues. Through AI-based documentation, Indonesia's concrete actions in tree-planting initiatives and ecosystem restoration can be presented in a transparent and accountable manner. This, in turn, would strengthen Indonesia's bargaining position in global environmental diplomacy (UNFCCC, 2022). This paper seeks to address ecological challenges by proposing an integrative approach that combines Artificial Intelligence and ecotheology. Employing a qualitative method, it analyzes the role of AI in supporting faith-based environmental movements, particularly tree-planting initiatives aimed at fostering a globally competitive Indonesia. Furthermore, the contribution of this study is intended to be relevant not only at the local level but also as part of Indonesia's contribution to shaping a global narrative that is humanistic, religious, and technology-based.

Methods

This study employed a descriptive qualitative approach to examine the integration of Artificial Intelligence (AI) and Islamic ecotheology in supporting tree-planting initiatives in Indonesia. Primary data were collected through questionnaires from 40 respondents across various regions, while secondary data were obtained from relevant scientific literature. The questionnaire explored respondents' involvement in environmental conservation, knowledge of AI applications in land identification, crop suitability analysis, satellite imagery, drones, machine learning, and reforestation monitoring, as well as their understanding of Islamic environmental values and perceptions of the opportunities and challenges of integrating technology and spirituality. Data were analyzed descriptively through data organization, reduction, interpretation, and percentage calculations to identify patterns in respondents' knowledge and perceptions. The analysis focused on technological awareness and ecotheological values, including tawḥīd, environmental stewardship, and ecological balance. Findings regarding opportunities, such as faith-based environmental education, digital and spiritual literacy, and AI-supported environmental advocacy, as well as challenges, including limited stakeholder collaboration, technical expertise, awareness, and training, were interpreted in relation to relevant literature on AI, environmental conservation, reforestation, and Islamic ecotheology.

Results

The findings of this study aim to analyze the relationship between artificial intelligence and ecotheology through several key aspects: respondents' experiences of participating in communities or institutions engaged in environmental conservation, their level of awareness regarding the role of artificial intelligence in addressing environmental issues, the perceived relationship between faith and innovation as a driving force for environmental action, as well as the opportunities and challenges arising from the integration of spirituality and science in tree-planting movements. To gather this information, the author designed a questionnaire that was distributed to 40 respondents from various regions. The responses were then synthesized and reduced according to the needs of this study, and the key results are presented below. First, with regard to whether respondents had ever participated in an institution or community focused on environmental conservation, as well as the types of activities they had engaged in for

environmental preservation. The results of the questionnaire from 40 respondents are as follows:

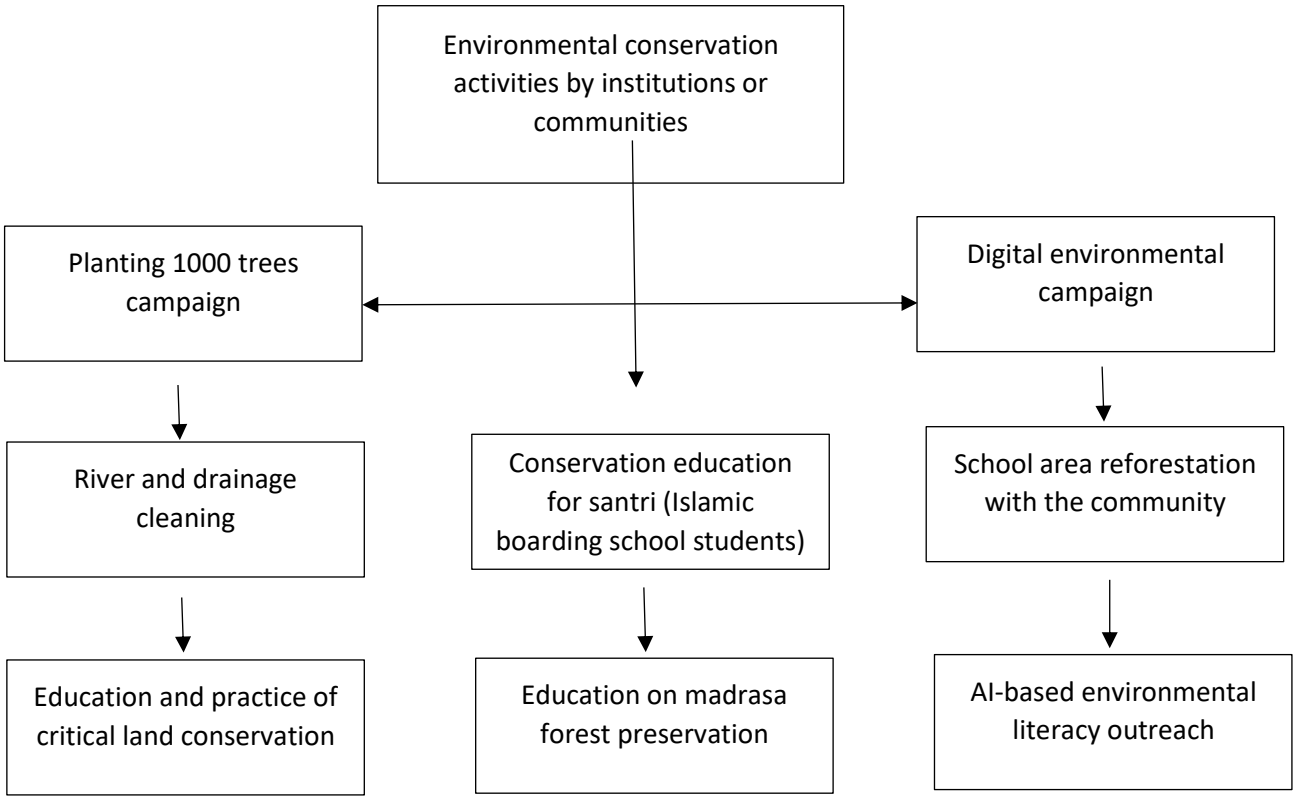


Figure 1. Quesioner result 2025

Based on Figure 1, it can be concluded that the majority of respondents had joined institutions or communities focused on environmental conservation. Several initiatives were reported, including the "Plant 1,000 Trees" campaign, digital environmental campaigns, river and canal cleanups, conservation outreach for *santri* (Islamic boarding school students), school reforestation programs in collaboration with local residents, education and practice on critical land conservation, forest stewardship education in *madrasah* settings, and environmental literacy outreach incorporating artificial intelligence.

Table 1. Opportunities for the Integration of Spirituality and Science

No.	Interpretation
1.	Character education based on faith and technology
2.	Fostering digital and spiritual literacy
3.	Bringing humans closer to spiritual responsibility toward nature
4.	Artificial intelligence da'wah for the sustainability of the Earth

Based on Table 1, the responses of 40 participants were analyzed and condensed into four interpretations regarding the opportunities arising from the integration of spirituality and science in green planting initiatives. First, the integration of spirituality and science can foster character education grounded in faith and technology; second, it can enhance both digital and

spiritual literacy; third, it can bring individuals closer to their spiritual responsibility toward nature; and fourth, it can promote artificial intelligence-based advocacy for the sustainability of the Earth.

In addition to presenting data on the opportunities arising from the integration of spirituality and science, the study also highlights the challenges posed by such integration in the context of green planting initiatives. The results from the questionnaire of 40 respondents are presented in Table 2:

Tabel 2. Challenges of Integrating Spirituality and Science

No.	Interpretation
1.	Lack of synergy among stakeholders
2.	Limited human resources with expertise in artificial intelligence
3.	Low awareness among educators of the importance of science and artificial intelligence
4.	Insufficient training for educators on artificial intelligence

Based on Table 2, the responses of 40 participants were analyzed and condensed into four interpretations regarding the challenges of integrating spirituality and science in green planting initiatives. First, there is a lack of synergy among stakeholders; second, there is a shortage of human resources skilled in artificial intelligence; third, there is low awareness among educators regarding the importance of science and artificial intelligence; and fourth, there is insufficient training for educators on artificial intelligence.

Discussion

Environmentally-Oriented Ethics Based on Spirituality

Ecological crises such as climate change, deforestation, environmental pollution, and the loss of biodiversity have raised global awareness of the need for a new paradigm in the relationship between humans and nature. Although various scientific approaches and technical policies have been implemented, they have not fully addressed the root problems, which are inherently moral and spiritual. In response to this, ecotheology has emerged as a framework to address the increasingly alarming global ecological crisis. Furthermore, ecotheology provides a sacred dimension to environmental ethics, whereby nature is valued not only for its utility to humans but also as a creation of God that deserves respect and protection. According to Seyyed Hossein Nasr, ecotheology represents an effort to restore the sacred dimension in the understanding of nature, where knowledge of the cosmos is inseparable from knowledge of God. The universe is an open book that reveals divine wisdom, and only through the restoration of awareness of human sacredness can humans repair their relationship with nature and prevent more severe ecological degradation (Nasr, 1989).

According to Jamin et al., ecotheology is described as a constructive theology centered on nature. Its aim is to create a balanced interaction between living beings and the environment through a religious approach. Ecotheology not only seeks to identify issues arising from the interaction between nature and religion but also generates potential harmonious solutions (Jamin et.al., 2024).). It situates the relationship between humans and the environment within

the broader context of humans' relationship with God, in which the stewardship of the Earth is understood as an expression of spiritual obedience and ethical responsibility toward the Creator (Nash, 1991). This concept has developed in response to the global ecological crisis, which is not only scientific in nature but also reflects issues of values, morality, and the worldview of modern humanity. From the ecotheological perspective, the primary cause of environmental degradation is not merely technological or economic; it stems from the desacralization of nature, the loss of the view that nature is a manifestation of transcendent reality (Nasr, 1989).

One of the core theological values underpinning the stewardship of the Earth is the concept of the sacredness of creation. In many religious traditions, nature is regarded as God's creation, deserving of respect and protection. In Islam, for example, humans are granted the mandate as *khalīfah* (stewards) on Earth to maintain balance and avoid causing harm. This is reflected in Qur'an, Surah Al-A'raf, verse 56 (Soenarjo et.al, 1971):

وَلَا تُفْسِدُوْا فِى الْاَرْضِ بَعْدَ اِصْلَاحِهَا وَادْعُوْهُ خَوْفًا وَّطَمَعًاۗ اِنَّ رَحْمَتَ اللّٰهِ قَرِيْبٌ مِّنَ الْمُحْسِنِيْنَ

Its meaning: "Do not cause corruption on the Earth after it has been set in order. Pray to Him with reverence and hope. Indeed, the mercy of Allah is near to those who do good."

Another theological value is the interdependence of all creatures, which asserts that all creation is interconnected within a harmonious cosmic order. Accordingly, human actions toward nature carry not only ecological consequences but also spiritual significance. Environmental degradation is viewed as a betrayal of the divine mandate and a violation of ecological justice (McFague, 2008). Therefore, the act of caring for the Earth is not merely a physical activity but also an act of worship and an expression of love toward God and His creation. This is further emphasized in Qur'an, Surah Al-Baqarah, verse 30 (Soenarjo et.al, 1971):

وَاِذْ قَالَ رَبُّكَ لِلْمَلٰۤئِكَةِ اِنِّيْ جَاعِلٌ فِى الْاَرْضِ خَلِيْفَةًۗ قَالُوْٓا اَتَجْعَلُ فِيْهَا مَنْ يُّفْسِدُ فِيْهَا وَيَسْفِكُ الدِّمَآءَۚ وَنَحْنُ نُسَبِّحُ بِحَمْدِكَ وَنُقَدِّسُ لَكَۗ قَالَ اِنِّيْٓ اَعْلَمُ مَا لَا تَعْلَمُوْنَ

Its meaning: "(Remember) when your Lord said to the angels, 'I will appoint a *khalīfah* on Earth.' They said, 'Will You appoint someone who will cause corruption and shed blood there, while we glorify and sanctify Your name?' He said, 'Indeed, I know what you do not know.'"

Based on Qur'an, Surah Al-Baqarah, verse 30, it is evident that humans are appointed as *khalīfah* on Earth, signifying that humans are chosen as God's representatives to manage the planet, not to exploit it indiscriminately. This appointment carries two important dimensions. First, the territorial or authority dimension, which means that humans are granted the freedom to utilize natural resources, but within the boundaries of *shari'ah* and moral principles. Second, the responsibility or *mas'ūliyyah* dimension, which implies that humans are accountable for their actions toward the environment, as all deeds will require justification. In an ecological context, the concept of *khalīfah* demands principles of management that are just, sustainable, and ethically sound regarding natural resources. This must be carried out with full awareness that the Earth is not an absolute possession of humans but a trust from the Creator (Syauqi et.al.,2025).

In an article, Vella & Derry describe several characteristics of humans as *khalīfah* (Vella & Rizal, 2024):

a. Literally, humans possess inherently good nature and do not inherit sin.

b. The relationship between the body and the soul produces the *khalīfah* quality, distinguishing humans from other creatures.
c. Humans, as *khalīfah*, have free will, meaning they possess the freedom to determine their own actions.
d. Humans are endowed with reason, which enables them to discern between right and wrong.

From the previous discussion, it can be reiterated that ecotheology is a branch of theology that examines the relationship between religious beliefs and the natural environment. Nature is not regarded merely as an object for exploitation but as an integral part of God's creation, possessing intrinsic value and requiring care. Ecotheology emphasizes that humans, as spiritual beings, bear moral and theological responsibility for the integrity of creation (*creation care*), including through concrete actions such as tree planting (Nash, 1991).

Tree-planting initiatives within the context of ecotheology are not merely ecological actions but also expressions of social worship that reflect concern for the sustainability of communal life. In many religious traditions, trees carry symbolic meaning as sources of life, shade, and continuity. Planting trees also embodies the principles of ecological justice, which underpin ecotheology. Ecological justice entails the notion that all creatures have the right to live and thrive within a balanced ecosystem. Therefore, tree planting can be understood as a restorative action that reestablishes ecological harmony disrupted by modern human activities, such as deforestation, excessive urbanization, and carbon emissions (Hessel & Ruether, 2000).

From the perspective of social worship, tree-planting initiatives contribute to community well-being by providing oxygen, reducing air pollution, improving soil quality, and preventing ecological disasters such as floods and landslides. Additionally, tree-planting activities create green spaces that can serve as venues for environmental education and spiritual contemplation. Tree planting carries its own liturgical value, as it is regarded as a form of prayer manifested through tangible action. Through planting trees, humans express their prayers not only in words but also through acts that give life (McFague, 2008). As highlighted by the Head of the Regional Office of the Ministry of Religious Affairs in North Sulawesi, H. Ulyas Taha, the "One Million Matoa Trees Planting Movement," carried out simultaneously on the 55th Earth Day, exemplifies the Ministry's tangible commitment to environmental sustainability (Kanwil Kemenag Sulut, 2025).

The "One Million Trees Planting Movement" is regarded not merely as a tree-planting activity but as an act of worship and a moral responsibility for religious communities to care for and preserve God's creation. According to the program's coordinator, this initiative serves as a momentum to foster collective awareness across religions and generations. In particular, the *matoa* tree is not only an endemic species but also offers multiple benefits: it contains vitamins C and E, has a sweet taste reminiscent of a mix between rambutan and durian, and is believed to possess high antioxidant properties. Additionally, it contributes to health benefits and provides shade and aesthetic value, making it suitable for greening various areas (Kanwil Kemenag Sulut, 2025).

Implications of AI- and Ecotheology-Based Tree Planting Movements for Global Competitiveness

Indonesia's Role in Global Affairs through Faith- and Technology-Based Environmental Action

Indonesia holds a strategic position in global affairs due to two major strengths: its natural resources and its large Muslim population. First, Indonesia's geographic position along the equator makes it home to the world's third-largest tropical rainforest, abundant biodiversity, and marine and terrestrial ecosystems that are ecologically crucial for global climate stability. Second, Indonesia is the world's most populous Muslim-majority country, with a population that largely embraces strong religious values. This combination of ecological wealth and faith-based social strength provides Indonesia with a unique foundation to lead the global narrative that integrates faith and technology in caring for the Earth. In this context, Indonesia can not only implement global environmental policies, but also generate ideas and values capable of inspiring the world (Al-Attas, 1993).

In addressing climate change and global ecological crises, spiritual and ethical approaches are increasingly recognized as essential, as the world realizes that environmental crises are not merely technical mismanagement of resources, but also crises of values damage in the way humans perceive nature. Therefore, a more holistic approach is needed, one that not only focuses on regulations but also touches the deepest human awareness through spiritual values. With its strong religious culture, Indonesia can promote an environmental management model emphasizing moral responsibility as God's creatures. The Islamic concept of *rahmatan lil 'alamin*, for instance, can serve as an ethical foundation for environmental preservation. When nature is no longer seen merely as an object of exploitation, but as part of a sacred life system to be protected, sustainable ecological behavior will emerge (Rifkin, 2019).

The use of AI in environmental monitoring systems is evidence that Indonesia is ready to lead with a data- and faith-based approach. Digital transformation has already entered the environmental sector, including in Indonesia, where various technologies have been applied to monitor and manage the environment in real time. Artificial Intelligence (AI) is used in applications such as early warning systems for forest fires, mapping landslide- and flood-prone areas, and calculating potential carbon stocks in conservation areas. The combination of AI with principles of faith presents an innovative and grounded dual approach. Technology enables accuracy and speed, while spiritual values provide direction and meaning. Thus, Indonesia can demonstrate to the world that environmental solutions are not only about tools and policies, but also about a moral vision driven by spiritual commitment (Kumar & Bhaduri, 2021).

This is further supported by Indonesia's strength in its religious social networks, namely pesantrens, Islamic organizations, and educational institutions that can be mobilized as pioneers of green movements. One of Indonesia's greatest assets in the socio-ecological context is its strong, organized, and widespread faith-based community structures, reaching even rural areas. Millions of students in pesantrens, thousands of Islamic schools, as well as organizations such as Nahdlatul Ulama and Muhammadiyah have tremendous capacity to shape public opinion and collective behavior. When these networks are synergized for environmental missions, they can form a robust and sustainable grassroots movement. Campaigns for tree planting, river clean-ups, mosque-based waste management, and ecological literacy through traditional Islamic texts (*kitab kuning*) are concrete examples of how religious strength can be directed toward environmental sustainability. This is Indonesia's unique strength not found in many other countries (UNEP, 2022).

In international forums, Indonesia can present not only promises but also well-documented real actions through AI technology. A country's international reputation on environmental issues is now determined by two things: commitment and evidence of

implementation. In various forums such as COP UNFCCC, G20, and the Islamic World Forum, Indonesia has great opportunities to demonstrate leadership through policy, community participation, and technological innovation. AI-based reporting systems can provide credible and verifiable data on how much forest area has been rehabilitated, how much carbon emissions have been reduced, and how many communities have been engaged in environmental programs. With data-based documentation, Indonesia not only makes promises to the world, but also demonstrates integrity and accountability. This adds value in strengthening bargaining positions in global negotiations (UNFCCC, 2022).

Faith-based environmental movements can also serve as cultural diplomacy tools, especially since Indonesia has rich Islamic values that align with principles of environmental preservation. Concepts such as *tawazun* (balance), *amanah* (responsibility), and *ishlah* (improvement) can be used as narrative content in cultural diplomacy. When environmental movements are combined with these principles and packaged in international programs, Indonesia becomes a country offering universal spiritual values. In this case, green diplomacy is not only political but also a medium for spreading goodness values that are accepted by all religions and nations. Promoting environmentally friendly Islamic values can be Indonesia's contribution to sustainable and ethical global development. Thus, environmental movements are not only about saving nature, but also about spreading messages of peace and collective human responsibility (Haq, 2001).

With all these strengths, Indonesia is not merely a participant but a leader in global affairs, bringing forward the narrative that technology and faith can unite for the benefit of the Earth.

Conclusion

The integration of artificial intelligence and ecotheology presents an opportunity for Indonesia to address ecological challenges while strengthening its global competitiveness. Artificial intelligence has proven effective in enhancing the identification of critical land, selecting plant species, and monitoring reforestation in real time, while ecotheology fosters spiritual awareness that protecting the environment is part of worship and an expression of tauhid. Although most informants do not yet fully understand the role of artificial intelligence, they hold a strong belief that environmental conservation is a religious obligation. Therefore, the synergy between faith and technology can serve as the foundation for a sustainable reforestation movement, while also reinforcing green diplomacy and Indonesia's image in international forums as a religious, innovative, and environmentally conscious nation.

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Conflict of interests

The authors declare that they have no conflict of interest.

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