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# -OPENING CEREMONY-

DATE: 12.12.2025 / TSI TIME-$10^{00}$ : $10^{30}$
VENUE: FACULTY OF ENGINEERING, ERCIYES UNIVERSITY
(F BLOK KONFERANS SALONU)
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# -PANEL SESSION-

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RHG Enertürk Enerji Mühendislik ve Teknik Destek Müdürü
"Net-Sıfır Yolculuğunda Sürdürülebilirlik Uygulamaları"

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## 13.12.2025 / Online Session-1 / Hall-5 / TSI Time-$10^{00}$:$12^{00}$

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HEAD OF SESSION: Asoc. Prof. Dr. Sonila Sinjari

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| **Denisa KUKAJ**<br>**Assoc. Prof. Dr. Sonila SINJARI**<br>**Xhesian BALILI** | University of Tirana, Albania | GEOSPATIAL MONITORING OF AIR QUALITY IN TIRANA |
| **Asoc. Prof. Dr. Sonila Sinjari**<br>**Res. Assist. Oltion Pupi**<br>**Asoc. Prof. Dr. Ferim Gashi** | University of Tirana, Albania<br>University of Prishtina, Kosovo | LEVERAGING LOCAL SOLAR RESOURCES IN A HYDROPOWER-DOMINATED SYSTEM: POLICY AND PLANNING LESSONS FROM THE DURRËS REGION (ALBANIA) |
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# FORESTS AS PEDAGOGICAL SPACES FOR ENERGY RESILIENCE: ECOLOGICAL BASED CHRISTIAN RELIGIOUS EDUCATION CURRICULUM DESIGN IN POST-DISASTER INDONESIA

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## Abstract

Indonesia faces a high level of ecological vulnerability due to deforestation, climate change, and weak natural resource governance, resulting in increased flooding and landslides as well as declining energy resilience. These challenges are not merely technical–environmental issues but also reflect a broader social, moral, and pedagogical crisis, including low levels of ecological literacy within society. In this context, Christian Religious Education (CRE) holds strategic potential to cultivate ecological awareness and faith-based responsibility for the care of creation. This study aims to formulate an ecology-based CRE curriculum design that utilizes forests as pedagogical spaces to strengthen energy resilience in post-disaster contexts in Indonesia. The research employs a qualitative method with a literature review approach, involving thematic analysis of Scopus-indexed scholarly publications alongside official government and reputable institutional sources. The findings indicate that deforestation significantly contributes to ecosystem degradation, disruption of hydrological and natural energy cycles, and heightened disaster risks. Post-disaster forests can function as transformative pedagogical spaces through action-based learning practices such as reforestation, field observation, and theological–ecological reflection. In conclusion, an ecology-based CRE curriculum that integrates creation theology, contextual pedagogy, and energy resilience issues has strong potential to enhance the role of Christian religious education in ecological recovery, disaster risk mitigation, and the formation of post-disaster recovery agents oriented toward human flourishing or *shalom*.

**Keywords:** Christian Religious Education; forest as pedagogical space; ecological curriculum design; reforestation; energy resilience

## Introduction

Indonesia is one of the countries with the highest levels of ecological vulnerability in the world, resulting from the combined pressures of environmental degradation, climate change, and sustained land-use intensification. One of the most prominent drivers of this vulnerability is deforestation. As noted by (Indrajaya et al., 2022), deforestation in Indonesia reached particularly high levels between 1970 and 2000, driven by the expansion of the timber industry, large-scale land clearing, forest fires, and the issuance of concession permits. Subsequently, deforestation declined gradually and experienced a significant reduction between 2015 and 2019, falling to below one million hectares per year. This decline has been associated with a decrease in forest and land fires, as well as the effects of improved forest governance and policy reforms, particularly in peatland and mangrove restoration initiatives and the strengthening of community participation in forest management.

From 2020 to 2025, deforestation in Indonesia increased sharply due to the pulp and paper industry and the expansion of oil palm plantations. Analysis by Auriga Nusantara shows that Indonesia's deforestation in 2023 reached 257,384 hectares, an increase of 26,624 hectares compared to 2022 (Kompas, 2024). As a case example in North Sumatra, deforestation has become a concern for many researchers, who emphasize that deforestation has occurred continuously in the forests of North Sumatra due to various space-intensive extractive industrial activities carried out by the industrial timber plantation company PT Toba Pulp Lestari; satellite imagery analysis shows that during the period 2013–2016, approximately 2,108 hectares of natural forest were lost within the company's concession area, indicating that PT Toba Pulp Lestari violated its

commitment to no longer conduct natural forest logging, even though the natural forest was located within its concession, while oil palm plantations located within the forest concession area (HPH) of PT Teluk Nauli in North Sumatra, which is situated within a designated forest zone, have demonstrated neglect and even violations by the government and business actors holding concession permits with respect to the applicable laws and regulations. Selanjutnya, yang perlu mendapatkan perhatian besar adalah deforestasi yang semakin meningkat di Kalimantan dan Maluku dengan kasus yang hampir sama dengan yang diungkapkan di atas (*Deforestasi_tanpa_henti_2013-2016_lowress*, 2018).

Demikian pula, Mongabay menyatakan bahwa Royal Golden Eagle (RGE) telah berkomitmen pada kebijakan "no-deforestation", namun perusahaan ini tetap melakukan deforestasi hutan alam di Kalimantan melalui pemasok kayunya sejak 2016, terutama oleh PT Industrial Forest Plantations. Hal ini menyoroti bahwa klaim perusahaan belum sepenuhnya tercermin dalam praktik, dan bahwa risiko deforestasi semakin tinggi (Indriyatno, 2023).

At the end of November 2025, a series of severe floods and landslides struck three provinces in Indonesia—Aceh, North Sumatra, and West Sumatra—resulting in loss of life and causing extensive damage to settlements, infrastructure, and forest ecosystems. A report from the National Disaster Management Agency dated December 14, 2025, indicates that the floods and landslides caused 1,006 deaths, 217 people to be reported missing, 5,400 injuries, and damage to 158,000 houses across 52 affected regencies and municipalities (*Geoportal Data Bencana Indonesia*, 2025). This demonstrates the very significant impacts of deforestation.

These large-scale floods accompanied by landslides have occurred very frequently in Indonesia. This situation should serve as a wake-up call for the government, actors in the forestry and oil palm plantation industries, and the wider public regarding the devastating impacts of deforestation. Particularly within religious communities, there appears to be a lack of moral awareness and pedagogical–religious consciousness concerning the importance of environmental (forest) stewardship. These ecological disasters should not be understood solely as technical or environmental problems, but also as social, religious, moral, and pedagogical crises. Therefore, the causes of recurrent floods and landslides are multidimensional, including weak natural resource governance, large-scale deforestation and land conversion, low levels of ecological literacy, and the fragility of ecological education within society.

This study focuses on the weakness of community-based ecological education, which affects levels of ecological literacy. Many people still have limited understanding of the meaning and functions of forests for human life, including energy resilience, the misuse of forests through deforestation and its impacts, forest theology, and the relationship between forests and religious communities. This condition highlights the need for ecological (forest-based) education for society, particularly within the context of Christian Religious Education, through the use of an ecological curriculum design. This curriculum emphasizes forests as learning spaces for energy resilience. The concept of forests as pedagogical spaces can serve as an innovative framework for strengthening Christian Religious Education and post-disaster ecological curriculum design in Indonesia, particularly in fostering awareness of sustainable energy and enhancing community energy resilience.

Accordingly, the purpose of this study is to formulate an ecology-based Christian Religious Education curriculum design that utilizes forests as pedagogical spaces to build energy resilience in post-disaster contexts in Indonesia. This approach positions forests not merely as objects of ecological study, but as theological, moral, and ecological learning spaces that provide direct experiential learning for students to understand the interconnectedness of ecosystem restoration, disaster risk mitigation, and sustainable energy resilience. Education, therefore, should play a strategic role in shaping ecological awareness and sustainability ethics as integral components of social and spiritual responsibility.

## Materials and Methods

This study employs a qualitative method with a literature review approach to develop an ecology-based Christian Religious Education curriculum design that utilizes forests as pedagogical spaces to build energy resilience in post-disaster contexts in Indonesia. The literature review approach was selected because this study does not involve field data collection; rather, it examines, integrates, and synthesizes theoretical concepts related to ecological theology, environmental pedagogy, curriculum, deforestation, and energy resilience, curriculum theory, as well as findings from relevant previous studies derived from trusted scientific research

sources (Scopus-indexed articles) and publications issued by official and credible governmental and non-governmental institutions.

The literature search process was conducted using combinations of key words and phrases such as ecological theology, forests, deforestation, Christian Religious Education, ecological education, energy resilience, and ecological curriculum design. The process included: (a) the selection of Scopus-indexed sources to ensure a high standard of academic quality; (b) source triangulation across various research articles and review studies to strengthen conceptual understanding; and (c) systematic thematic analysis to map key concepts and their interrelationships, ensuring that the curriculum design is grounded in robust and high-quality scientific findings.

## Findings and Discussion

### 1. Deforestation and Its Impacts

Scientific studies over the past five years have affirmed that deforestation has exacerbated environmental conditions, resulting in major disasters affecting human populations. Awareness of the need to conserve forests remains very low, as humans often overlook the extensive impacts of deforestation. The impacts of deforestation have been documented in various studies; for example, research by Parsons et al. (2021) demonstrates that deforestation in tropical countries has significantly increased temperatures beyond natural climate variability. This condition has led to the loss of forests' natural cooling services and has intensified heat-related health risks for human populations. It has also resulted in a reduction in safe working hours for outdoor workers—those employed in agriculture, fisheries, and forestry—thereby constraining labor productivity due to the loss of more than 0.5–2 safe working hours per day during the period 2003–2018. This indicates that deforestation is not only an ecological issue but also a public health concern and a problem of economic productivity.

King et al. (2024) emphasize that deforestation in tropical regions generally leads to increased surface temperatures, reduced cloud cover, decreased evapotranspiration, and disruptions to precipitation patterns and atmospheric circulation. The loss of forests causes regions to become drier because the amount of water vapor released into the atmosphere is substantially reduced, thereby weakening cloud formation and rainfall processes. Deforestation can significantly alter regional climate patterns, and its impacts are often greater than the benefits obtained when forests are replanted.

Thohiron et al. (2024) note that deforestation and forest fires contribute approximately 20% of $CO_2$ emissions, which can lead to global warming and climate change. According to Ridwan and Sarjito, the impacts of deforestation include a significant reduction in soil capacity to absorb and retain water, increased surface runoff, and heightened sedimentation and soil erosion, which ultimately elevate the risks of floods and landslides. Therefore, risk mitigation is urgently needed through the implementation of several strategies, namely forest conversion control and rehabilitation through reforestation; sustainable agricultural land management through crop rotation, terracing, and related practices; the development of green infrastructure and drainage systems; and integrated cross-sectoral management encompassing forestry, settlements, agriculture, and infrastructure (Ridwan & Sarjito, 2024).

If forest conservation and protection are neglected by all stakeholders, the recurrent risk of major floods and landslides will persist. Therefore, it is essential to enhance public awareness—from children to adults—regarding the importance of forests for human life. Communities must also recognize the severe consequences that arise when they fail to participate in maintaining, monitoring, and protecting forests from various forms of misuse. For this reason, integrative and transformative education must be implemented in a continuous and sustained manner.

### 2. Forests as Post-Disaster Pedagogical Spaces

Drawing on experiences from Barcelona, Ruiz-Mallén et al. highlight grassroots initiatives in implementing environmental education to build climate resilience through service-learning and situated learning approaches. Communities carried out two main projects, namely the greening of public spaces and energy literacy programs in schools. These initiatives fostered the development of critical reflection, awareness, and concrete action among learners in addressing the impacts of climate change (Ruiz-Mallén et al., 2022). This approach is

relevant to the concept of forests as post-disaster pedagogical spaces, as forests can function as living laboratories for action-based learning such as reforestation, ecosystem observation, and the strengthening of local identity. By engaging communities and learners in forest recovery efforts, these spaces not only restore ecological conditions but also build adaptive capacity, a sense of ownership, and social transformation, thereby supporting community resilience to future disasters.

Forests as post-disaster pedagogical spaces refer to a concept that utilizes forest areas damaged by disasters as living laboratories for ecological and social learning. Forest recovery processes, such as reforestation and landscape restoration, can serve as action-based learning approaches that involve both learners and communities. These activities not only teach technical skills, such as tree planting and forest maintenance, but also foster critical awareness of human–nature relationships, risk mitigation, and adaptation to climate change (Krasny & Tidball, n.d.; Tidball et al., 2010).

Moreover, post-disaster forests support field-based observation that enables learners to directly examine disaster impacts, natural regeneration processes, and ecosystem interactions. This approach aligns with the principles of place-based education, which emphasize contextual and reflective learning, allowing learners to connect theoretical knowledge with local realities (Ruiz-Mallén et al., 2022). Furthermore, community involvement in forest recovery fosters a sense of ownership, local identity, and social networks, which are essential elements of socio-ecological resilience. Thus, post-disaster forests function not only as spaces for conservation but also as instruments of social transformation that strengthen community adaptive capacity to future disasters.

## 3. Ecological Pedagogical Practices (Forests) and Energy Resilience

In the educational process that positions forests as learning spaces, various learning practices can be conducted by students under teacher guidance. This naturally requires specific skills related to forests. These skills encompass cognitive, affective, and psychomotor domains. Educators need to explain the forest, its functions, and its roles, thereby raising students' awareness of the profound impact of forests on human life and other living beings. For instance, as Piazza et al. state, forest cover and vegetation play a crucial role in regulating surface energy balance, local temperature, and the hydrological cycle through mechanisms such as evapotranspiration and interactions between solar radiation and forest canopies. This directly affects the resilience of terrestrial systems to climate stresses such as heat waves and droughts. Large-scale deforestation disrupts the natural energy balance by increasing extreme temperatures and reducing the landscape's natural cooling capacity. Conversely, the restoration of vegetation cover through reforestation contributes to microclimate stabilization and ecological energy resilience, defined as the ecosystem's ability to manage energy flows sustainably (Piazza et al., 2024). This knowledge provides a strong scientific basis for ecological pedagogical practices, as reforestation can be understood as a science-based restorative action, rather than merely an ethical symbol. Students can also be engaged in field observations as an essential learning method to comprehend the concrete relationships among forests, energy, and climate. Within the context of ecological pedagogical practices, students will understand and realize that energy resilience cannot be separated from the health of forest ecosystems. Their direct involvement in vegetation restoration contributes to the development of ecological awareness grounded in the biophysical realities of Earth systems. Cantarello et al. propose forest recovery strategies through reforestation and landscape restoration to restore ecosystems (Cantarello et al., 2024). Learning can be project-based, integrating practical reforestation activities, field observation, and critical discussions on renewable energy, enabling students to understand the interconnections among conservation, sustainability, and energy resilience.

In the context of Christian religious education, students are not only taught about creation theology (particularly forests) as abstract knowledge, but they must also be directly engaged with the forest. They can discuss their faith regarding creation in relation to the immediate reality of the forest, and they can express their faith through various practical activities that connect environmental theology, bioenergy, ecosystems, and renewable energy solutions, in accordance with the Christian religious education curriculum to cultivate critical ecological, spiritual, and religious awareness. In this way, students develop an awareness of the fundamental relationship among humans, forests, and God.

## 4. Ecological Curriculum Foundation

In Christian theology, the theology of creation serves as the foundation for developing an ecological-based Christian Religious Education (CRE) curriculum, drawn from Genesis 1 and 2. This theology explains the origin, meaning, and purpose of the universe and all its contents based on God's revelation in the Bible. It emphasizes God as the sovereign Creator, humans as the imago Dei entrusted with the mandate to steward creation, and the importance of the integrity of creation within God's overarching plan of salvation. The theology of creation demands a pedagogical model that is inseparable from the social and ecological context in which learners live and serve. In this regard, Tollison proposes the framework of the ecological pedagogy of embeddedness, which views theological education as a living ecology rather than a mechanistic system isolated from worldly realities. According to Tollison, theological education must be rooted in place, challenges, and competencies—through place-based education, challenge-based learning, and competency-based education—so that the learning process genuinely promotes human flourishing or shalom, defined as the wholeness of relationships among humans, communities, and creation. He asserts that theological education "never occurs in the abstract" but always unfolds within specific socio-ecological contexts that simultaneously shape and challenge learners' faith and praxis (Tollison, 2023). This perspective reinforces the mandate of creation stewardship as the foundation of an ecological-based CRE curriculum, positioning environmental crises, ecosystem degradation, and human responsibility toward nature as essential pedagogical and theological loci, rather than merely supplementary topics in Christian education.

Within the framework of the ecological pedagogy of embeddedness, Tollison emphasizes care for creation as a pedagogical praxis rooted in the real contexts where humans live and serve. Through place-based education, theological education is positioned to learn from and for a specific place, making the human relationship with the ecological environment a locus for reflection on faith and theological responsibility. The challenge-based learning approach further directs the learning process toward concrete challenges faced by communities, including environmental crises and ecological injustices, so that the theology of creation stewardship is understood as a faith-based response to real problems rather than merely an abstract discourse. Meanwhile, competency-based education asserts that care for creation must be realized in measurable practical competencies, such as the ability to make ethical decisions, develop sustainable practices, and lead communities in environmental stewardship. By integrating these three approaches, Tollison situates theological education as an ecological process aimed at human flourishing or shalom, understood as the wholeness of relationships among humans, communities, and all creation (Tollison, 2023). In this context, when forests experience deforestation, learners can engage in theology directly through their physical presence in forest environments. They can learn and reflect firsthand in degraded or barren forests, express their faith when confronted with real challenges or problems, and actualize their faith through actions of restoration or rehabilitation of the forest environment.

The book Intersections of Religion, Education, and a Sustainable World emphasizes that sustainable education cannot be separated from the religious, ethical, and existential dimensions of human life, as the ecological crisis in the Anthropocene era is not merely a technical issue but touches on how humans understand themselves, others, and the created world. The authors assert that religious education holds strategic potential to develop ethical literacy, relational sensitivity, and moral responsibility for the sustainability of both human and non-human life through the integration of religious values, critical reflection, and contextual pedagogical praxis. Within the framework of Christian Religious Education (CRE), this idea aligns with the mandate of creation care as the foundation of an ecological curriculum, situating the human–creation relationship as an essential theological and pedagogical locus. Christian religious education does not merely teach doctrines about creation but shapes learners to live ethically, responsibly, and in solidarity amidst environmental crises, understanding sustainability as a faith-based calling to realize shalom, or the wholeness of relationships among God, humans, and all creation (Windsor & Franck, 2025).

The term Anthropocene is used by scientists to describe a temporal phase in which the impacts of human activities on Earth systems have been so extensive and intense that they have globally altered the planet's key components, marking a systemic shift beyond the normal variability of the Holocene. Contemporary research indicates that these changes—including greenhouse gas emissions, ecosystem degradation, and large-scale modifications of landscapes and biogeochemical cycles—leave "clear planetary signatures" studied within geoscience and environmental disciplines as part of the Anthropocene concept, although its status as a formal epoch remains debated within the scientific community. This concept helps to understand the Anthropocene not merely as a geological term but as an ecological and anthropological context for environmental education

and policy, highlighting that ecological transformations caused by human actions have become an inseparable part of Earth's history. This underscores the urgency of creation care as a faith-based and pedagogical response in Christian Religious Education, fostering ethical engagement with the environmental realities experienced by contemporary societies (Svenning et al., 2024; Gienger et al., 2024).

## 5. Curriculum Design in Supporting Forest Restoration and Energy Resilience

The ecological curriculum in Christian Religious Education (CRE) for the post-disaster context is designed as a contextualized learning framework that integrates Christian faith, ecological restoration, and national energy resilience. This curriculum is grounded in the theological mandate of creation care while simultaneously responding to the realities of environmental degradation and social vulnerability caused by natural disasters. Within this framework, the post-disaster environment, particularly forested and degraded ecosystems, is positioned as a pedagogical space that enables transformative learning through the direct engagement of learners.

The learning objectives of this curriculum are: (1) to foster a comprehensive theological and ecological understanding of the relationships between humans, nature, and energy; (2) to develop critical awareness of the impacts of environmental degradation on energy resilience; and (3) to cultivate a sense of responsibility, care, and active participation in ecological restoration and sustainable development efforts. More specifically, this curriculum aims to prepare learners as post-disaster recovery agents capable of integrating Christian faith with ecological action, thereby making tangible contributions to energy resilience at both community and national levels.

**The learning materials in this curriculum encompass four main areas:**

1) The theological foundation of creation care, including biblical reflections and Christian ethical perspectives on nature, disasters, and human responsibility.
2) Post-disaster ecology, which examines the impacts of disasters on forests, biodiversity, hydrological systems, and the balance of natural energy.
3) Energy resilience and sustainability, addressing the role of ecosystems—particularly forests—in maintaining climate stability, developing ecology-based renewable energy (such as bioenergy), and the linkage between environmental degradation and energy crises.
4) The role of church members and local communities in ecological restoration, strengthening community resilience, and supporting the national energy resilience agenda.

The learning strategies in this curriculum emphasize action-oriented and context-based approaches, such as service-learning, project-based learning, and place-based education. Learners are actively engaged in activities such as reforestation, environmental restoration, and field observations in post-disaster areas as an integral part of the learning process. Theological reflection, critical discussions, and case studies are employed to connect field-based experiences with concepts of faith, ecology, and energy. Additionally, collaboration with local communities, churches, and relevant stakeholders is emphasized to strengthen meaningful learning and achieve broader social impact.

Evaluation and assessment in this curriculum are designed to be authentic and holistic, encompassing cognitive, affective, and psychomotor domains. Assessment methods include learning portfolios, field observation reports, environmental restoration projects, theologically–ecologically reflective writings, and group presentations. Assessments also consider changes in students' attitudes, levels of ecological awareness, and commitment to creation care and energy resilience. Thus, evaluation not only measures knowledge acquisition but also character formation, ecological spirituality, and learners' readiness to make tangible contributions to post-disaster recovery and sustainable development.

**Conclusion and Recommendations**

In conclusion, this study affirms that deforestation and environmental degradation in Indonesia have significant ecological, social, and economic impacts, including increased risks of disasters such as floods and landslides, as well as threats to energy resilience. In this context, Christian religious education based on an ecological curriculum offers a transformative approach by utilizing post-disaster forests as pedagogical spaces that integrate creation theology, ecological restoration, and energy resilience. The curriculum not only emphasizes theological and ecological understanding but also develops practical skills, critical awareness, and moral responsibility among learners through direct involvement in forest restoration and environmental action. Accordingly, Christian religious education can play a strategic role in fostering ecological, spiritual, and social consciousness, while supporting energy resilience and sustainable development in Indonesia.

Based on the research findings, it is recommended that Christian religious education systematically integrate issues of deforestation, post-disaster forest restoration, and energy resilience into the curriculum through contextual and action-based pedagogical approaches. Post-disaster forests and surrounding environments should be positioned as pedagogical spaces that enable transformative learning through place-based education, service-learning, and project-based learning. This approach allows learners not only to understand creation theology conceptually but also to internalize it through direct engagement in reforestation, ecosystem restoration, and field observation. Such a strategy strengthens the development of ecological awareness, creation-centered spirituality, and scientific understanding of the interrelations between forests, energy, climate, and socio-ecological resilience.

Furthermore, it is recommended to strengthen collaboration among Christian educational institutions, churches, local communities, and relevant stakeholders to support sustainable forest restoration and the national energy resilience agenda. Religious education should be recognized as a strategic partner in developing post-disaster recovery agents equipped with theological, ecological, and practical competencies to respond to environmental crises in the Anthropocene era. Thus, Christian religious education goes beyond the mere transmission of normative values, actively contributing to human flourishing or shalom through the integration of Christian faith, ecological responsibility, and sustainable development.

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