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Integrating Islamic Ethical Stewardship in Regulating Emission of Per- and poly-fluoroalkyl substances: A Case Study of Al-Hikmah University Ilorin, Kwara State, Nigeria

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Abstract

Per- and poly-fluoroalkyl substances (PFAS), commonly referred to as “forever chemicals,” represent one of the most persistent and hazardous classes of emerging contaminants worldwide. Their durability, mobility, and bio-accumulative nature have raised significant environmental health concerns, including potential liver, renal, immune, and developmental effects. In Nigeria, limited empirical studies have detected PFAS in soil, water, and biota; however, comprehensive regulatory frameworks, monitoring systems, and risk communication mechanisms remain absent. This paper is empirical and descriptive research. The population of the study consisted of all law and science education student in 300 level of Al-Hikmah University, Ilorin 2024/2025 academic session while the sample consist of 150 student randomly selected (75 Law and 75 Science Education). A structure questionnaire was raised for data collection on Islamic ethical stewardship and impact assessment act stewardship towards regulating forever contaminants chemicals (IESIARFCC) with six items using four Linkert scale the research question was answered using mean and standard deviation. A pilot test was conducted to non-participant with the reliability coefficient of 0.82. The result reveal that Islamic ethical stewardship had not being integrated into environment regulatory use and environmental act assessment is yet to be achieved its recommended that the government should intensify effort of integration Islamic ethics stewardship into environmental regulatory used.

Keywords: Forever chemicals, contaminant, Environmental law, Islamic ethics, stewardship.

Introduction

The development of any nation is determined mostly by astronomical increase in population this might have a grate increase in human activities leading huge amount of generating waste this need to be stop or reduce to barest minimum through Islamic ethics in the regulatory process. The poor attitude toward waste management and its disposal can contaminate the environment this had become a great concern as they pose several challenges to the well-being of city living within a resident's Ogungbemi *et al.* (2023). Industrialization and population growth in most cities of the world result in changes in the quantity, composition and quality of waste generated, this can be observed in most cities of developing countries such as Nigeria (Fazeli, G., Karbassi, A., Khoramnejadian, S., & Nasrabadi, T. 2019). Persistent chemical pollutants represent one of the most pressing environmental challenges of the 21st century. Among these, per- and polyfluoroalkyl substances (PFAS) often referred to as “forever chemicals” have become a global concern due to their remarkable chemical stability, resistance to degradation, and tendency to accumulate in ecosystems and living organisms. Their widespread use in industrial processes, non-stick coatings, firefighting foams, and packaging materials has resulted in global distribution, affecting soil, water, air, and food chains (UNEP, 2023). Scientific studies increasingly associate PFAS exposure with severe health risks, including endocrine disruption, liver damage, immune suppression, and carcinogenic effects (WHO, 2024). Consequently, PFAS contamination is not merely an environmental issue but a multidimensional legal, ethical, and public health crisis demanding urgent attention. Heavy contamination from solid waste dumpsites poses significant environmental risks, impacting soil quality and potentially harming non-human biota through bioaccumulation and ecosystem disruption. While some studies indicate low to moderate pollution levels, others show higher concentrations with potential for long-term ecological damage. These risks include soil contamination, water pollution, and bioaccumulation in the food chain, with potential harm to plants, animals, and humans through various exposure pathways



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In Nigeria, research on PFAS remains limited but steadily growing. Emerging evidence has detected PFAS residues in surface water, agricultural soils, and fish species in the Niger Delta and Lagos lagoon regions, highlighting risks of bioaccumulation within food webs Okeke *et al.*, 2024; Chukwuemeka & Ajayi, (2023). However, despite these findings, Nigeria currently lacks a specific legal or regulatory framework targeting PFAS. The country's principal environmental statutes such as the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act 2007 and its subsidiary regulations address pollution broadly but do not list PFAS as controlled substances. This regulatory vacuum contrasts sharply with global developments where jurisdictions like the European Union and United States have begun imposing stringent limits on PFAS manufacturing, use, and discharge (European Chemicals Agency [ECHA], 2024).

Nigeria's environmental governance also faces challenges of institutional overlap, enforcement weaknesses, and inadequate laboratory capacity to monitor persistent organic pollutants. Moreover, the absence of a national PFAS inventory or standards for permissible concentrations in drinking water and industrial effluents leaves both ecosystems and communities vulnerable. Addressing this deficiency requires an integrated framework that combines scientific regulation, ethical responsibility, and community awareness a perspective that Islamic thought can meaningfully contribute to the awareness of the effects and consequence toward environmental contamination. From an Islamic ethical standpoint, environmental preservation is not optional but a divine mandate. The Qur'anic principles of stewardship (*khilāfah*), trustworthiness (*amānah*), and balance (*mizān*) offer a holistic paradigm for environmental responsibility. Humanity is viewed as a trustee over creation, tasked with maintaining the balance established by God: "And the heaven He raised and imposed the balance that you not transgress within the balance" (Qur'an 55:7–8). Violations of environmental harmony such as the unchecked spread of persistent pollutants represent a breach of this trust. As Al-Fahmi (2024) argues, ecological negligence in Islamic jurisprudence equates to moral corruption (*fasād fī al-ard*), forbidden under divine law. This paper, therefore, explores the intersection of environmental law and Islamic ethics in the context of PFAS regulation in Nigeria. It addresses four central questions: However, integrating juridical mechanisms with Islamic stewardship principles, this study proposes a normative model for ethical environmental governance in Nigeria. It argues that combating PFAS contamination is not only a regulatory necessity but also a moral duty in Islamic perspective, consistent with the higher objectives of Shariah (*Maqasid al-Shariah*) namely, the protection of life (*nafs*), health (*aql*), property (*mal*), and future generations (*nasl*).

PFAS have found extensive applications due to their unique physicochemical properties thermal stability, hydrophobicity, and oleophobicity. They are integral to numerous industrial and consumer products, such as non-stick cookware (Teflon), stain- and water-resistant textiles, grease-proof food packaging, electronics, chrome plating, paints, and aqueous film-forming foams (AFFFs) used in firefighting (OWSD, 2024; OECD, 2023). While these properties have contributed significantly to industrial innovation and product performance, they have also led to widespread and long-lasting environmental contamination. Globally, PFAS are now detected in virtually every environmental matrix including groundwater, drinking water, sediments, and atmospheric particles and in human blood serum samples across diverse populations (ECHA, 2024). Their ability to travel long distances and resist natural breakdown processes makes them a transboundary pollutant, prompting increasing global calls for restriction and remediation. Moreover, studies have linked PFAS exposure to adverse health outcomes, including immunotoxicity, endocrine disruption, developmental effects, and potential carcinogenicity (WHO, 2024; Rahman & Lee, 2025). In the Nigerian context, recent studies have begun documenting PFAS contamination in surface waters, sediments, and fish tissues in industrial and urban regions such as Lagos, Port Harcourt, and the Niger Delta (Chukwuemeka & Ajayi, 2023). These findings indicate bioaccumulation risks in local aquatic food webs, raising concerns about long-term exposure among fishing and riverine communities. Since Nigeria lacks national drinking water standards or environmental thresholds for PFAS, exposure pathways remain largely unmonitored and unregulated. This situation poses a hidden but significant environmental justice issue, as rural and low-income populations are more likely to rely on untreated surface water and locally sourced fish.

The toxicological profile of PFAS is increasingly well-documented. Epidemiological studies link chronic exposure to various adverse health outcomes, including liver enzyme dysfunction, kidney and thyroid disorders, immune system suppression, and developmental delays in children (WHO, 2024; Rahman & Lee, 2025). Some compounds, notably PFOA and PFOS, are classified as "possibly carcinogenic to humans" by the International Agency for Research on Cancer (IARC).



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PFAS exposure has also been associated with reduced vaccine efficacy and hormonal imbalances, further underlining their systemic health effects (UNEP, 2023). In addition, PFAS contamination represents a multidimensional threat chemical, ecological, and ethical. It challenges the adequacy of Nigeria's environmental governance while invoking deeper moral imperatives of stewardship and protection of human life as emphasized in Islamic ethics. Addressing this crisis demands coordinated scientific monitoring, regulatory enforcement, and a value-driven approach that prioritizes public health, ecological balance, and intergenerational justice. From an Islamic ethical perspective, regulating PFAS constitutes a sacred duty embedded within the moral architecture of stewardship (khilāfah). Humanity's role as vicegerent on earth mandates the preservation of life (ḥifẓ al-nafs), property and livelihood (ḥifẓ al-māl), and communal dignity (ḥifẓ al-'irdh). The pervasive contamination caused by PFAS directly contravenes these objectives, threatening both human health and ecological equilibrium. Neglecting to prevent or remediate such pollution disrupts the divine balance (mizān) and undermines the Qur'anic imperative to avoid corruption on earth, thereby violating principles of intergenerational justice (Kamali, 2023; Al-Qaradawi, 2021). Consequently, Nigeria's environmental reform agenda must integrate statutory enforcement with moral and theological guidance. Harmonising domestic law with international frameworks such as the Basel Convention and the United Nations Environment Programme (UNEP) Chemicals Roadmap (2023) will ensure coherence between global obligations and faith-based ethics. In this synthesis, environmental protection transcends technocratic governance to become an act of 'adl (justice) and amānah (divine trust), reaffirming humanity's responsibility to safeguard creation as an ethical and spiritual imperative.

Ethical education and religious engagement play a transformative role in embedding environmental consciousness into society. Integrating environmental stewardship into sermons, Islamic education, and community outreach can help reshape public attitudes toward pollution and sustainability. Mosques and faith-based organisations can serve as hubs for disseminating ecological awareness, underscoring that environmental protection is both a civic obligation and a divine trust. Through amānah, khilāfah, and iḥsān (moral excellence), individuals and institutions are reminded that the care of creation is a sacred duty that extends beyond legal compliance toward moral accountability before God (Ahmad Zuhdi et al., 2024; Alhinai & Ringer, 2025).

Statement of the problem

Chemical Nature and Industrial Applications of PFAS Per- and polyfluoroalkyl substances (PFAS) constitute a vast family of synthetic organofluorine compounds distinguished by the presence of strong carbon–fluorine (C–F) bonds, among the most stable in organic chemistry and biodegradable and become remnant in the soil. This exceptional stability, which makes the C–F bond nearly unbreakable under natural environmental conditions, underlies their persistence and the designation “forever chemicals” (OWSD, 2024). PFAS have been manufactured since the mid-20th century without observing its effects cause on living organisms encompass over 10,000 distinct compounds, including well-known substances such as perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), and their derivatives (UNEP, 2023). These compounds resist photolysis, hydrolysis, and biodegradation, leading to their bioaccumulation in soil, water, wildlife, and human tissue (WHO, 2024). The paradox of PFAS lies in their dual role as both technological enablers and environmental hazards. Their durability, once celebrated for enhancing industrial efficiency, has now become a major liability for global environmental and public health governance. For Nigeria where industrial use and waste management systems are often underregulated understanding the chemical and ecological behavior of PFAS is essential for developing effective regulatory, monitoring, and ethical response frameworks.

Environmental and Health Impacts of PFAS Because of their exceptional persistence, mobility, and bio-accumulative potential, per- and polyfluoroalkyl substances (PFAS) have emerged as a critical environmental and public health concern worldwide. Their chemical resilience enables them to resist natural degradation processes, allowing them to persist in air, water, soil, and biological systems for decades (DSpace Repository, 2024). Once released, PFAS compounds readily migrate through surface and groundwater systems, contaminating drinking water sources and agricultural lands. Their high solubility and resistance to breakdown also facilitate their entry into food chains, where they accumulate in aquatic organisms, livestock, and eventually humans through dietary exposure (Okeke et al., 2024). Absence of a national chemical inventory and analytical capacity limits the country's ability to evaluate PFAS prevalence in industrial discharges, consumer products, or drinking water systems.



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Lack of regulatory intervention. This regulatory vacuum not only delays preventive intervention but also exposes vulnerable populations especially in northern and riverine communities to unquantified health risks. The absence of local toxicological baselines and biomonitoring data further constrains risk assessment and remediation planning.

Methodology

The population of the study consisted of all law and science education student in 300level of Al-Hikman University, Ilorin 2024/2025 academic session while the sample consist of 150 students randomly selected (75 Law and 75 Science Education). A structure questionnaire was raised for data collection on Islamic ethical stewardship and impact assessment act stewardship towards regulating forever contaminants chemicals (IESIARFCC) with question items using four Linkert scale the research question was answered using mean and standard deviation. A pilot test was conducted to non-participant with the reliability coefficient of 0.82 using Alpha Cronbach. The data collected was analyzed using mean and standard deviation.

Research Question

1. To determine integrating environmental regulatory of Islamic ethical Stewardship towards regulating forever contaminants chemicals on environmental procedures
2. To determine environmental regulatory Impact Assessment act Stewardship towards regulating forever contaminants chemicals on environmental procedures

Presentation of Result

Research Question 1: To determine environmental regulatory use of Islamic ethical Stewardship towards regulating forever contaminants chemicals on environmental procedures

Table 1: Mean analysis on integrating Islamic ethical Stewardship towards regulating forever contaminants chemicals

Items	Mean	Standard Deviation
Islamic ethical stewardship towards regulating forever contaminants chemicals	2.18	1.004
impact assessment act stewardship towards regulating forever contaminants chemicals	3.23	0.343

The result in the table 1; revealed that the Mean of 2.18 (43.6%) and Standard Deviation of 1.004 lesser than 2.5 of the decision rule which strongly indicate that Islamic ethical Stewardship towards regulating forever contaminants chemicals on environmental procedures was not used. Recent empirical studies confirm the presence of per- and polyfluoroalkyl substances (PFAS) across multiple environmental matrices in Nigeria, highlighting an emerging national environmental health concern. For instance, a 2024 investigation in Yobe State detected measurable concentrations of PFAS in fish, soil, vegetables, and surface water across selected Local Government Areas (LGAs), indicating widespread environmental dissemination (ChemClass Journal, 2024). Similarly, Afropolitan Journals (2025) reported that PFAS concentrations in water samples from Bade and Jakusko LGAs occasionally exceeded the U.S. Environmental Protection Agency (EPA) recommended health advisory levels for perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). These findings underscore the risk of chronic exposure in regions dependent on untreated groundwater and local agricultural produce for sustenance. This means that people are yet to understand the consequence and the principle of contaminant. Integrating legal reforms with Islamic ethical principles of justice ('adl), trust (amānah), and stewardship (khilāfah) can provide a dual framework for accountability and redress, ensuring that remediation efforts protect both ecological systems and human dignity. This strategy echoes Islamic injunctions against excess (isrāf) and underscores stewardship (khilāfah) and balance (mizān) as ecological virtues (Evident Monthly, 2024). Responsible industrial transformation safeguards both current and future generations.

Research Question 2: Table 1; also show the mean response to determine environmental regulatory Impact Assessment act Stewardship towards regulating forever contaminants chemicals on environmental procedures. The mean scores of 3.23 ethical greater than the decision rule of 2.5. Which is strongly agree that environmental regulatory Impact Assessment act Stewardship towards regulating forever contaminants chemicals on environmental procedures was used but the sole aim and its goal was not achieve. This means that the only convectional method used by the government is not yielding well therefore there is the need to integrate another method. The use of Islamic ethical Stewardship towards regulating forever



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contaminants chemicals on environmental will help in closing the gap. Islamic Impact Assessment act Stewardship inability to give persistence and uncertain health effects, regulatory inaction until scientific certainty emerges would contradict both rational policy and the Shariah objective of preserving life (hifz al-nafs). Islamic jurisprudence prohibits harm (ḍarar) and enjoins preventive action to safeguard communities (Rahman, 2024).

Challenges on the Implementation

- 1 Data and technical capacity remain major obstacles. Few Nigerian laboratories can analyse PFAS, constraining risk assessment and evidence-based policy (PMC, 2024).
- 2 Strengthening research infrastructure and fostering collaborations between universities and regulatory agencies still inconvertible.
- 3 Legal enforcement weaknesses further undermine progress. Fragmented authority, mild sanctions, and poor coordination have long hindered Nigerian environmental law (Nnamdi Azikiwe University Journals, 2023)..
- 4 Reforming enforcement mandates and enhancing institutional capacity within NESREA and state agencies is difficult.
- 5 Economic and industrial resistance pose additional challenges. PFAS are embedded in numerous supply chains, and transitioning away from them incurs significant cost. Comparative evidence from Europe and Asia shows that phased regulation, financial incentives, and stakeholder consultation improve compliance (Sagentia Consulting, 2024).
- 6 Ethical–religious integration requires deliberate collaboration among jurists, policymakers, scientists, and faith-based organisations. Translating Islamic environmental values into legal mandates may be complex but offers deep moral legitimacy for environmental protection (Research Corridor, 2024)

Conclusion

PFAS represent a silent but significant environmental threat in Nigeria and globally. While Nigeria’s environmental law frameworks provide a basis for chemical pollution regulation, they currently lack PFAS-specific provisions, monitoring infrastructure and implementation strength. However, integrating Islamic ethical framework of stewardship (khilāfah), trust (amānah), and the higher objectives of Shari’ah offers a rich ethical foundation to animate regulation and public policy.

Recommendations

- 1 Adequate provisions of monitoring personnel with the control of penalizing domestic industries that discharge PFAS-containing effluents into local waterways.
- 2 Apart of giving monitoring an enforcement regulatory committee must be sett up for the implementation of laws and order
- 3 There must be a consistent regulatory monitoring, and bureaucratic overlap between agencies such as NESREA and the Federal Ministry of Environment
- 4 Establishment of national PFAS monitoring systems, define discharge standards, and maintain transparent reporting. Continuous surveillance exemplifies amānah—the duty to protect divine trust in creation—and maintains equilibrium in ecosystems (OWSD, 2024).
- 5 Ethical education and religious engagement are transformative. Integrating environmental ethics into sermons, schools, and mosque-based initiatives can mobilise moral action against pollution. Faith leaders serve as powerful agents in embedding ecological consciousness within communities (rabitah.org.ng, 2023).

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