Policy Pathways for Agroclimate Justice: Legal Strategies for Climate-Smart Agriculture and Environmental Rights Protection in Indonesia

Mohammad Hazyar Arumbinang[1*]

[1]Faculty of Law, Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia

Abstract. The increasing frequency and severity of climate change impacts have threatened Indonesia's agricultural sustainability, exposing structural vulnerabilities in environmental governance and rural justice. While Climate-Smart Agriculture (CSA) provides a potential framework for adaptation and mitigation, its policy deployment in Indonesia remains fragmented and insufficiently rights-based. This research investigates the legal and institutional readiness of Indonesia to ensure agroclimate justice by posing two key research questions: To what extent does Indonesia's legal and policy framework integrate agroclimate adaptation with environmental and human rights protection? and What normative legal strategies are necessary to strengthen the role of CSA in promoting inclusive and equitable agricultural transformation? This study applies a normative legal research methodology encompassing statutory interpretation, policy document analysis, and contextual examination of selected case practices. The results reveal that while Indonesia's policy landscape acknowledges climate risk in agriculture, it inadequately embeds participatory rights, digital equity, and environmental justice. To address these deficits, this article proposes a restructured CSA framework based on environmental constitutionalism, legal empowerment of local communities, and integrated digital governance. These legal pathways offer a sustainable and inclusive approach to climate adaptation in Indonesia's agricultural sector. **Keywords**: agroclimate justice, climate-smart agriculture environmental rights, Indonesia

1 Introduction

The increasing evidence of human-induced climate change has profoundly impacted the course of global agricultural systems, especially in developing nations such as Indonesia. Increasing temperatures, unpredictable precipitation patterns, extended droughts, and more frequent extreme weather events are altering environmental conditions and necessitating corresponding legal and policy adaptations for climate resilience [1]. Agriculture, the cornerstone of Indonesia's economy and rural livelihoods, is at the forefront of these disruptions [2]. Agroclimatic changes increasingly jeopardize food security, environmental sustainability, and socio-economic equity, necessitating a reassessment of the responsiveness

* Corresponding author: mohammad.hazyar@umy.ac.id

© The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

of legal and policy frameworks to these vulnerabilities. In this context, Climate-Smart Agriculture (CSA) has emerged as a widely endorsed framework aimed at concurrently enhancing agricultural productivity, bolstering resilience (adaptation), and diminishing greenhouse gas emissions (mitigation) sustainably. Notwithstanding its conceptual clarity and international endorsement, the implementation of CSA in Indonesia has been characterized by legal fragmentation, normative ambiguity, and a lack of foundation in human rights and environmental justice principles.

Indonesia's legal and institutional framework features a multilevel governance system encompassing national, provincial, and local jurisdictions. This decentralized model facilitates policy innovation at subnational levels but frequently leads to legal and administrative fragmentation, particularly in climate and agricultural governance. Multiple legal instruments, such as the Environmental Protection and Management Law (Law No. 32 of 2009), the Agricultural Law (Law No. 19 of 2013), and the Climate Change Adaptation Policy (RAN-API), address climate adaptation and agricultural sustainability. Nevertheless, these laws often function independently and lack a cohesive mechanism to incorporate CSA into a legally binding framework [3]. Furthermore, Indonesia's Nationally Determined Contributions (NDCs) and long-term development strategies recognize the imperative of climate adaptation in agriculture but lack substantial normative assurances for participatory rights, social safeguards, and equitable access to agricultural and digital resources, especially for Indigenous peoples, women farmers, and marginalized rural communities [4].

Recent research on climate governance and sustainable development in agriculture has provided significant insights into the implementation of Climate-Smart Agriculture (CSA) in Indonesia and the Global South at large. Some researchers underscored the importance of incorporating local knowledge systems, institutional coherence, and multi-stakeholder governance into Climate Smart Agriculture programs. It emphasizes that although Climate-Smart Agriculture (CSA) can enhance resilience and yield, it must be tailored to local contexts and incorporate inclusivity in its design and execution. Others also highlight the inadequacies of Indonesia's environmental and agricultural legislation in providing meaningful protection for vulnerable communities impacted by climate-related hazards. Nonetheless, these contributions often frame CSA as either a policy instrument or a collection of technical practices, thereby neglecting the legal aspects essential for its equitable execution. A significant gap persists in the literature regarding the intersection of CSA with constitutional rights, administrative justice, and normative accountability. Likewise, Indonesia's digital transformation in agriculture via e-agriculture platforms, smart farming technologies, and agricultural informatics has predominantly evaded legal examination. The ramifications of data governance, digital equity, and algorithmic transparency within the framework of CSA are still insufficiently theorized, notwithstanding their increasing significance [4].

This study seeks to address that gap by conducting a legal-normative analysis of agroclimate justice, specifically within the Indonesian context. It diverges from prevailing technocratic and policy-focused viewpoints on CSA by emphasizing legal principles, institutional structures, and rights-based methodologies. Agroclimate justice, as defined in this paper, denotes a framework aimed at guaranteeing equity in the allocation of climate risks, adaptive capabilities, and agricultural advantages, based on constitutional environmental rights, procedural fairness, and access to justice. The study contends that attaining agroclimate justice via CSA transcends mere policy efficiency or economic optimization; it constitutes a legal and ethical duty that the state is obligated to uphold. This aims to assess the sufficiency of Indonesia's legal and policy framework in safeguarding environmental and human rights in CSA initiatives, and to formulate a series of legal strategies that can facilitate a more inclusive and sustainable agricultural transition.

The study utilizes a normative legal methodology, integrating statutory and doctrinal analysis with policy assessment and contextual interpretation. This methodological selection is crucial for revealing the foundational legal framework that influences Indonesia's strategy towards climate-smart agriculture. The study analyzes the text and implementation of current legal instruments and assesses their alignment with agroclimate justice principles. This paper examines specific case studies from various agroecological zones in Indonesia, including Java, Sumatra, and Papua, to contextualize the manifestation of legal gaps in practice and to demonstrate how community-based responses can contribute to a more participatory legal framework. The case-based approach facilitates the recognition of best practices and governance innovations that are developing at the grassroots level yet are inadequately represented in national legal frameworks.

This investigation is directed by two primary research questions. The first assesses the degree to which Indonesia's existing legal and policy framework incorporates agroclimate adaptation alongside environmental and human rights safeguards. The second examines normative legal strategies that can be utilized to guarantee that CSA policies promote agroclimate justice and inclusive resilience, especially for marginalized and structurally disadvantaged agricultural communities. These inquiries seek to evaluate legal adherence while also critiquing the normative framework concerning equity, accountability, and transformative justice.

The imperative of this investigation is highlighted by Indonesia's distinct vulnerability to climate-related calamities and its significant reliance on climate-sensitive industries, including agriculture, forestry, and fisheries. Indonesia is one of the most climate-vulnerable nations worldwide, with its agricultural communities experiencing diminished productivity, altered cropping patterns, and water scarcity. These challenges disproportionately impact smallholder farmers, Indigenous populations, and women, who frequently lack secure land tenure, access to adaptive technologies, and representation in decision-making processes. In the absence of a legally coherent and justice-oriented framework for Climate-Smart Agriculture (CSA), there exists a risk that adaptation measures may reinforce existing inequalities, displace traditional practices, and infringe upon the rights of the communities they intend to assist [5].

The Indonesian Constitution explicitly guarantees the right to a good and healthy environment (Article 28H), the right to social justice for all citizens (Preamble and Article 33), and mandates the state to protect natural resources in a manner that ensures prosperity for the people. Furthermore, Indonesia is a party to several international treaties relevant to environmental protection, climate governance, and socio-economic rights, including the International Covenant on Economic, Social and Cultural Rights (ICESCR), the Convention on Biological Diversity (CBD), and the Paris Agreement. These commitments impose both procedural and substantive obligations on the state to adopt climate adaptation policies that are rights-based, transparent, and inclusive. However, there is a significant implementation gap between these constitutional and international commitments and the operational realities on the ground.

Ultimately, this research seeks to contribute to the evolving discourse on climate justice and sustainable development by positioning legal institutions at the center of climate-smart agricultural transformation. The following sections will provide a detailed analysis of the adequacy of Indonesia's current legal framework and propose a set of legally grounded strategies that align CSA with the imperatives of justice, equity, and sustainability in the digital age [6].

2 Assessing the Adequacy of Indonesia's Legal and Policy Framework in Integrating Agroclimate Adaptation with Environmental and Human Rights Protection

The integration of agroclimate adaptation with the safeguarding of environmental and human rights in Indonesia persists as a normative goal rather than a practical implementation. Despite the recognition of climate change's effects on agriculture and the necessity for sustainable adaptation in various legal and policy instruments, these frameworks frequently exhibit deficiencies in structural coherence, enforceability, and participatory engagement essential for safeguarding the most vulnerable populations. An in-depth analysis of Indonesia's legal framework uncovers substantial deficiencies in the normative foundation of Climate-Smart Agriculture (CSA) and its coherence with the tenets of environmental and human rights law [6].

In recent decades, Indonesia has undertaken significant efforts to establish a legal framework that facilitates environmental protection and climate adaptation. The Environmental Protection and Management Law (Law No. 32 of 2009) delineates overarching obligations for environmental sustainability and specifies state responsibilities in mitigating environmental harm. Article 65 of this legislation unequivocally asserts citizens' rights to a quality and healthy environment and ensures public involvement in environmental decision-making processes [1]. Nonetheless, its relevance to agriculture-specific climate risks is neither clear nor comprehensive. The legislation primarily emphasizes pollution regulation and conservation, rather than adaptive land utilization, climate resilience, or agroecological frameworks. Thus, a disparity exists between overarching environmental standards and sector-specific climate adaptation within agriculture.

The Agricultural Law (Law No. 19 of 2013) is the principal legal framework regulating agricultural development in Indonesia. Although it acknowledges the significance of sustainable agriculture and food sovereignty, it lacks a definitive climate adaptation agenda. References to environmental sustainability in the law are ambiguous and devoid of actionable definitions or enforceable obligations [7]. The law notably omits any reference to CSA or any analogous concept that encapsulates the multifaceted nature of climate-smart practices. This legal instrument does not require the incorporation of climate data, early warning systems, or community-based adaptation strategies, which are essential to an effective Climate-Smart Agriculture framework. The lack of explicit institutional mandates and inter-agency coordination mechanisms impedes the implementation of agroclimate adaptation at both national and local levels [8].

The Indonesian government has issued multiple strategic documents demonstrating its dedication to climate adaptation. The National Action Plan for Climate Change Adaptation (RAN-API), the National Medium-Term Development Plan (RPJMN), and the Nationally Determined Contributions (NDCs) submitted under the Paris Agreement collectively delineate objectives for climate-resilient agriculture. These policy instruments explicitly reference CSA and advocate for actions including the development of climate-resilient crop varieties, the promotion of sustainable land management, and the enhancement of farmers' adaptive capacity. Nonetheless, these commitments constitute policy declarations rather than enforceable legal obligations. The NDCs, although internationally relevant, are not legally enforceable domestically, as they have not been integrated into binding legislation. The RAN-API, while extensive, lacks clarity regarding the rights of local communities, mechanisms for public engagement, and legal recourse in instances of maladaptation or rights infringements.

A significant deficiency exists in the inadequate acknowledgment and safeguarding of Indigenous peoples' rights within agroclimate adaptation policies. Indigenous and customary communities are among the most vulnerable to climate change due to their dependence on

traditional agricultural practices and their historical exclusion from formal governance frameworks. The Constitutional Court Decision No. 35/PUU-X/2012 validated the legal acknowledgment of customary land rights (*ulayat*), yet its implementation is inconsistent [1]. Agricultural policies frequently favor commercial agribusiness and food estate initiatives without adequate consultation or consent from impacted communities. This has led to land dispossession, deforestation, and social conflict factors that directly compromise agroclimate resilience and equity. The absence of a legal framework to incorporate Indigenous ecological knowledge into Climate Smart Agriculture programming underscores the normative and procedural exclusion of marginalized communities [9].

Human rights legislation, both national and international, establishes a basis for integrating justice and equity into agroclimate adaptation. The Indonesian Constitution guarantees the right to a healthy environment and requires the fair management of natural resources. Indonesia is a signatory to international human rights treaties, including the International Covenant on Economic, Social and Cultural Rights (ICESCR), which ensures the rights to food, health, and an adequate standard of living. These provisions necessitate the obligation to guarantee that climate adaptation in agriculture not only preserves but also strengthens these rights. Nonetheless, the current legal framework fails to convert these obligations into explicit regulatory mandates for climate-smart agriculture. For instance, there are no enforceable regulations mandating human rights impact assessments in agricultural adaptation initiatives, nor are there legal criteria for inclusive participation or grievance mechanisms available to rural communities [10].

Environmental constitutionalism, which involves the application of constitutional principles to environmental protection, presents a viable legal pathway for incorporating agroclimate justice into Indonesian legislation. This concept, however, remains inadequately developed within the national legal framework. Notwithstanding the constitutional acknowledgment of environmental rights, there exists a paucity of jurisprudence regarding the enforceability of these rights in relation to agriculture or climate change. Historically, courts have been hesitant to confront the distributive impacts of environmental degradation or to impose structural reforms in public policy. Furthermore, the legal standing criteria for environmental litigation are restrictive, frequently barring community-based organizations or informal collectives of impacted individuals. This diminishes the capacity of communities to hold the state accountable for ineffective agricultural practices or policies inadequate for climate resilience [11].

The institutional framework tasked with executing climate and agricultural policy complicates the attainment of agroclimate justice. Entities such as the Ministry of Environment and Forestry (MoEF), the Ministry of Agriculture (MoA), and the National Development Planning Agency (Bappenas) possess overlapping responsibilities yet function under distinct legal frameworks. Collaboration among these institutions is frequently improvised and motivated by donor-funded initiatives rather than enduring legal obligations. Local governments, constitutionally authorized to oversee their development priorities, frequently lack the legal authority, technical expertise, and financial resources necessary for effective implementation of Climate-Smart Agriculture (CSA). This vertical fragmentation hinders policy coherence and diminishes accountability [12].

An emerging concern that warrants critical examination is the increasing dependence on digital technologies in agriculture. Precision agriculture, mobile extension services, and remote sensing technologies are progressively advocated as facilitators of Climate Smart Agriculture (CSA) [13]. Nevertheless, the legal framework governing digital agriculture is, at best, in its nascent stages. Comprehensive legal standards to govern the collection, ownership, and utilization of agricultural data are absent. Farmers frequently supply data inadvertently or without informed consent, which raises substantial issues regarding data sovereignty, privacy, and algorithmic bias. This "data extractivism" can perpetuate historical

inequalities and disempowerment, especially among smallholders who lack access to technological infrastructure or legal knowledge. In the absence of a rights-based legal framework for digital governance in agriculture, the digital transformation in Climate-Smart Agriculture (CSA) may evolve into an instrument of exclusion rather than empowerment.

Indonesia's existing legal and policy framework offers a disjointed, inadequate, and poorly enforceable foundation for agroclimate adaptation. Although national strategies recognize the necessity for climate-resilient agriculture, they lack enforceable commitments that guarantee the protection of environmental and human rights. The absence of legal clarity regarding community involvement, the marginalization of Indigenous and smallholder perspectives, and the lack of protections in digital innovation expose a fundamental disparity between climate policy discourse and legal practice. Rectifying this disjunction necessitates both legislative reform and a comprehensive normative transformation that acknowledges agroclimate justice as a constitutional and legal obligation. The forthcoming section will examine particular legal strategies to entrench this transformation within Indonesia's legal framework [4].

3 Legal Strategies to Institutionalize Agroclimate Justice through Climate-Smart Agriculture

The progression of agroclimate justice in Indonesia requires acknowledgment of current legal and policy shortcomings, as well as the formulation of transformative legal strategies to reconcile the disparity between environmental adaptation and rights-based development. Although policy documents have started to recognize Climate-Smart Agriculture (CSA) as a vital adaptation strategy, they have not yet developed into legally binding frameworks that can provide substantial and procedural justice to those most impacted by climate change [2]. An approach to CSA that is legally sound must incorporate environmental constitutionalism, enhance participatory governance, and implement digital legal protections. If effectively executed, these strategic pillars can facilitate Indonesia's agricultural transformation to be both climate-resilient and socially equitable.

The initial strategy entails integrating agroclimate justice into the overarching structure of environmental constitutionalism. The 1945 Constitution of Indonesia guarantees every citizen's right to a healthy environment and requires the state to manage natural resources to promote public welfare. Nonetheless, these constitutional principles necessitate implementation via legislative precision, judicial involvement, and administrative enforcement [11]. An essential measure to achieve this objective would be the implementation of a Climate Justice and Adaptation Law, which explicitly incorporates the notion of Climate-Smart Agriculture into the framework of constitutional environmental rights. This law should specify the state's responsibilities to formulate climate-resilient agricultural policies, implement environmental protections in all CSA-related projects, and offer remedies for communities negatively impacted by maladaptive or inequitable adaptation efforts.

This proposed legal framework should delineate agroclimate harms as a category of environmental degradation with direct implications for human rights, thereby facilitating climate-related public interest litigation. Judicial bodies must be authorized to not only adjudicate cases of environmental degradation but also to assess the constitutionality of climate-insufficient laws and policies that disproportionately impact marginalized agricultural communities. This necessitates a broader doctrine of legal standing that permits impacted farmers, Indigenous communities, civil society organizations, and environmental groups to contest breaches of agroclimate justice in administrative and constitutional courts. The judiciary must establish comprehensive jurisprudence on climate equity and acknowledge the advancing standards of international environmental law, including the

principles of intergenerational equity, common but differentiated responsibilities, and the precautionary principle [9].

A secondary legal strategy entails enhancing legal empowerment and participatory governance throughout all phases of Climate Smart Agriculture (CSA) planning, execution, and assessment. Agroclimate justice cannot be attained solely through hierarchical technical solutions; it must be rooted in the lived experiences, knowledge systems, and priorities of the communities it aims to benefit. Indonesia's Law No. 6 of 2014 on Villages establishes a legal framework for participatory rural development and acknowledges the autonomy of villages in managing their own affairs, encompassing environmental and agricultural issues. This decentralization, however, has not been effectively leveraged within the framework of CSA. National legislation and climate adaptation initiatives frequently overlook local institutions or regard participation as a superficial formality rather than a fundamental right [14].

To rectify this, CSA-related regulations must mandate free, prior, and informed consent (FPIC) from communities prior to the implementation of any climate-smart intervention on their land or territory. Legal standards must be established to guarantee that participatory processes are inclusive, gender-sensitive, and accessible to marginalized populations. The state must ensure access to decision-making forums while also providing legal literacy, institutional support, and financial resources essential for effective community engagement. Village governments, customary councils, and farmer associations ought to be acknowledged as formal stakeholders in CSA governance, possessing the authority to influence policy priorities, oversee implementation, and reap the benefits of adaptation outcomes.

Participation, however, lacks significance without access to information and the legal authority to interpret and act upon that information. The Public Information Disclosure Law (Law No. 14 of 2008) stipulates the right to access government-held information; however, its execution in rural and agricultural sectors is inconsistent. Numerous communities are either uninformed of their rights or lack the technological and institutional resources to access pertinent data. CSA legislation must incorporate requirements for the obligatory disclosure of climate risk evaluations, land-use planning documents, digital instruments, and financial mechanisms that impact community interests [8]. This requires institutional mechanisms to convert technical information into culturally and linguistically suitable formats, thus empowering communities to make informed decisions regarding their adaptive futures.

The third and progressively critical strategy entails the creation of a rights-based legal framework for digital and data governance in agriculture. Indonesia is advancing its digital transformation via initiatives like “Agriculture 4.0” and the Smart Village Program, where the utilization of digital tools such as satellite imaging, precision agriculture platforms, mobile weather alerts, and agricultural data analytics is becoming integral to Climate-Smart Agriculture (CSA). However, these digital systems are frequently created by private entities or external benefactors with limited legal regulation. No definitive national laws or regulations exist regarding the collection, ownership, utilization, and dissemination of agricultural data, particularly concerning vulnerable rural populations [3]. This regulatory void poses considerable risks of data extraction, surveillance, exclusion, and algorithmic bias.

Indonesia must establish a comprehensive legal framework for digital rights in agriculture to address this gap. This framework must encompass legal definitions of data ownership, consent, and sovereignty, guaranteeing that farmers and communities maintain control over their data and can dictate its utilization. Specific provisions must also forbid the commercialization or third-party transfer of agricultural data without explicit, informed, and voluntary consent. Moreover, legal standards must be instituted for algorithmic transparency and equity in CSA tools, encompassing mandates for human oversight, impact evaluations, and accountability frameworks in the implementation of digital technologies. Data justice in agriculture must be acknowledged not only as a technical or ethical issue but also as a legal right that warrants enforcement and remedy [5].

Implementing these legal strategies necessitates multi-tiered coordination and institutional reform. At the national level, ministries overseeing agriculture, environment, digital transformation, and rural development must synchronize their regulatory mandates and create cross-sectoral legal frameworks that encapsulate the intricacies of Climate-Smart Agriculture (CSA). Interministerial task forces may be formed to create and oversee agroclimate justice indicators, legal compliance standards, and adaptive legislative processes [3]. Local governments at the subnational level must be empowered through legal training, technical assistance, and financial resources to execute Climate-Smart Agriculture (CSA) in alignment with the principles of equity and justice. Provincial and district governments ought to be incentivized to promulgate regional regulations (*perda*) that embody local ecological circumstances and community values, thus facilitating legal pluralism within a national agroclimate justice framework [8].

Indonesia must synchronize its Climate Smart Agriculture strategies with its commitments to human rights and environmental treaties at the international level. The Paris Agreement, the United Nations Declaration on the Rights of Peasants (UNDROP), and the International Labour Organization (ILO) Convention No. 169 on Indigenous and Tribal Peoples offer legal and normative frameworks for incorporating rights into climate and agricultural governance. Indonesia ought to domesticate these international standards within its national legal system via ratification, legal harmonization, and judicial referencing. Judicial bodies ought to be urged to reference international jurisprudence when interpreting constitutional and statutory provisions concerning climate adaptation, environmental protection, and rural rights [15].

Alongside formal legal reforms, Indonesia must allocate resources towards legal empowerment infrastructures, encompassing legal aid for rural populations, paralegal training initiatives, and mobile legal clinics. These mechanisms are crucial for guaranteeing that legally recognized rights are practically accessible. Legal education curricula must evolve to incorporate environmental and climate justice as fundamental subjects, thus equipping a new generation of legal professionals to promote agroclimate justice in judicial, legislative, and policy arenas [11].

Achieving agroclimate justice via CSA in Indonesia requires more than mere rhetorical commitment or policy alignment. The intentional development of legal frameworks, participatory institutions, and accountability mechanisms that emphasize environmental sustainability, human rights, and digital equity is necessary. The aforementioned legal strategies constitutional embedding, participatory legal design, and digital data governance represent a multifaceted approach to climate-smart agricultural transformation. These strategies are both viable within Indonesia's current legal framework and essential for ensuring equitable and just distribution of the burdens and benefits of climate adaptation among all societal segments. The subsequent and final section will provide concluding observations and recommendations for policy, legislation, and future research endeavors.

4 Conclusion

This research has demonstrated that Indonesia’s current legal and policy frameworks insufficiently integrate climate-smart agriculture (CSA) with environmental and human rights protections. While CSA is recognized in national policies, its legal implementation remains fragmented, lacking enforceable standards, participatory guarantees, and digital governance mechanisms.

To advance agroclimate justice, three legal strategies are essential: embedding environmental constitutionalism into CSA frameworks, empowering farming communities through participatory legal processes, and institutionalizing digital rights to ensure equitable access and data sovereignty in agricultural innovation. These approaches are necessary to

align climate adaptation in agriculture with Indonesia's constitutional and international obligations. Ultimately, CSA must be reframed not only as a policy tool but as a legal imperative. Building a just, inclusive, and sustainable agricultural future requires legal reforms that protect rights, address inequalities, and support community resilience in the face of climate change.

References

1. M.H. Arumbinang, I. Satriawan, Indonesian constitutional rights protection and climate change: safeguarding future generations, IOP Conf. Ser.: Earth Environ. Sci. 1475, 012032 (2025), https://doi.org/10.1088/1755-1315/1475/1/012032
2. G. Prayitno, et al., The role of social and human capital on climate change adaptation in agricultural activities in Indonesia, Environ. Challenges 21, 101353 (2025), https://doi.org/10.1016/j.envc.2025.101353
3. Z. Rozaki, M.F. Kamarudin, A.M. Kiloes, N. Rahmawati, D.L. Wibisana, Assessing environmental impact and farmers' awareness in irrigated and rainfed rice farming for sustainable agriculture in Yogyakarta, Indonesia, Int. J. Des. Nat. Ecodynamics 19, 1269–1277 (2024), https://doi.org/10.18280/ijdne.190418
4. A. Ghirardelli, P. Tarolli, Bridging the gap between science, policy, stakeholders: delineating a virtuous framework for agriculture under climate change scenarios, iScience 28, 113326 (2025), https://doi.org/10.1016/j.isci.2025.113326
5. D.P. Loucks, Impacts of climate change on economies, ecosystems, energy, environments, and human equity: a systems perspective, in The Impacts of Climate Change, Elsevier, pp. 19–50 (2021), https://doi.org/10.1016/B978-0-12-822373-4.00016-1
6. M. Pardede, et al., Perspectives of sustainable development vs. law enforcement on damage, pollution and environmental conservation management in Indonesia, J. Water Clim. Chang. 14, 3770–3790 (2023), https://doi.org/10.2166/wcc.2023.417
7. J. Peel, H.M. Osofsky, A rights turn in climate change litigation?, Transnatl. Environ. Law 7, 37–67 (2018), https://doi.org/10.1017/S2047102517000292
8. T. Begna, R.B. Wakweya, Mitigating climate change impacts on food security via climate-smart agriculture, Plant Stress 101152 (2025), https://doi.org/10.1016/j.stress.2025.101152
9. I.D. Rafiqi, Recognition of Indigenous Peoples' values in Indonesia for policy addressing climate change, J. Law Leg. Reform 6, 1–40 (2025), https://doi.org/10.15294/jllr.v6i1.11746
10. S. Goulden, M. Negev, S. Reicher, T. Berman, Implications of standards in setting environmental policy, Environ. Sci. Policy 98, 39–46 (2019), https://doi.org/10.1016/j.envsci.2019.05.002
11. P. Mohai, D. Pellow, J.T. Roberts, Environmental justice, Annu. Rev. Environ. Resour. 34, 405–430 (2009), https://doi.org/10.1146/annurev-environ-082508-094348
12. A.M. Rohmy, Hartiwiningsih, I.G.A.K.R. Handayani, Judicial mafia and ecological injustice: obstacles to policy enforcement in Indonesian forest management and protection, Trees For. People 17, 100613 (2024), https://doi.org/10.1016/j.tfp.2024.100613
13. S. Clark, H.A. Roop, N.J. Meyer, A. Farris, An assessment of the Midwest climate adaptation network: a call for improved coordination and collaboration, J. Environ. Manage. 370, 122467 (2024), https://doi.org/10.1016/j.jenvman.2024.122467
14. A.A.K. Sudiana, N.P.N. Suharyanti, U.F. Faxriddinovich, Assessing the government's commitment to achieving ecological justice for society, J. Hum. Cult. Leg. Stud. 5, 1 (2025), https://doi.org/10.53955/jhcls.v5i1.489
15. S.E. Walker, et al., Defining and conceptualizing equity and justice in climate adaptation, Glob. Environ. Chang. 87, 102885 (2024), https://doi.org/10.1016/j.gloenvcha.2024.102885