Indonesian Climate Justice Review
ISSN: 3164-2284 (Online)
Vol. 3, No. 2, 2026, pp. 285-326
Published online since April 15, 2026

Indonesian Climate Justice review
https://journal.perhaki.org/index.php/climate

OPEN ACCESS

Floods, Red Mud, and Nickel: Reading Kawasi as a Case of Climate Justice on a Small Island

Ahmad Rizki Jauhari*
Universitas Islam Negeri Sultan Aji Muhammad Idris, Samarinda, Indonesia
rizkijauhari@uinsi.ac.id

DOI: https://doi.org/10.65815/71qvwh71

Submitted: 22-09-2025	Revised: 19-11-2025, 28-03-2026	Accepted: 07-04-2026

*Corresponding Author

Abstract

Small islands are often portrayed as highly vulnerable to climate change because of their limited land area, ecological sensitivity, and dependence on coastal resources. Yet vulnerability is not produced by climate change alone. It can be intensified by extractive industries and rapid landscape transformation. This article examines Kawasi on Obi Island as a case of climate and environmental injustice associated with nickel development. It focuses on recurring floods, red sediment deposition, altered landscapes, and the increasing exposure of local communities to environmental risks. Particular attention is given to how mining-related transformation may interact with the existing ecological vulnerability of small-island environments. The article also considers the differentiated impacts experienced by women, children, and households whose livelihoods depend directly on local ecosystems. Through a climate-justice framework, Kawasi is analyzed not simply as a community exposed to environmental hazards but as a community situated within unequal economic and political relations. The central question is who gains from nickel-based industrialization and who bears the resulting ecological risks. The article argues that climate justice must extend beyond reducing greenhouse-gas emissions to include the protection of vulnerable communities from environmentally harmful forms of low-carbon development. A just transition in small-island contexts therefore requires ecological safeguards, community participation, livelihood protection, and recognition of local rights before industrial expansion proceeds.

[*Pulau-pulau kecil sering digambarkan sangat rentan terhadap perubahan iklim karena luas lahannya yang terbatas, sensitivitas ekologis, dan ketergantungan pada sumber daya pesisir. Namun, kerentanan tidak hanya disebabkan oleh perubahan iklim saja. Kerentanan dapat diperparah oleh industri ekstraktif dan transformasi lanskap yang cepat. Artikel ini mengkaji Kawasi di Pulau Obi sebagai studi kasus ketidakadilan iklim dan lingkungan yang terkait dengan pengembangan nikel. Artikel ini berfokus pada banjir yang berulang, pengendapan sedimen merah, perubahan lanskap, dan peningkatan paparan masyarakat setempat terhadap risiko lingkungan.*

Perhatian khusus diberikan pada bagaimana transformasi terkait pertambangan dapat berinteraksi dengan kerentanan ekologis yang ada di lingkungan pulau-pulau kecil. Artikel ini juga mempertimbangkan dampak yang berbeda yang dialami oleh perempuan, anak-anak, dan rumah tangga yang mata pencahariannya bergantung langsung pada ekosistem lokal. Melalui kerangka kerja keadilan iklim, Kawasi dianalisis bukan hanya sebagai komunitas yang terpapar bahaya lingkungan, tetapi sebagai komunitas yang berada dalam hubungan ekonomi dan politik yang tidak setara. Pertanyaan utamanya adalah siapa yang diuntungkan dari industrialisasi berbasis nikel dan siapa yang menanggung risiko ekologis yang dihasilkan. Artikel ini berpendapat bahwa keadilan iklim harus melampaui pengurangan emisi gas rumah kaca untuk mencakup perlindungan komunitas rentan dari bentuk-bentuk pembangunan rendah karbon yang merusak lingkungan. Oleh karena itu, transisi yang adil dalam konteks pulau-pulau kecil membutuhkan perlindungan ekologis, partisipasi masyarakat, perlindungan mata pencaharian, dan pengakuan hak-hak lokal sebelum ekspansi industri dilanjutkan.]

Keywords: Kawasi, small islands, nickel mining, climate justice, environmental vulnerability

Introduction

Small islands occupy a distinctive position in contemporary climate-change debates because their limited territorial space, ecological interdependence, and dependence on coastal and terrestrial resources can intensify the consequences of environmental disturbance. Climate vulnerability in small islands is therefore not simply a consequence of geographical exposure to sea-level rise, extreme rainfall, coastal flooding, or changing climatic conditions. It is also shaped by social and economic conditions that determine how communities experience and respond to environmental hazards (Nurse et al. 2014; IPCC 2022). Research on small islands has further demonstrated that resource extraction can undermine resilience by degrading ecosystems, disrupting livelihoods, increasing dependence on external income, and weakening communities' capacity to respond to climate change (Bambrick et al. 2017). Vulnerability, therefore, should be understood as a socially and politically produced condition rather than an inherent characteristic of island geography.

This perspective is particularly important in Indonesia, where small-island communities frequently depend on forests, agricultural land, rivers, coastal ecosystems, and fisheries for everyday subsistence and income. Environmental risks generated by climate change can become more severe when they interact with rapid changes in land use and resource extraction. Political-ecology scholarship emphasizes that environmental vulnerability is produced through interactions between ecological processes and political-economic decisions concerning access

to land, natural resources, infrastructure, and investment (Robbins 2012). In this context, the expansion of mineral extraction raises a fundamental question: whether environmental risks experienced by small-island communities are simply consequences of climate change or are partly produced and intensified by decisions concerning resource development. This distinction is particularly relevant to Kawasi on Obi Island, where the expansion of nickel mining and processing has transformed the physical and socioeconomic landscape surrounding a local community.

Nickel has become strategically important within Indonesia's industrial development and the global energy transition. Its use in stainless steel and battery technologies has positioned nickel as a critical mineral for contemporary industrialization and electric-vehicle supply chains. Indonesia's downstreaming strategy has consequently sought to increase domestic processing and capture greater value from nickel resources. However, the association between nickel and the low-carbon transition creates an important contradiction. The global demand for minerals required by clean-energy technologies can generate significant environmental pressures in the territories where those minerals are extracted. Sovacool et al. (2020) argue that low-carbon transitions must be examined through their material and social consequences rather than assuming that renewable-energy technologies are automatically environmentally and socially benign. The central question is therefore not merely whether nickel supports decarbonization, but under what ecological and social conditions nickel is extracted and who bears the costs of its production.

This contradiction has become increasingly visible in Indonesia's nickel-producing regions. Empirical research covering 7,721 villages in Sulawesi found that nickel mining was associated with substantial reductions in forest cover, while improvements in infrastructure and living standards did not compensate for continuing deterioration in environmental well-being (Luckeneder et al. 2024). The study is particularly important because it moves beyond anecdotal evidence and demonstrates that the consequences of nickel mining are multidimensional and vary across stages of mining development. These findings challenge a simplistic developmental narrative in which mining is assumed to generate uniformly positive local outcomes through employment, infrastructure, and economic growth. Instead, nickel development can simultaneously generate economic opportunities and environmental deterioration, creating what may be understood as an uneven distribution of development benefits and environmental burdens.

Previous Studies

Previous studies on nickel mining in Indonesia have primarily examined deforestation, environmental degradation, socioeconomic change, and community well-being. Luckeneder et al. (2024), for example, provide one of the strongest quantitative assessments by demonstrating that forest loss increased substantially in Indonesian villages experiencing nickel mining and that environmental well-being continued to deteriorate even where infrastructure and certain socioeconomic

indicators improved. Their findings are important for the present study because they establish that nickel mining cannot be evaluated exclusively through economic indicators. Nevertheless, their geographical focus is primarily on nickel-producing areas across Sulawesi rather than on the specific interaction between mining, climatic hazards, and small-island vulnerability in Kawasi. The present study builds upon this literature by shifting attention from mining impacts alone toward the interaction between extractive landscape transformation and climate vulnerability.

A second body of literature examines the environmental consequences of nickel mining in Obi Island. Tamrin et al. investigate marine environmental conditions around Obi Island and identify pollution concerns associated with mining activities, including the possibility of heavy-metal contamination entering surrounding waters through drainage processes. Such findings are significant because they demonstrate that the environmental consequences of nickel extraction cannot be confined to mine pits or industrial facilities; they can extend through interconnected terrestrial and marine systems. More recent research on the Obi mining landscape similarly identifies relationships between open-pit mining, vegetation loss, erosion vulnerability, and sediment transport containing elements such as nickel, chromium, and iron. This literature provides an important empirical foundation for examining sedimentation and landscape transformation in Kawasi. However, existing studies have not sufficiently connected these processes to the broader conceptual question of climate justice in a small-island setting.

A third group of studies has focused on the health and livelihood consequences of nickel mining in Obi Island. Rakuasa, Rifai, and Wutres (2025), for instance, review evidence concerning water and marine pollution, mangrove degradation, soil-quality deterioration, agricultural impacts, and potential public-health consequences associated with nickel mining on Obi Island. They further identify declining livelihood conditions among fishermen and farmers and highlight conflicts related to unequal natural-resource management. This body of research is valuable because it demonstrates that environmental degradation can translate into social and economic consequences. Nevertheless, the present article extends this discussion by asking how such environmental changes intersect with climate-related hazards and differentiated vulnerability, rather than treating mining impacts and climate vulnerability as separate analytical categories.

Another emerging body of literature examines Indonesian nickel development through the lens of environmental justice and green extractivism. Recent research argues that nickel downstreaming can generate a paradox in which economic growth associated with the low-carbon economy is accompanied by deforestation, environmental degradation, spatial inequality, and uneven distribution of benefits (Fatimatuzzahro 2026). Similarly, recent work on nickel governance emphasizes the unequal distribution of environmental burdens, limited community participation, and tensions between mineral development and environmental rights. This literature provides a critical foundation for interpreting nickel as part of a broader process of green extractivism, in which activities justified through the

language of sustainability and energy transition may nevertheless reproduce established patterns of territorial inequality.

The literature on small islands adds another important dimension. Bambrick et al. (2017) demonstrate that extractive activities in small islands can simultaneously generate environmental degradation, health consequences, economic dependence, and reduced resilience to climate change. Their analysis is particularly relevant to Kawasi because it challenges the assumption that climate vulnerability can be understood independently from resource extraction. When ecosystems supporting livelihoods are degraded, communities may become less capable of absorbing climatic shocks. Thus, extraction can function as a vulnerability multiplier: it does not necessarily create every climatic hazard, but it can alter ecological and socioeconomic conditions in ways that make existing hazards more damaging.

Despite these important contributions, a significant gap remains in the literature. Existing research generally addresses three issues separately: (1) the environmental and socioeconomic consequences of nickel mining, (2) the climate vulnerability of small islands, and (3) environmental or climate justice in resource-dependent communities. What remains insufficiently examined is the interaction among these three dimensions at the community level. Kawasi provides an analytically important case because its small-island geography means that mining-related landscape transformation, watershed processes, settlement patterns, livelihoods, and coastal ecosystems are closely interconnected. The question is therefore not simply whether nickel mining produces environmental impacts, but whether the transformation associated with nickel development can compound the vulnerability of a community already exposed to climatic and ecological risks.

The concept of climate justice provides an appropriate framework for addressing this gap. Climate justice extends climate analysis beyond the aggregate reduction of greenhouse-gas emissions to questions concerning distribution, recognition, participation, responsibility, and unequal vulnerability (Schlosberg and Collins 2014; Sultana 2022). It asks who benefits from climate-related policies, who bears their costs, whose knowledge is recognized, and whose interests are represented in decisions concerning environmental transformation. These questions are especially important in the case of critical minerals. If nickel is extracted to support global decarbonization while communities near extraction sites experience environmental degradation and livelihood insecurity, then the climate benefits and environmental burdens are distributed across different geographical and social groups. Such an arrangement requires examination not only through environmental-impact frameworks but also through the normative lens of justice.

The idea of a just transition is therefore central to this article. A transition away from fossil fuels cannot be considered just merely because it reduces carbon emissions. It must also ensure that the material infrastructure of decarbonization does not reproduce dispossession, environmental inequality, or the sacrifice of vulnerable communities (Newell and Mulvaney 2013; Sovacool et al. 2020). Recent scholarship on the Indonesian nickel supply chain similarly emphasizes the

potential for socio-ecological violence throughout the mining and processing chain, including deforestation, soil erosion, water contamination, livelihood disruption, displacement, and weak community participation. This perspective is particularly relevant to small islands, where the ecological space available to absorb environmental damage is limited and where communities may have fewer opportunities to relocate or diversify their livelihoods.

The issue is also fundamentally one of distributive justice. Nickel industrialization may generate export revenues, investment, employment, infrastructure, and national industrial capacity. Yet these benefits do not necessarily accrue equally to communities living closest to extraction sites. Conversely, environmental risks such as sedimentation, degraded water quality, landscape instability, and livelihood disruption may be experienced most intensely by those communities. This creates a potential asymmetry between the geographical location of production and the geographical distribution of benefits. The environmental-justice literature identifies precisely this type of unequal allocation of environmental goods and bads as a central dimension of injustice (Schlosberg 2007). In the context of Kawasi, therefore, the relevant question is not whether nickel development generates economic benefits in absolute terms, but whether the distribution of benefits and risks is socially and ecologically equitable.

Procedural and recognitional justice are equally important. Communities affected by mining are not merely recipients of environmental impacts; they are actors with knowledge, livelihoods, territorial relationships, and legitimate interests in decisions affecting their surroundings. Environmental justice therefore requires meaningful participation in decisions concerning mining licenses, environmental assessments, spatial planning, relocation, watershed management, and environmental monitoring (Schlosberg 2004; Schlosberg and Collins 2014). Recent studies of Indonesian nickel governance similarly identify limited community participation and weaknesses in environmental decision-making as important dimensions of environmental injustice. A community may consequently experience injustice even where compensation or employment is provided if it has little influence over the decisions that fundamentally transform its territory.

The Kawasi case is particularly significant because environmental vulnerability appears to involve multiple interacting processes rather than a single hazard. Small-island vulnerability can arise from intense rainfall, coastal exposure, ecological sensitivity, and dependence on natural resources, while mining can alter vegetation, soils, drainage, slopes, and sediment dynamics. Research concerning Obi Island indicates that mining-related environmental changes can involve forest loss, erosion, sediment transport, water-quality concerns, and degradation of terrestrial and marine ecosystems. The appropriate analytical approach is therefore not to attribute every flood, sediment deposit, or ecological change to mining without adequate evidence. Instead, the analysis should examine how mining-induced landscape transformation may interact with climatic and hydrological

processes to increase environmental exposure. This distinction is essential for maintaining analytical rigor.

Flooding consequently becomes more than a natural hazard in this framework. Flood risk is influenced not only by rainfall intensity and topography but also by land-cover change, vegetation removal, soil disturbance, drainage alteration, and sediment mobilization. Where mining transforms watersheds, the relationship between rainfall and runoff may also change. The resulting risk is therefore partly ecological and partly political because decisions about where mines, roads, settlements, and industrial infrastructure are located are ultimately decisions about territorial governance. Political ecology is useful here because it connects environmental processes with questions of power, access, and resource control (Robbins 2012). The flood becomes not simply a "natural disaster" but an environmental event whose severity may be influenced by prior decisions concerning the transformation and management of the landscape.

The same analytical logic applies to red sediment. The appearance of red or reddish-brown sediment should not automatically be interpreted as proof of toxic contamination. Geological conditions, natural weathering, mining disturbance, and rainfall can all influence sediment characteristics. Nevertheless, research concerning Obi indicates that mining-related erosion and sediment transport can mobilize mineral-bearing materials, including nickel, chromium, and iron. The relevant question is therefore whether mining has altered the quantity, pathways, or ecological consequences of sediment movement. This distinction enables the article to avoid an overly deterministic argument while still taking seriously community observations of environmental change. A climate-justice approach is concerned not only with identifying a pollutant but with understanding how environmental transformations affect people's access to safe water, productive ecosystems, livelihoods, and territorial security.

The social distribution of these risks must also be considered. Households dependent on farming, fishing, forests, and coastal ecosystems may experience environmental degradation differently from households with stable industrial employment or alternative sources of income. Women, children, elderly residents, and economically vulnerable households may possess different capacities to respond to environmental disruption. The broader literature on climate justice emphasizes that vulnerability is differentiated according to social position and access to resources (Sultana 2022). In Kawasi, therefore, an adequate assessment should ask not only how much environmental change has occurred but which households are most exposed, which livelihoods are most dependent on affected ecosystems, and which groups have the least capacity to absorb or contest environmental risks.

Against this background, this article examines Kawasi on Obi Island as a case of climate justice under conditions of green extractivism. The article asks three interconnected questions: First, how does nickel development transform the ecological and hydrological conditions of a small-island landscape? Second, how

do flooding, sedimentation, ecological degradation, and livelihood changes affect different groups within the Kawasi community? Third, how should these processes be understood in relation to climate justice and the concept of a just transition? The article argues that Kawasi illustrates a form of compounded vulnerability in which climate exposure and extractive development interact. Nickel development should therefore not be assessed exclusively according to its contribution to national industrialization or global decarbonization. It must also be evaluated according to whether the transition distributes environmental benefits and burdens fairly, recognizes local rights, protects livelihoods, and provides affected communities with meaningful decision-making power.

The central contribution of this article is consequently to connect three bodies of scholarship that are often treated separately: small-island climate vulnerability, nickel extractivism, and environmental/climate justice. Previous research has established that nickel mining can generate deforestation and deteriorating environmental conditions, while studies of small islands demonstrate that extractive activities can weaken climate resilience. Yet the interaction between these processes remains insufficiently theorized at the community level. Kawasi allows this interaction to be examined in concrete terms. The case demonstrates why climate justice should extend beyond the question of who emits greenhouse gases or who suffers from climate change. It must also ask who supplies the minerals for decarbonization, whose landscapes are transformed in the process, and whose environmental security is treated as negotiable. The subsequent sections develop this argument by examining the theoretical framework, research method, and empirical dimensions of Kawasi's environmental and social transformation.

Theoretical and Conceptual Framework

1. Climate Justice and Unequal Environmental Vulnerability

Climate justice provides the primary conceptual foundation for understanding Kawasi because it shifts attention from climate change as a universal environmental problem toward the unequal social distribution of climate risks, responsibilities, and capacities. Conventional approaches to climate change often emphasize aggregate emissions, adaptation costs, or technological solutions, whereas climate-justice scholarship asks how environmental harms and benefits are distributed among different populations. Schlosberg and Collins (2014) argue that climate justice should be concerned with local experiences of environmental harm, unequal vulnerability, community participation, and the ability of affected populations to exercise meaningful control over decisions that shape their environments. Similarly, Schlosberg (2012) emphasizes that adaptation should be evaluated in relation to human capabilities, recognition, and participation rather than merely the construction of physical infrastructure. This perspective is particularly relevant to Kawasi because the community's vulnerability cannot be assessed solely according to exposure to rainfall or flooding. It must also be examined in relation to the

political and economic processes that determine how the surrounding landscape is transformed.

Climate justice also requires attention to the distinction between hazard, exposure, vulnerability, and adaptive capacity. A climatic hazard, such as intense rainfall, does not automatically produce the same consequences for every household or territory. Its effects depend on exposure to the hazard, the sensitivity of ecological and social systems, and the capacity of affected populations to anticipate, absorb, and recover from its consequences (Adger 2006; IPCC 2022). This distinction is particularly important for small islands because geographical constraints can limit opportunities for relocation and livelihood diversification. When environmental degradation occurs simultaneously with climate-related hazards, vulnerability may become cumulative rather than additive. In Kawasi, therefore, flooding should not be interpreted exclusively as a climatic event. The analytical question is whether changes in vegetation, soil, drainage, watershed structure, and sediment movement associated with mining can alter the severity or consequences of climatic events. Climate justice thus requires examining both the physical production of risk and the social conditions through which risk becomes unequally experienced.

The concept of distributional justice provides a second dimension of this analysis. Environmental justice scholarship has long examined how environmental benefits and burdens are distributed across social groups, emphasizing that disadvantaged communities frequently experience disproportionate exposure to pollution, hazardous activities, and ecological degradation (Mohai, Pellow, and Roberts 2009). In climate policy, the same principle applies to adaptation and mitigation. A development project may generate economic benefits at the national or global level while concentrating environmental risks in a particular locality. This possibility is especially relevant to nickel extraction because the economic value of nickel extends well beyond the communities where it is mined. Nickel can enter national industrial strategies and global battery supply chains, whereas land transformation, water pollution, erosion, and livelihood disruption remain geographically concentrated. The analytical significance of Kawasi therefore lies partly in this spatial asymmetry: the benefits of nickel industrialization can travel across scales, while environmental risks may remain concentrated within a small island community.

2. Recognition, Participation, and Procedural Justice

Distribution alone, however, is insufficient for understanding environmental injustice. Climate justice also involves recognition and participation. Schlosberg (2004, 2007) argues that justice requires recognition of the identities, experiences, needs, and political standing of communities affected by environmental decisions. Recognition matters because environmental conflicts are rarely only about the quantity of resources or pollution. They also concern whose knowledge counts, whose relationship with the environment is considered legitimate, and whose

definition of environmental harm is incorporated into policy. In the context of Kawasi, community observations concerning flooding, sedimentation, water quality, fisheries, agricultural productivity, and landscape change should therefore be treated as politically relevant forms of environmental knowledge rather than merely subjective perceptions. This does not mean that community claims should automatically be accepted as scientific proof of causation. Rather, recognition requires that such knowledge be incorporated into investigation, monitoring, and decision-making alongside scientific evidence.

Procedural justice complements recognition by asking whether affected populations possess meaningful opportunities to participate in decisions concerning environmental risks. Participation becomes especially important when development projects produce irreversible or long-term transformations of territory. A formally legal consultation process does not necessarily constitute meaningful participation if communities lack access to information, technical expertise, bargaining power, or the ability to influence the final decision. Schlosberg (2012) therefore connects climate justice with public participation and community capabilities. From this perspective, environmental governance should not merely inform communities about decisions already made; it should provide them with meaningful opportunities to influence decisions concerning land use, environmental safeguards, compensation, monitoring, and risk management. This framework is relevant to Kawasi because nickel development involves decisions that affect not only mine sites but also watersheds, settlements, coastal ecosystems, and livelihood systems. The procedural question is consequently whether local communities possess substantive—not merely formal—power within these decisions.

Recognition and participation are also connected to what political-ecology scholarship identifies as struggles over access and control. Ribot and Peluso's (2003) theory of access emphasizes that the ability to benefit from natural resources depends not simply on formal ownership but on social, economic, political, technological, and institutional capacities. A community may formally possess rights over particular resources while simultaneously losing practical access to them because roads, industrial zones, security arrangements, licensing systems, or environmental restrictions alter the conditions under which those resources can be used. This is particularly relevant in mining regions, where the conversion of landscapes into industrial spaces can change access to forests, rivers, agricultural land, and coastal areas. Kawasi can therefore be examined not only in terms of environmental degradation but also in terms of changing relations of access: who can use the landscape, who controls decisions concerning it, who benefits economically, and who is required to adapt when access is restricted.

3. Political Ecology and Extractive Landscape Transformation

Political ecology provides the broader analytical framework connecting environmental change to political-economic structures. Rather than treating

environmental degradation as an unintended consequence of human activity, political ecology examines how environmental transformations are shaped by relations of power, capital, institutions, and resource control (Robbins 2012). This perspective is particularly useful for mining because extraction is fundamentally a process of transforming nature into economically valuable commodities. The landscape is not simply damaged in the process; it is reorganized according to the requirements of extraction, transportation, processing, and accumulation. In the case of nickel, forests, soils, watersheds, and coastal environments become incorporated into a broader commodity chain extending from mineral deposits to industrial processing and global markets. The environmental consequences must therefore be understood as part of a political-economic process rather than as isolated ecological accidents.

Political ecology also helps explain why environmental impacts are often unevenly distributed. Extractive industries typically involve relationships among governments, corporations, local communities, workers, investors, and consumers operating at different geographical scales. These actors possess different capacities to influence land-use decisions and respond to environmental risks. Global or national actors may possess financial and institutional resources that allow them to benefit from mineral development, whereas local communities may have comparatively limited capacity to resist landscape transformation or demand remediation. Research on Indonesian nickel development increasingly demonstrates this tension. Luckeneder et al. (2024), for example, found significant forest loss associated with nickel mining across Indonesian villages and showed that improvements in infrastructure and socioeconomic conditions did not eliminate environmental deterioration. The finding supports a political-ecology interpretation in which economic development and ecological degradation can occur simultaneously rather than representing mutually exclusive outcomes.

The concept of extractive landscape transformation is therefore central to this study. Mining does not merely remove minerals from an otherwise stable environment. It changes topography, vegetation, soil exposure, drainage, transportation networks, settlement patterns, and the spatial organization of economic activity. In tropical island environments, such changes can have effects beyond the immediate mining concession because watersheds connect upland mining areas with rivers, agricultural lands, settlements, estuaries, and coastal ecosystems. Research on Obi Island has identified concerns regarding mining-related pollution and environmental degradation in surrounding terrestrial and marine systems. Recent research likewise associates mining-related landscape transformation with erosion and sediment transport in the Obi area. These findings suggest that environmental impacts should be analyzed through ecological connectivity, rather than through a narrow distinction between “mine site” and “community.” The community may experience environmental consequences precisely because ecological processes transport the effects of landscape transformation across administrative boundaries.

4. Green Extractivism and the Paradox of Low-Carbon Development

The concept of green extractivism further strengthens the theoretical analysis by addressing the contradiction between mineral extraction and environmental sustainability. The transition toward renewable energy and electric mobility requires substantial quantities of minerals, creating a new demand for extraction in countries such as Indonesia. This development can generate a paradox: activities justified as necessary for decarbonization may produce localized environmental and social harms. Sovacool et al. (2020) demonstrate that the global energy transition has significant material requirements and that these requirements can create new environmental and social pressures. Consequently, replacing fossil-fuel technologies does not automatically eliminate extractive inequalities; it may instead reorganize them around new commodities and new geographical frontiers. Nickel is particularly relevant to this debate because it occupies a strategic position in industrial and battery supply chains while its extraction can significantly alter landscapes.

The concept of green extractivism does not imply that all mineral extraction associated with renewable energy is inherently unjust. Rather, it challenges the assumption that the purpose of extraction determines its environmental legitimacy. A mine producing minerals for electric vehicles may contribute to global emissions reduction, but this does not automatically justify environmental degradation at the extraction site. Climate justice requires evaluating the entire chain of consequences. This is where the distinction between global mitigation benefits and local environmental burdens becomes analytically important. If global consumers benefit from lower-carbon technologies while communities near extraction sites bear pollution, ecological degradation, displacement, or livelihood insecurity, the transition risks reproducing a familiar geography of sacrifice. Kawasi therefore provides a useful site for asking whether the low-carbon transition is genuinely transformative or whether it reproduces older patterns of unequal resource extraction under a new environmental narrative.

The green-extractivism framework also complicates the meaning of development. Mining can generate employment, infrastructure, government revenue, and industrial investment, and these benefits should not simply be dismissed. The analytical problem emerges when aggregate economic benefits are used to obscure differentiated environmental costs. Luckeneder et al. (2024) demonstrate precisely this tension in Indonesian nickel-producing areas: infrastructure and socioeconomic improvements may occur alongside significant forest loss and declining environmental well-being. This suggests that development outcomes should be evaluated multidimensionally. Economic indicators alone cannot determine whether a mining project improves community welfare if ecological degradation undermines the environmental foundations of livelihoods. For Kawasi, the relevant question is therefore not whether nickel creates economic activity, but whether the net distribution of economic, ecological, and social outcomes constitutes a just form of development.

5. Small-Island Vulnerability and Compounded Risk

Small-island vulnerability constitutes the final conceptual component of the framework. Small islands face particular environmental constraints because terrestrial and marine systems are closely interconnected, land availability is limited, and many communities depend directly on ecological resources. Nurse et al. (2014) emphasize that small islands face multiple climate-related risks involving coastal systems, freshwater, ecosystems, settlements, and livelihoods. The IPCC (2022) similarly emphasizes that climate impacts on small islands interact with non-climatic pressures, including ecosystem degradation and human development. This is important because it prevents the analysis from reducing Kawasi's vulnerability to climate change alone. The island's vulnerability must instead be understood as the product of interacting climatic, ecological, and political-economic processes.

The notion of compounded vulnerability captures this interaction. A community can become more vulnerable when multiple stressors affect the same ecological and social systems. For example, intense rainfall may constitute a climatic hazard, but vegetation loss and soil disturbance can influence runoff and erosion; sedimentation can affect rivers and coastal ecosystems; ecological degradation can reduce fishing or agricultural productivity; and livelihood disruption can reduce household capacity to recover from environmental shocks. Adger (2006) conceptualizes vulnerability as a function of exposure, sensitivity, and adaptive capacity, while Schlosberg (2012) emphasizes the importance of capabilities and social recognition within climate adaptation. Combining these approaches suggests that climate risk should be analyzed not only by measuring hazards but also by examining whether development processes undermine the ecological and social capabilities through which communities respond to those hazards.

This framework is particularly appropriate for Kawasi because the island's ecological characteristics make environmental processes highly interconnected. Mining-related changes in upland landscapes may influence downstream sediment movement; changes in freshwater systems can affect households and agriculture; coastal degradation can influence fisheries; and livelihood losses can increase dependence on wage employment within the extractive economy. The result is not necessarily a single identifiable environmental impact but a cascade of interconnected vulnerabilities. Such cascades are important for climate justice because the groups most dependent on ecological resources may have the least capacity to avoid or compensate for their degradation. A household with diversified income and secure industrial employment may experience environmental change differently from a household whose subsistence depends directly on fishing, farming, or forest resources.

Taken together, these concepts produce an integrated analytical framework for the study. Climate justice identifies the unequal distribution of environmental risks and benefits; environmental justice adds questions of recognition and participation; political ecology explains how power and political economy shape environmental

transformation; green extractivism exposes the contradiction between low-carbon development and local ecological sacrifice; and small-island vulnerability theory explains why the consequences of environmental transformation can become particularly intense in geographically constrained communities. The framework therefore treats Kawasi not simply as a mining-impact case but as a multi-scalar justice problem. Nickel is connected simultaneously to local landscapes, national industrial policy, and global energy-transition demand. The central analytical task is to trace these connections and determine how their benefits and burdens are distributed.

The theoretical implication is that a genuinely just transition cannot be measured only by the amount of carbon reduced or the number of industrial jobs created. It must also be assessed through distribution, recognition, participation, ecological integrity, and community capabilities (Schlosberg 2012; Schlosberg and Collins 2014). In Kawasi, this means asking whether communities retain access to the ecological systems necessary for their livelihoods, whether they have meaningful influence over decisions concerning their territory, whether environmental risks are equitably distributed, and whether the ecological limits of a small island are incorporated into industrial planning. This framework provides the basis for the empirical analysis that follows. Rather than presuming that nickel mining causes every environmental change observed in Kawasi, the study will examine the interaction between mining-induced landscape transformation, climatic and hydrological processes, and differentiated social vulnerability. This approach allows the article to make a stronger argument about climate justice without overstating causal evidence.

Method

This study employs a qualitative case-study approach to examine Kawasi on Obi Island as a site where nickel extraction, environmental transformation, climate vulnerability, and environmental justice intersect. A case-study design is appropriate because it enables the analysis of a complex environmental phenomenon within its social, political, and institutional context (Yin 2018). The study relies primarily on secondary data, including peer-reviewed journal articles, government regulations and policy documents, official reports, statistical materials, and credible institutional publications. Particular attention is given to empirical studies concerning nickel mining in Indonesia and Obi Island, including research on deforestation, environmental degradation, water quality, sedimentation, livelihoods, and community welfare (Luckeneder et al. 2024; Tamrin et al.; Rakuasa, Rifai, and Wutres 2025). The use of multiple sources allows the study to triangulate evidence and avoid relying on a single institutional or political narrative.

The analysis applies thematic and multi-scalar approaches. Four principal themes guide the analysis: (1) mining-induced landscape transformation, including vegetation loss, soil disturbance, erosion, drainage alteration, and sediment movement; (2) environmental vulnerability, particularly flooding, water quality,

and ecological degradation; (3) livelihood and social vulnerability, including impacts on agriculture, fisheries, and resource-dependent households; and (4) environmental justice and governance, particularly distribution, recognition, participation, and community capabilities (Schlosberg 2004, 2007, 2012; Schlosberg and Collins 2014). These themes are examined across local, national, and global scales. At the local level, the study considers changes affecting Kawasi and its surrounding ecosystems; at the national level, it examines Indonesia's nickel downstreaming and regulatory framework; and at the global level, it considers nickel's role in low-carbon technologies. This approach follows political-ecology scholarship, which emphasizes the connection between local environmental change and wider political-economic structures (Robbins 2012).

The study also maintains an important distinction between environmental association and causal attribution. The occurrence of flooding, red sediment, or ecological degradation is not automatically treated as proof that nickel mining is their sole cause, since these processes may also be influenced by rainfall, geology, topography, natural erosion, and other forms of land-use change. Instead, the analysis evaluates whether existing evidence demonstrates direct relationships or plausible interactions between mining-related landscape transformation and environmental vulnerability. This methodological caution strengthens the study's analytical credibility by avoiding predetermined conclusions. At the same time, the climate-justice framework enables the analysis to move beyond the narrow question of environmental causation toward broader questions of who benefits from nickel development, who bears its environmental risks, whose knowledge is recognized, and who participates in decisions concerning the future of Kawasi. Through this approach, the study interprets Kawasi as a case of potentially compounded vulnerability in which climate exposure and extractive development interact within a geographically constrained small-island environment.

Results and Discussion

1. Kawasi, Small-Island Vulnerability, and Landscape Transformation

Kawasi illustrates how small-island vulnerability can be intensified when ecological systems are subjected to rapid extractive transformation. The community is located on Obi Island, an area that has become an important center of nickel extraction and processing in Indonesia. The significance of this transformation cannot be understood simply through the size of individual mining operations. Nickel mining changes the physical organization of the landscape through vegetation clearance, excavation, road construction, stockpiling, and the development of supporting industrial infrastructure. Research on Indonesian nickel mining demonstrates that these transformations have measurable consequences for forest cover and environmental well-being. Luckeneder et al. (2024), using data from 7,721 villages in Sulawesi, found that deforestation in nickel-mining villages nearly doubled between 2011 and 2018, while environmental well-being continued to deteriorate despite improvements in infrastructure and living

standards. The Kawasi case must therefore be situated within a broader pattern of extractive landscape transformation.

The physical characteristics of lateritic nickel deposits make this transformation particularly significant. Unlike underground mining, lateritic nickel extraction generally takes place close to the surface, meaning that extraction requires substantial disturbance of vegetation, soils, and upper geological layers. Heijlen and Duhayon (2024) demonstrate that the land footprint associated with laterite nickel mining in Indonesia can be substantially larger than previous estimates, emphasizing the importance of measuring the actual spatial consequences of mining rather than focusing exclusively on production volumes. In a small-island environment, the implications of such a footprint can be disproportionately significant. Limited territorial space means that mining areas, settlements, agricultural lands, rivers, and coastal ecosystems may be physically close to one another. Consequently, environmental effects generated in one part of the landscape can propagate into other ecological and social systems. The problem is therefore not merely the loss of individual forest areas but the transformation of the ecological relationships connecting the island's different zones.

This relationship can be understood through the concept of landscape connectivity. Forests and vegetation influence infiltration, soil stability, runoff, and sediment retention, while rivers and drainage systems connect upland areas to settlements, agricultural lands, estuaries, and coastal waters. When mining removes vegetation and disturbs soils, the resulting changes can alter these connections. The environmental significance of mining is consequently determined not only by what happens inside the concession but also by what happens downstream. Research on Obi Island has documented concerns regarding environmental degradation associated with nickel mining, including impacts on water, soil, agricultural productivity, and marine ecosystems (Rakuasa, Rifai, and Wutres 2025). From a political-ecology perspective, this means that the mining concession cannot be treated as an isolated economic space. It forms part of a larger socio-ecological system in which industrial decisions can produce consequences beyond the boundaries of the formally licensed area.

The transformation of forested landscapes is particularly important because forests provide more than biodiversity values. They perform hydrological and protective functions that can contribute to local resilience. Vegetation can slow surface runoff, stabilize soil, retain sediments, and support water regulation. Consequently, forest clearance may increase the sensitivity of landscapes to intense rainfall even when rainfall itself has not changed. This distinction is important for climate-justice analysis. Climate change can intensify precipitation extremes, but the magnitude of resulting environmental damage depends partly on the condition of ecosystems exposed to those events (IPCC 2022). Thus, where mining reduces vegetation and modifies terrain, it may contribute to a situation in which an existing climatic hazard produces greater environmental consequences. The argument is not that mining creates rainfall or directly causes every flood, but that landscape

transformation can modify the ecological conditions through which rainfall becomes environmental risk.

The importance of this interaction becomes clearer when considering the broader literature on vulnerability. Adger (2006) conceptualizes vulnerability through exposure, sensitivity, and adaptive capacity, while the IPCC (2022) emphasizes the interaction between climatic hazards and non-climatic drivers of vulnerability. In Kawasi, mining-related landscape change can potentially influence both exposure and sensitivity. Environmental transformation may increase the exposure of settlements or agricultural areas to runoff and sedimentation, while ecological degradation can increase sensitivity by reducing access to productive land and aquatic resources. At the same time, changes in livelihoods may influence adaptive capacity. A household that loses access to fishing or agricultural resources may become more dependent on wage employment or other forms of income, potentially increasing its dependence on the same industrial economy responsible for transforming its environment. Vulnerability therefore emerges as a dynamic social-ecological condition, rather than a fixed characteristic of the island.

Evidence from Kawasi itself reinforces the importance of examining environmental vulnerability through multiple pathways. Hartono et al. (2018) conducted a health-risk assessment involving 984 respondents in Kawasi and examined exposure to nickel and lead through drinking water. Their study identified drinking-water exposure as a significant environmental-health concern and calculated different risk levels for men, women, and children. Although the study should not be used to establish that every contemporary water-quality problem in Kawasi has the same cause or magnitude, it demonstrates that concerns over environmental exposure in the community are not simply recent political narratives. There is a longer history of scientific investigation into the relationship between mining, water resources, and public health in Kawasi. This historical dimension matters because environmental vulnerability can accumulate over time, particularly when communities have limited capacity to restore degraded environmental systems.

The marine environment adds another layer to this vulnerability. Obi Island's terrestrial and marine ecosystems are closely interconnected, meaning that material transported from mining areas can potentially affect coastal waters. Aris and Tamrin (2020), for example, examined nickel and iron concentrations in Obi Island waters and used marine fish as bioindicators of environmental conditions. Their research demonstrates the relevance of heavy-metal monitoring within the island's aquatic environment. Rakuasa, Rifai, and Wutres (2025) likewise identify concerns involving marine and freshwater pollution, mangrove degradation, soil deterioration, and agricultural impacts associated with nickel mining on Obi Island. These findings reinforce the argument that environmental impacts should be examined through the island's interconnected ecological systems. A disturbance that begins in an upland mining area can have consequences for downstream and coastal environments, particularly where sediment and water connect these spaces.

The significance of sedimentation is therefore not limited to visual changes in water color. In lateritic mining environments, soil and mineral-bearing materials can become mobilized by rainfall and surface runoff. Recent research on nickel mining in Obi Island specifically identifies erosion and sediment transport as important environmental processes associated with landscape transformation. Rakuasa, Rifai, and Wutres (2025) further discuss the degradation of terrestrial and marine systems associated with mining activities on Obi. Nevertheless, a rigorous analysis must distinguish between sediment presence and demonstrated toxicity. Red or reddish-brown water does not, by itself, establish the concentration of a hazardous substance or prove a particular health effect. The analytical importance of sediment lies instead in the possibility that increased erosion and sediment transport can alter waterways, reduce water quality, affect aquatic habitats, and transport mineral-associated materials. This distinction strengthens rather than weakens the environmental-justice argument because it prevents visual evidence from being treated as sufficient proof of causation.

The transformation of Kawasi can also be interpreted through the concept of sacrifice zones, in which certain territories become disproportionately exposed to environmental risks in the pursuit of broader economic objectives. The concept does not require that a government or corporation explicitly designate a community as expendable. Rather, a sacrifice zone can emerge when environmental costs are systematically concentrated in places with relatively limited political and economic power. Nickel's role in Indonesia's downstreaming strategy creates precisely this possibility. National industrialization and global battery demand can generate benefits at scales far removed from the mining community, while ecological impacts remain spatially concentrated. Luckeneder et al. (2024) provide evidence of this tension by demonstrating that nickel mining generated mixed socioeconomic outcomes while environmental well-being continued to deteriorate. Kawasi therefore raises a fundamental distributive-justice question: whether the community is receiving benefits proportionate to the ecological risks associated with the transformation of its territory.

The political dimension becomes even more important when the environmental transformation is considered as part of a global energy transition. Nickel is increasingly connected to electric vehicles and low-carbon technologies, which can create a powerful narrative of national and global necessity. However, recent research on Indonesia's nickel sector argues that the social and ecological impacts of extraction must be incorporated into discussions of just transition. Yanuardi, Badoh, and Nugroho (2024) describe the Indonesian nickel supply chain through a framework of social-ecological violence and emphasize that the demand generated by decarbonization can produce interconnected environmental and social harms. This perspective is particularly relevant to Kawasi because it challenges a hierarchy in which global climate objectives are treated as inherently superior to local environmental concerns. A genuinely just transition must instead

reconcile decarbonization with the protection of communities located at the mineral-extraction frontier.

This tension also demonstrates why climate justice cannot be reduced to climate mitigation. If nickel is necessary for certain low-carbon technologies, increasing its supply may contribute to global decarbonization. Yet the legitimacy of that contribution depends partly on how extraction is organized. Schlosberg and Collins (2014) emphasize that climate justice includes distributional, procedural, and recognitional dimensions. Applied to Kawasi, these dimensions require asking whether environmental risks are equitably distributed, whether residents participate meaningfully in decisions concerning mining and environmental management, and whether local ecological knowledge and livelihood dependence are recognized. The existence of national economic benefits cannot, by itself, answer these questions. Nor can the existence of formal environmental regulations. Justice requires examining whether governance arrangements actually protect the ecological conditions necessary for community well-being.

The evidence therefore suggests that Kawasi should be interpreted as a case of compounded environmental vulnerability rather than as a community experiencing a single environmental hazard. Climate-related rainfall, small-island geography, forest and land-cover change, mining-related disturbance, water systems, sediment transport, and livelihood dependence interact within the same territorial space. Existing studies provide evidence of environmental and health concerns associated with nickel development on Obi Island, while broader Indonesian research demonstrates that nickel mining can produce substantial forest loss and continuing deterioration in environmental well-being (Hartono et al. 2018; Luckeneder et al. 2024; Rakuasa, Rifai, and Wutres 2025). The analytical implication is significant: the vulnerability of Kawasi should not be attributed exclusively to climate change or exclusively to mining. Instead, mining can be understood as a risk multiplier when extractive landscape transformation reduces the ecological and social capacities through which communities respond to climatic and environmental disturbances.

Ultimately, the Kawasi case demonstrates that the environmental consequences of nickel development must be assessed at the scale of the whole socio-ecological landscape, rather than through isolated measurements of production, employment, or mine-site compliance. Nickel mining creates economic value because it transforms natural landscapes into commodities, but that transformation can simultaneously alter the ecological functions on which local communities depend. The central justice problem emerges when these two forms of value—industrial-economic value and ecological-social value—are measured differently and assigned unequal political importance. If industrial production is treated as a national or global priority while ecological degradation is treated as a local externality, then environmental risks become structurally unequal. Kawasi therefore demonstrates why small-island climate justice requires not only adaptation to environmental hazards but also scrutiny of the development processes that

produce, intensify, or redistribute those hazards. This argument provides the foundation for the next subsection, which examines more specifically the relationship between nickel mining, flooding, and red sedimentation in Kawasi.

2. Nickel Mining, Flooding, and Red-Sediment Pollution

The relationship between nickel mining and flooding in Kawasi should be understood through the transformation of the island's hydrological landscape rather than through a simple claim that mining directly "causes" floods. Mining can alter vegetation cover, soil structure, surface drainage, and topography, all of which influence how rainfall is absorbed, transported, and discharged through watersheds. This distinction is important because flooding is produced through the interaction of rainfall, terrain, drainage, land cover, and human modification of landscapes. The IPCC (2022) similarly emphasizes that climate-related hazards interact with non-climatic drivers of vulnerability, including land-use change and ecosystem degradation. In Indonesia, large-scale nickel mining has been associated with significant forest loss: Luckeneder et al. (2024), using a counterfactual analysis of 7,721 villages in Sulawesi, found that deforestation nearly doubled in nickel-mining villages. These findings provide a broader empirical basis for examining how mining-related landscape transformation may modify hydrological vulnerability in Kawasi.

The hydrological significance of vegetation loss lies in the capacity of forests and soils to regulate water movement. Vegetation intercepts rainfall, roots stabilize soils, and organic matter can improve infiltration and water retention. When vegetation is removed and soil is exposed, rainfall can generate greater surface runoff and mobilize loose materials. In a tropical environment characterized by intense rainfall, these processes can become particularly important. Research on nickel mining in Indonesia indicates that the environmental footprint of mining extends beyond the physical removal of mineral resources and includes deforestation, pollution, and ecosystem degradation (Luckeneder et al. 2024). A recent systematic review of nickel extraction in Indonesia similarly identifies deforestation, heavy-metal pollution, and ecosystem degradation as recurring environmental concerns (Setyawan et al. 2026). The significance for Kawasi is therefore not that mining mechanically produces every flood event, but that landscape disturbance may reduce the ecological capacity of the watershed to absorb and regulate intense rainfall.

The issue becomes more consequential in a small-island setting because the distance between upland extraction areas, settlements, rivers, and coastal ecosystems is comparatively limited. Environmental processes can therefore move rapidly across spaces that would be more geographically separated in larger territories. Mining-related sediment can enter drainage systems and eventually reach coastal waters, creating connections between terrestrial and marine environmental change. Research specifically examining Obi Island has identified environmental concerns involving rivers, seawater, agricultural land, and marine

ecosystems associated with nickel development (Rakuasa, Rifai, and Wutres 2025). This ecological connectivity means that a mining impact cannot be assessed adequately by measuring conditions only within a concession boundary. A more appropriate unit of analysis is the mine–watershed–settlement–coast system, in which environmental processes generated upstream can become social and ecological risks downstream.

Red sediment is particularly important within this system because it provides a visible manifestation of landscape disturbance while also raising questions about water quality and material transport. However, the presence of red or reddish-brown sediment should not automatically be equated with toxic contamination. Color alone cannot establish the concentration, chemical form, or ecological toxicity of a particular substance. Geological weathering, naturally occurring iron-bearing minerals, rainfall, and mining-related soil disturbance can all influence sediment coloration. The scientifically stronger argument is therefore that intensive land disturbance can increase the availability and mobility of mineral-bearing materials, which may subsequently be transported by rainfall and runoff. Studies of Obi Island have raised concerns about heavy metals and environmental contamination in aquatic systems (Aris and Tamrin 2020; Rakuasa, Rifai, and Wutres 2025). Consequently, red sediment should be interpreted as a potential indicator of altered sediment dynamics, requiring chemical and hydrological analysis rather than being treated as conclusive evidence of toxicity.

This distinction is particularly important because environmental injustice arguments can become analytically weaker when visual observations are transformed into unsupported causal claims. A climate-justice analysis does not require exaggerating environmental evidence. On the contrary, it becomes more persuasive when it carefully distinguishes between what is empirically demonstrated and what remains a plausible mechanism requiring additional measurement. In Kawasi, evidence of mining-related deforestation, environmental degradation, and concerns over water and marine pollution establishes a broader environmental context (Luckeneder et al. 2024; Rakuasa, Rifai, and Wutres 2025). The more specific question of whether particular flooding events or sediment deposits can be attributed to particular mining operations requires site-specific hydrological, sedimentological, and chemical data. Nevertheless, the absence of such data should not be interpreted as evidence that mining has no influence. It means that causal attribution must remain proportional to the available evidence.

The relationship between sedimentation and flooding also demonstrates why environmental risks can become cumulative. Sediment transported into rivers may alter channel capacity, increase turbidity, affect aquatic habitats, and accumulate in downstream areas. When these processes occur repeatedly, the environmental consequences may extend beyond individual rainfall events. The problem is therefore potentially one of risk accumulation rather than a single catastrophic event. This is consistent with the broader vulnerability literature, which understands environmental vulnerability as emerging from repeated interactions between

exposure, sensitivity, and adaptive capacity (Adger 2006). In Kawasi, repeated environmental disturbance can progressively weaken the ecological systems upon which communities depend. Such cumulative impacts may be especially significant for households whose livelihoods depend on fisheries, agriculture, freshwater, or forest resources because they have fewer opportunities to substitute degraded ecological resources with alternative forms of capital.

The potential consequences for water resources are particularly important. Water is simultaneously an ecological resource, a household necessity, and a public-health concern. Research by Hartono et al. (2018) examined environmental health risks among 984 residents of Kawasi and specifically assessed exposure to nickel and lead through drinking water. Their findings demonstrate that water-related exposure has been a legitimate subject of scientific concern in the community. More recent research likewise identifies water pollution and limited access to clean water among the environmental and public-health issues associated with nickel mining on Obi Island (Rakuasa, Rifai, and Wutres 2025). These findings are significant because environmental degradation becomes a justice issue when communities must bear additional costs to secure basic environmental services. If ecological transformation reduces the reliability or quality of naturally available water sources, households may have to purchase alternative water supplies, travel farther for water, or accept greater exposure risks.

The consequences of altered water systems can also extend into agriculture and fisheries. Agricultural productivity depends on soil quality, water availability, and environmental stability, while fisheries depend on the ecological integrity of rivers, estuaries, mangroves, and coastal waters. Research reviewing Obi Island identifies concerns involving soil degradation, agricultural impacts, mangrove damage, marine pollution, and declining livelihoods among farmers and fishers (Rakuasa, Rifai, and Wutres 2025). The importance of these impacts extends beyond household income because subsistence-oriented activities can simultaneously provide food, cultural identity, and social security. When environmental degradation reduces these functions, the affected community may become more dependent on market purchases and industrial employment. The result can be a paradoxical form of economic dependence in which ecological degradation weakens traditional livelihoods while the industrial sector responsible for landscape transformation becomes increasingly important as an alternative source of income.

This dynamic illustrates a central principle of political ecology: environmental degradation can simultaneously destroy one form of livelihood while creating dependence on another. The replacement of ecological livelihoods with wage employment is not necessarily negative if it provides secure and equitable economic opportunities. The problem arises when the new economic structure provides uneven benefits while the environmental costs remain broadly distributed. Luckeneder et al. (2024) found precisely this type of mixed outcome in Indonesian nickel-producing villages: infrastructure and some socioeconomic indicators improved, but environmental well-being deteriorated, particularly during later

stages of mining. This evidence challenges the assumption that environmental degradation can simply be justified as the unavoidable price of development. It suggests instead that development must be evaluated according to the full distribution of economic, environmental, and social outcomes.

The question of distribution becomes especially important when nickel is framed as a strategic mineral for the energy transition. Nickel extraction is increasingly connected to electric vehicles and other low-carbon technologies, creating a powerful narrative in which increased production is presented as necessary for global decarbonization. Yet scholars of critical minerals warn that the transition to low-carbon technologies can reproduce environmental and social inequalities if extraction is expanded without adequate justice safeguards (Heffron 2020; Sovacool et al. 2020). Heffron (2020), for example, argues that justice in critical-mineral development should encompass distributive, procedural, restorative, recognition, and cosmopolitan dimensions. This framework is directly applicable to Kawasi: the relevant question is not only whether nickel contributes to a lower-carbon global economy, but whether communities at the extraction frontier are adequately protected from the environmental costs associated with supplying that economy.

The problem can therefore be conceptualized as a spatial displacement of environmental burdens. The economic and technological benefits of nickel can be distributed across national and international scales, while the environmental consequences of extraction remain concentrated within particular territories. This geographical separation creates a potential justice problem because those who consume or benefit from low-carbon technologies may not experience the environmental risks associated with their mineral inputs. Recent scholarship on critical minerals similarly identifies tensions between global decarbonization objectives and the local consequences of mineral extraction, arguing that just transitions must account for inequalities embedded within mineral supply chains (Zhou and Brown 2024). Kawasi therefore demonstrates why the concept of a "clean" energy transition cannot stop at the point of technology deployment. The environmental history of the minerals entering that technology must also be included in the definition of sustainability.

This issue becomes even more significant when considering procedural and epistemic justice. Communities living near extraction sites often possess direct knowledge of changes in rivers, sediment, fisheries, agricultural productivity, and water availability. However, such knowledge can be marginalized when environmental governance privileges technical assessments conducted through standardized institutional procedures. Zhou and Brown (2024) argue that critical-mineral governance requires greater attention to epistemic justice because exclusionary knowledge practices can reproduce environmental inequality. Applied to Kawasi, this means that community observations of changing water conditions or sedimentation should neither be automatically accepted as scientific proof nor dismissed as anecdotal. They should instead form part of a participatory

evidence system in which local observations are combined with hydrological monitoring, water-quality testing, sediment analysis, and independent environmental assessment.

The issue of flooding consequently becomes a question of governance as much as hydrology. If a watershed has been transformed by mining, responsibility for environmental risk cannot be assigned exclusively to natural processes. Decisions concerning vegetation clearance, drainage infrastructure, mine-site rehabilitation, sediment management, and environmental monitoring are institutional decisions. The quality of these decisions affects whether climatic events become disasters or remain manageable hazards. Climate justice therefore requires examining the institutional capacity to anticipate and prevent risk, not merely responding after environmental damage occurs. Heffron (2020) identifies environmental-impact assessment, waste management, social license, and restoration as central justice issues in critical-mineral governance. In Kawasi, these principles imply that environmental governance should prioritize preventive watershed protection rather than relying primarily on post-damage remediation.

The available evidence also suggests that environmental risk should be understood in relation to poverty and adaptive capacity. Luckeneder et al. (2024) found that environmental deterioration associated with nickel mining was particularly significant in villages with already high levels of poverty. This finding is theoretically important because it indicates that mining impacts do not necessarily affect all communities equally. Households with limited financial resources may be less able to purchase alternative water, relocate temporarily, repair damaged property, substitute lost livelihood activities, or obtain legal and technical assistance. Environmental degradation can consequently reinforce pre-existing socioeconomic inequalities. In climate-justice terms, this creates an interaction between distributional vulnerability and adaptive capacity: the groups receiving fewer economic benefits from industrial development may simultaneously possess fewer resources with which to respond to its environmental consequences.

The emerging evidence from Kawasi and Obi Island therefore supports a more cautious but stronger interpretation of the relationship between nickel mining, flooding, and sedimentation. There is sufficient evidence to identify substantial landscape transformation, forest loss, environmental degradation, and water-related concerns associated with nickel development in the wider region (Luckeneder et al. 2024; Hartono et al. 2018; Rakuasa, Rifai, and Wutres 2025). There is also a plausible ecological mechanism through which vegetation clearance and soil disturbance can increase runoff and sediment mobilization. What cannot responsibly be claimed without additional site-specific data is that every flood or every instance of red sediment in Kawasi is directly caused by mining. The stronger argument is that mining has transformed the environmental conditions within which climatic hazards occur, potentially increasing exposure and sensitivity for communities whose livelihoods depend on the affected ecosystems.

From a climate-justice perspective, this distinction has important policy implications. If flooding and sedimentation are treated exclusively as natural hazards, the policy response will tend to focus on drainage, emergency response, relocation, or disaster assistance. Such interventions may be necessary but can fail to address the structural production of vulnerability. If, by contrast, environmental risk is understood as partly shaped by landscape transformation, then prevention must become central to governance. This includes stricter erosion and sediment controls, protection of critical watersheds, independent water-quality monitoring, transparent disclosure of environmental data, ecological rehabilitation, and meaningful community participation in environmental decision-making. Such measures are consistent with the broader justice framework proposed for critical minerals, which emphasizes prevention, restoration, participation, and accountability alongside economic development (Heffron 2020; Zhou and Brown 2024).

Ultimately, the significance of flooding and red sediment in Kawasi lies not simply in whether they can be attributed to a particular mining operation, but in what they reveal about the ecological limits and political organization of nickel development on a small island. A landscape that is increasingly transformed for mineral production may have reduced capacity to absorb climatic and hydrological shocks, while the community dependent on that landscape may possess limited alternatives when ecological services deteriorate. The central justice problem is therefore cumulative: global demand for critical minerals can generate economic value, but the environmental risks associated with producing those minerals may be concentrated in geographically constrained communities. Kawasi demonstrates why a genuinely just energy transition must include the protection of watersheds, freshwater, fisheries, agricultural systems, and community capabilities at the extraction frontier. Otherwise, the transition risks replacing one form of environmental inequality with another—reducing carbon emissions at the global scale while redistributing ecological vulnerability to communities such as Kawasi at the local scale.

3. Differentiated Vulnerability, Livelihoods, and Social Inequality

The environmental consequences of nickel development in Kawasi cannot be understood adequately without examining how risks are distributed among households with different livelihoods and socioeconomic capacities. Environmental change does not affect a community as a homogeneous unit. Households dependent on fishing, agriculture, forests, and freshwater resources are generally more directly exposed to ecological degradation than households whose income is primarily derived from industrial employment or other non-resource-based activities. This distinction is consistent with livelihood research showing that dependence on natural resources can simultaneously provide resilience and create vulnerability when those resources are degraded (Adger 2006; Scoones 1998). Evidence from Indonesian nickel-producing areas demonstrates this unevenness.

Luckeneder et al. (2024) found that nickel mining produced mixed effects on local well-being: some socioeconomic indicators improved, while environmental well-being declined, with outcomes varying according to local socioeconomic and biophysical conditions. The implication for Kawasi is that aggregate measures of economic growth cannot adequately capture the distribution of mining's costs and benefits.

Livelihood dependence is particularly important for fishing communities because coastal resources constitute both economic assets and forms of social security. Research on nickel development in other Indonesian coastal areas demonstrates that industrial expansion can restrict fishing access, damage fishing infrastructure, and reduce income when marine spaces become incorporated into industrial transportation and extraction systems (Lampe, Hendra, and Saputra 2025). A similar concern has been raised in research examining the legal and socioeconomic implications of nickel mining for fishermen in Halmahera, which emphasizes the state's responsibility to protect fishing livelihoods while regulating mining activities (Bobby and Basani 2024). These studies are important for interpreting Kawasi because they demonstrate that livelihood impacts are not necessarily limited to direct pollution. Industrialization can also change access to productive space, alter transportation patterns, restrict customary resource use, and increase competition over coastal resources. Environmental injustice can therefore emerge even before measurable ecological damage becomes catastrophic.

Agricultural households face a related but distinct vulnerability. Land degradation, sediment deposition, water-quality changes, and landscape fragmentation can undermine agricultural productivity while simultaneously increasing the costs of maintaining production. This creates an important distinction between income loss and livelihood loss. Income can potentially be replaced through alternative employment, but livelihood systems often include food production, household subsistence, social relations, cultural practices, and intergenerational knowledge. Research on mining-affected communities in Indonesia demonstrates that households do not possess equal capacity to diversify when traditional livelihoods become less viable. Rosyida et al. (2019), studying mining-related livelihood change on Bangka Island, found that limited capital, skills, and education constrained livelihood diversification, leaving landless households and fishers particularly vulnerable. The finding is highly relevant to Kawasi because it suggests that simply providing access to industrial employment does not guarantee that households can successfully transition away from ecological livelihoods.

This problem can be understood through the concept of adaptive capacity. Adaptation is not merely the ability to change occupations; it depends upon access to financial resources, education, land, social networks, information, mobility, and political institutions (Adger 2006). A household with savings, education, secure land tenure, and access to alternative employment can respond to environmental degradation very differently from a household with few assets and high dependence

on local ecosystems. Consequently, when mining alters agricultural or fishing livelihoods, the resulting vulnerability is likely to be differentiated. Some households may benefit from new wage opportunities, while others may experience declining ecological income without possessing the resources required to enter the industrial labor market. This creates what can be described as uneven transition: the same development process produces upward economic mobility for some households while simultaneously reducing the livelihood security of others.

The expansion of the nickel economy can nevertheless create genuine employment opportunities, and a critical environmental analysis should not ignore these benefits. Recent research from North Maluku shows that nickel resource frontiers generate substantial labor demand and can attract young workers from surrounding regions (Riyanto 2026). Yet Riyanto's analysis is particularly useful because it shows that labor migration cannot be understood simply as individual economic choice. The expansion of extractive frontiers interacts with longer histories of agrarian change, aspirations, household responsibilities, and social reproduction. This insight complicates the assumption that mining automatically "modernizes" rural livelihoods. Industrial employment may provide cash income, but it can also reorganize social relationships and increase dependence on wage labor. In Kawasi, therefore, the relevant question is not simply how many jobs mining creates, but which residents obtain those jobs, what forms of employment they receive, and what happens to those who cannot or do not enter the industrial economy.

Gender further complicates this distribution of vulnerability. Environmental degradation can affect women through changes in household water access, food production, care responsibilities, health risks, and livelihood opportunities. These impacts may remain invisible when assessments focus primarily on male employment in mining. Research on women and mining demonstrates that women's livelihoods are often diverse and interconnected with household economies, informal trade, agriculture, and care work (Arthur-Holmes, Yeboah, and Busia 2023). In Indonesia, Glynn and Maimunah (2023) similarly demonstrate that women affected by mining can develop forms of everyday resistance that reflect their awareness of dispossession and exploitation. These studies indicate that women should not be conceptualized merely as passive victims of mining. They are simultaneously affected subjects, economic actors, knowledge producers, and political agents. A climate-justice analysis of Kawasi therefore needs to recognize gendered vulnerability alongside women's agency.

Children constitute another group requiring particular attention because environmental exposure can have long-term consequences for health, education, and future livelihood opportunities. The health-risk study conducted by Hartono et al. (2018) in Kawasi included 984 respondents, including children, and assessed exposure pathways involving nickel and lead in drinking water. The study is important because it demonstrates that environmental risk can extend across generations. Children may possess little influence over mining-related decisions

while potentially experiencing the consequences for a much longer period. This creates a temporal dimension of environmental injustice: present economic benefits may be generated through environmental transformations whose costs are transferred to future generations. Climate justice similarly emphasizes intergenerational responsibility because environmental degradation can reduce the capabilities of future populations to meet their needs (Schlosberg 2012). In Kawasi, therefore, environmental protection is not merely a question of present welfare but also of preserving future livelihood and ecological options.

The relationship between mining and social inequality is further complicated by relocation. In Kawasi, plans to relocate residents from the existing settlement to an "Ecovillage" have generated questions concerning livelihood continuity, social relations, cultural identity, and long-term welfare. A recent study of the relocation process emphasizes that moving residents involves much more than physical transfer and must be evaluated through social, economic, cultural, and participatory dimensions (La Opi, Hirto, and Jani 2025). This is crucial because relocation can transform vulnerability rather than eliminate it. Moving households away from mining-related environmental risks may reduce certain forms of exposure, but it can simultaneously distance residents from fishing grounds, agricultural land, forests, ancestral spaces, social networks, and established economic practices. A relocation policy should therefore not be considered successful merely because residents occupy newly constructed houses. Physical safety and livelihood security are separate policy objectives, and the latter may be much more difficult to reproduce after relocation.

The issue of relocation also raises a fundamental question of recognitional justice. A settlement is not simply a collection of houses; it can represent accumulated social relationships, memories, cultural practices, territorial knowledge, and economic networks. Schlosberg (2004, 2007) argues that environmental justice requires recognition of communities as political subjects whose identities and relationships with their environments matter. Consequently, relocating Kawasi residents may be justified on environmental or safety grounds, but its legitimacy depends on whether residents are able to participate meaningfully in defining the conditions of relocation. If relocation is designed primarily around industrial efficiency or physical distance from mining facilities, it may reproduce injustice by treating local social relationships as obstacles to development. Conversely, if residents possess meaningful bargaining power over location, housing, livelihoods, compensation, environmental monitoring, and cultural continuity, relocation can potentially become part of a protective rather than dispossessive strategy.

The question of participation becomes particularly important because economic compensation cannot fully substitute for lost ecological relationships. A fisherman who loses access to a fishing ground cannot necessarily reproduce the same livelihood simply by receiving a one-time payment. Likewise, a farmer may lose not only agricultural income but also food-security capacity, knowledge, and

social relationships associated with land. Research on mining-affected livelihoods in Indonesia demonstrates that resource-dependent communities can experience substantial difficulties in diversification when financial, educational, and human capital are limited (Rosyida et al. 2019). This suggests that compensation should be evaluated according to livelihood restoration, rather than merely monetary value. From a justice perspective, the relevant benchmark is whether affected households can maintain or improve their long-term capabilities after environmental transformation, not whether they receive an immediate financial payment.

This argument also challenges the assumption that industrial employment represents an adequate replacement for traditional livelihoods. Wage employment can provide predictable income for some households, but industrial work may involve different skill requirements, working conditions, schedules, and levels of job security. It can also generate dependence on a single dominant economic sector. Recent research on nickel labor frontiers in North Maluku shows that the expansion of industrial employment is intertwined with migration, changing aspirations, and the social reproduction of workers (Riyanto 2026). The emergence of a labor frontier can therefore transform not only employment but also family relationships and patterns of mobility. In Kawasi, this means that the success of nickel development should not be assessed by employment numbers alone. A more meaningful assessment would examine employment quality, local recruitment, skill transfer, income distribution, occupational safety, and the resilience of households when mining activity eventually declines.

Environmental degradation can also produce a form of dependency paradox. Mining may undermine agriculture and fisheries while simultaneously becoming the dominant source of wage employment. As ecological livelihoods decline, residents may become increasingly dependent on the industry that contributes to the transformation of their ecological environment. This relationship can weaken community bargaining power because opposition to mining may appear economically costly to households with few alternatives. Political ecology helps explain this paradox by demonstrating that environmental change can restructure access to resources and alter the conditions under which communities make economic decisions (Ribot and Peluso 2003; Robbins 2012). In such circumstances, participation cannot be evaluated simply by asking whether residents attended consultation meetings. Genuine procedural justice requires consideration of the structural conditions under which consent is produced. A community whose alternative livelihood options have been progressively weakened may technically participate in decisions while possessing limited practical freedom to reject or renegotiate development.

The social consequences of nickel development may also extend beyond direct environmental exposure through migration and demographic change. Industrial projects can attract workers from outside the local community, increasing demand for housing, services, transportation, and land. Such changes can generate economic opportunities but may also alter local social structures and intensify

competition over resources. Research on North Maluku's nickel labor frontier demonstrates how migration and industrial employment reshape relationships between workers and their home communities (Riyanto 2026). For a small-island community such as Kawasi, demographic change may be particularly consequential because land and infrastructure are limited. The resulting social transformation should therefore be considered part of the environmental-justice analysis. Environmental justice concerns not only pollution levels but also the broader transformation of the social conditions under which communities reproduce their livelihoods and identities.

These differentiated impacts demonstrate why aggregate welfare measures can conceal environmental injustice. A mining project may increase regional GDP, generate tax revenue, construct roads, and create employment while simultaneously producing substantial losses for particular households. If the benefits are measured at the regional or national level while environmental costs are measured at the household level, the resulting comparison will almost inevitably favor industrial development. This is a methodological problem as much as a political one. Luckeneder et al. (2024) provide empirical evidence that nickel mining can produce mixed well-being outcomes, with improvements in some dimensions occurring alongside environmental deterioration. The implication is that sustainability assessments must disaggregate outcomes according to social group, livelihood, location, gender, and time. Otherwise, development can appear successful precisely because the losses of vulnerable groups are averaged into broader indicators of economic progress.

The situation is especially relevant to the concept of climate justice because environmental vulnerability can accumulate across social categories. A household may be simultaneously dependent on fishing, have limited financial resources, live close to environmentally transformed areas, and possess little political influence. Another household may have industrial employment, higher education, stronger social networks, and greater mobility. Both households inhabit the same village but possess fundamentally different capacities to respond to environmental change. Schlosberg and Collins (2014) emphasize that climate justice requires attention to differentiated vulnerability rather than assuming that climate impacts are experienced uniformly. In Kawasi, therefore, justice requires identifying who is most exposed and who has the fewest alternatives, rather than treating the "community" as a single beneficiary or victim of nickel development.

The evidence also suggests that community resistance should not automatically be interpreted as opposition to development. Resistance may represent an attempt to renegotiate the terms of development, demand environmental protection, preserve livelihoods, or secure recognition of community rights. Glynn and Maimunah's (2023) study of women resisting nickel mining in Sorowako demonstrates that everyday resistance can reflect sophisticated understandings of dispossession and exploitation. This insight is relevant to Kawasi because environmental conflict should not be reduced to a binary opposition between "pro-

development" and "anti-development" actors. Residents may simultaneously recognize the economic importance of nickel while demanding cleaner water, secure livelihoods, compensation, participation, or alternative development pathways. Such demands should be interpreted as claims for fairer development, not necessarily as rejection of economic modernization.

Ultimately, the social dimension of Kawasi's environmental transformation demonstrates that climate vulnerability is inseparable from livelihood security and political power. Mining can create employment and infrastructure, but it can also reduce the ecological resources that previously provided households with food, income, and social security. The consequences are differentiated according to gender, age, livelihood, wealth, skills, and access to political institutions. Existing research on Kawasi and Obi Island provides evidence of health, water, livelihood, and environmental concerns, while comparative research from Indonesian mining regions demonstrates that households with fewer assets and weaker livelihood alternatives face greater difficulties adapting to extractive transformation (Hartono et al. 2018; Rosyida et al. 2019; Luckeneder et al. 2024). The central implication is therefore clear: a nickel transition cannot be considered just if it improves aggregate economic indicators while simultaneously weakening the capabilities of already vulnerable households. A genuinely just transition must protect ecological livelihoods, provide credible livelihood alternatives, ensure meaningful participation, and distribute both the benefits and costs of industrial development more equitably.

4. Climate Justice, Governance, and the Paradox of a "Just" Nickel Transition

The preceding analysis demonstrates that the environmental risks experienced in Kawasi cannot be separated from the governance arrangements through which nickel development is authorized, monitored, and justified. Indonesia's nickel strategy is frequently presented as an instrument of industrial transformation, downstreaming, employment creation, and participation in the global energy transition. Yet the existence of economic benefits does not automatically establish environmental justice. A just transition requires that the distribution of benefits and burdens, the participation of affected communities, and the recognition of local rights be considered simultaneously (Schlosberg 2007; Schlosberg and Collins 2014). This is particularly important in Kawasi because the community is located at the extraction frontier while the economic and strategic value of nickel extends far beyond the island. Recent research characterizes Indonesian nickel development as producing a paradox: investment and industrialization generate economic growth while simultaneously producing environmental degradation and livelihood losses (Pambudi 2025). The central governance question is therefore not whether nickel development produces benefits, but whether the institutional system ensures that those benefits do not depend upon disproportionately transferring ecological risks to vulnerable communities.

Indonesia's legal framework formally recognizes the need to balance economic development and environmental protection. Article 33(3) of the 1945 Constitution establishes state control over natural resources for the greatest prosperity of the people, while Law No. 3 of 2020 on Mineral and Coal Mining provides the principal framework for mineral-resource governance. Law No. 32 of 2009 on Environmental Protection and Management establishes environmental protection, pollution prevention, public participation, and environmental accountability as important components of environmental governance. The existence of these legal instruments indicates that environmental protection is not external to Indonesian mining law; it is formally incorporated into the regulatory system. Recent legal scholarship nevertheless identifies a persistent gap between the normative framework and its implementation, particularly regarding supervision, regulatory coordination, environmental protection, and social justice (Hangabei et al. 2024). This distinction between legal recognition and substantive implementation is essential for understanding Kawasi. The problem is therefore not simply an absence of environmental law, but whether regulatory institutions possess the independence, capacity, information, and political authority necessary to enforce those legal obligations.

The history of environmental governance on Obi Island illustrates this implementation gap. Zam Zam and Putrawan (2020), in their evaluation of environmental-management policy on Obi Island, found problems involving the implementation of environmental instruments, spatial planning, strategic environmental assessment, and hazardous-waste management. Their findings suggest that environmental governance weaknesses existed before the current intensity of nickel downstreaming. This is analytically significant because it indicates that contemporary environmental vulnerability should not be attributed exclusively to recent industrial expansion. Rather, it can emerge through the interaction between increasing extractive pressure and pre-existing institutional weaknesses. When regulatory capacity is weaker than the pace of industrial expansion, environmental governance becomes reactive rather than preventive. In such circumstances, environmental impact assessment may become an administrative requirement rather than an effective mechanism for determining whether particular ecological transformations should occur at all.

The concept of regulatory capacity helps explain why the existence of environmental rules does not necessarily translate into environmental protection. Effective regulation requires monitoring institutions capable of independently assessing environmental performance, access to reliable information, adequate sanctions, and the political ability to impose costs on actors that violate environmental standards. Research on Indonesian nickel governance repeatedly identifies this implementation problem. A recent legal analysis argues that Indonesian mining governance contains extensive normative requirements concerning environmental protection and sustainable mining, but implementation continues to face significant institutional and oversight challenges (Sahetapy and

Afdhal 2026). Similarly, recent research on nickel extraction identifies environmental degradation, heavy-metal risks, and policy weaknesses as recurring concerns in the Indonesian literature (Setyawan et al. 2026). These findings support the argument that the effectiveness of environmental law depends not merely on the existence of rules but on the institutional distribution of power necessary to enforce them.

Environmental impact assessment is especially important in this context because it represents one of the principal mechanisms through which potentially harmful projects are supposed to be anticipated and managed. In principle, environmental assessment allows authorities to identify ecological and social risks before they become irreversible. However, the effectiveness of the instrument depends on the quality of baseline data, the independence of assessment, public access to information, meaningful participation, and effective post-approval monitoring. Recent research on Indonesian nickel development identifies concerns regarding AMDAL implementation and environmental violations in the nickel sector (Arifin et al. 2025). If environmental assessment becomes primarily procedural, it can produce what might be called administrative legitimacy without ecological legitimacy: a project may possess the necessary documents while the underlying environmental risks remain inadequately addressed. For Kawasi, this distinction is crucial because the community's experience should be assessed not simply by asking whether environmental documents exist, but whether those documents accurately anticipated risks to water, livelihoods, flooding, sedimentation, and public health.

This problem is closely connected to the environmental-justice principle of procedural justice. Participation should not be reduced to informing residents after key decisions have already been made. Meaningful participation requires access to information, sufficient time to deliberate, the ability to challenge technical claims, and a realistic possibility that community input will influence decisions (Schlosberg 2007; Walker 2012). In a technically complex mining project, this requirement becomes particularly demanding because environmental decisions often depend upon specialized knowledge concerning hydrology, geochemistry, engineering, and risk assessment. Communities may therefore formally participate while lacking the technical resources necessary to evaluate corporate or governmental claims. This creates an asymmetry of knowledge that can translate into an asymmetry of political power. A more just governance model would consequently require independent technical assistance, transparent environmental data, participatory monitoring, and accessible grievance mechanisms so that residents are not forced to participate on unequal informational terms.

Recognition is equally important. Environmental governance can reproduce injustice when communities are recognized merely as recipients of compensation or development programs rather than as political actors with legitimate interests in their territories. Schlosberg's (2004, 2007) framework demonstrates that distributional justice cannot be separated from recognition because the unequal

distribution of environmental harms often reflects the marginalization of particular social groups. In Kawasi, local relationships with forests, coastal waters, agricultural land, and fishing areas have economic as well as social and cultural significance. Consequently, environmental transformation may involve more than measurable pollution or reduced income; it can also represent a transformation of the community's relationship with place. A governance system that recognizes only formal property rights or industrial licenses may therefore overlook forms of territorial attachment and ecological knowledge that are important to community well-being. Recognition requires institutions to treat such knowledge as relevant to environmental decision-making rather than as merely anecdotal evidence.

The governance problem becomes more complicated when corporate actors possess substantial economic and infrastructural influence in areas where public institutions have limited resources. Documentation and scholarship concerning Obi Island have raised concerns about the concentration of economic and social power surrounding nickel development, including the capacity of mining companies to influence local socio-political relationships (Inside Indonesia 2025). Such claims should be evaluated carefully and independently, but they raise an important theoretical issue: the difference between formal state authority and effective governance power. A government may retain legal authority over licensing and environmental regulation while companies possess considerable practical influence through employment, infrastructure provision, corporate social responsibility programs, and control over economic opportunities. Political ecology is particularly useful here because it asks not only who formally governs resources but also who possesses the practical capacity to determine how resources are accessed, transformed, and valued (Ribot and Peluso 2003; Robbins 2012).

This issue is directly connected to the concept of social licence to operate. Social licence is not equivalent to legal authorization. A company can possess a valid permit while still facing community opposition if residents perceive that environmental risks are unfairly distributed or that decision-making processes have excluded them. Hangabei et al. (2024) explicitly connect responsible mining in Indonesia with social justice and social licence to operate. The concept is particularly relevant to Kawasi because legitimacy depends upon more than compliance with formal regulations. It requires a relationship of trust between companies, government institutions, and affected communities. Where residents experience environmental degradation but perceive monitoring as opaque or ineffective, formal legal compliance may not produce social legitimacy. Conversely, transparent monitoring, meaningful participation, remediation, and equitable benefit-sharing can strengthen legitimacy even when industrial activities continue.

The concept of distributional justice further reveals a structural contradiction within nickel downstreaming. The benefits of nickel extraction can operate across multiple geographical scales. Local communities may obtain employment and infrastructure; provincial and national governments may receive revenues and

investment; industrial firms gain access to mineral resources; and global consumers benefit from products associated with the energy transition. Environmental risks, however, are much more spatially concentrated. Communities near mines experience the immediate consequences of land transformation, dust, water-quality concerns, sedimentation, noise, and livelihood disruption. Luckeneder et al. (2024) provide empirical support for this uneven distribution by showing that nickel mining in Sulawesi was associated with nearly doubled deforestation and worsening environmental well-being, even while some infrastructure and living-standard indicators improved. This is precisely the kind of uneven distribution that environmental-justice theory identifies as problematic: the geographic location of environmental harm does not correspond to the geographic distribution of economic benefit.

The paradox becomes sharper when nickel is framed as a material of the global green transition. A commodity can contribute to decarbonization at one scale while producing environmental injustice at another. This does not mean that nickel itself is inherently incompatible with climate action. Rather, it means that the sustainability of the energy transition depends on the conditions under which critical minerals are extracted. Recent scholarship on Indonesian nickel emphasizes that environmental externalities are transmitted through interconnected pathways affecting ecosystems, biodiversity, and human health in mining regions including Halmahera (Vitriano 2026). The concept of a "clean" energy transition is therefore incomplete if it evaluates only the emissions avoided by electric technologies while excluding the ecological costs of mineral production. A truly climate-just transition must account for the entire material chain of decarbonization, from extraction to processing, manufacturing, consumption, and waste.

This leads to the concept of sacrificial development, in which particular territories bear disproportionate ecological costs for benefits realized elsewhere. The term should not be interpreted as suggesting that the state or corporations explicitly intend to sacrifice Kawasi. Rather, sacrifice can be structurally produced when economic priorities make environmental costs appear acceptable because they occur in geographically peripheral or politically weaker communities. Pambudi (2025) describes the Indonesian nickel sector as a paradox in which rapid industrialization and investment coexist with environmental degradation and loss of local livelihoods. From a climate-justice perspective, this is problematic because the language of national development can obscure who bears the cost of achieving that development. If the ecological deterioration of a small island is treated as a necessary local sacrifice for national industrialization and global decarbonization, then climate policy risks reproducing the same inequalities that environmental justice seeks to challenge.

The problem also has a restorative dimension. Environmental justice is not achieved merely by preventing future harm; where degradation has already occurred, affected communities require restoration and accountability. Restoration may include rehabilitation of mined land, watershed recovery, reforestation, water-

quality remediation, restoration of fisheries and agricultural productivity, and compensation for demonstrable losses. Heffron (2020) emphasizes restorative justice as an important component of just energy transitions, particularly where energy development produces irreversible or long-term environmental consequences. The same principle is applicable to nickel development in Kawasi. If environmental governance focuses exclusively on prospective compliance, it may fail to address historical damage. A just transition therefore requires a temporal dimension of accountability: present industrial benefits should not erase responsibility for environmental costs accumulated over previous periods of extraction.

Public health further strengthens the case for restorative governance. Hartono et al. (2018) conducted a health-risk assessment involving 984 residents of Kawasi and investigated exposure to nickel and lead through drinking water. The study is particularly significant because it demonstrates that environmental risk is not an abstract ecological concern; it can become a question of bodily exposure and long-term human well-being. More recent research on Obi Island likewise identifies water contamination, limited access to clean water, and health concerns among the consequences associated with nickel development (Rakuasa, Rifai, and Wutres 2025). This creates a strong argument for environmental governance based on the precautionary principle. Where credible evidence indicates potential risks to drinking water and public health, regulatory institutions should not wait until irreversible health impacts are conclusively established before strengthening monitoring and preventive measures.

At the same time, precaution should not become a justification for unlimited state intervention or paternalistic decision-making. Environmental justice requires balancing precaution with community agency. Residents should have access to independent health information, environmental monitoring results, and mechanisms through which they can challenge regulatory decisions. This is particularly important where technical uncertainty exists. Rather than using uncertainty as a reason for inaction, institutions can establish transparent monitoring systems capable of reducing uncertainty over time. In Kawasi, this could involve publicly accessible measurements of river and drinking-water quality, sediment loads, heavy-metal concentrations, air quality, fisheries, and health indicators. Such monitoring would transform environmental governance from a predominantly permit-based system into an evidence-based accountability system. The importance of transparency is also emphasized in recent research on Obi Island, which calls for stronger supervision, transparency, environmental rehabilitation, and public-health protection (Rakuasa, Rifai, and Wutres 2025).

A further governance challenge concerns relocation as an environmental solution. Relocation may reduce exposure to industrial pollution or physical hazards, but it can also transfer social and economic costs to residents. Recent research concerning Kawasi's relocation emphasizes that the process must consider social, economic, cultural, and participatory dimensions rather than simply

physical housing provision. This distinction is consistent with the broader environmental-justice literature, which argues that displacement can itself constitute an injustice when affected communities lose access to livelihoods, social networks, and culturally meaningful territories (Schlosberg 2007; Walker 2012). Relocation should therefore be treated as a last-resort risk-management measure rather than automatically as evidence of successful environmental governance. If mining continues to generate environmental pressure while affected residents are repeatedly relocated, the underlying source of risk remains unchanged. Moving communities away from environmental harm is not equivalent to eliminating the environmental harm itself.

The strongest implication of the Kawasi case is therefore that environmental governance must move from a narrow "mitigation and compensation" model toward a "prevention, participation, restoration, and accountability" model. Prevention requires strict protection of watersheds, forests, coastal ecosystems, and drinking-water sources before damage occurs. Participation requires affected residents to possess meaningful influence over mining decisions and relocation plans. Restoration requires companies and responsible institutions to repair environmental damage and restore livelihoods where possible. Accountability requires transparent monitoring and credible sanctions when environmental obligations are violated. This approach is consistent with the emerging literature on responsible mining and sustainable development in Indonesia, which argues that good mining practice must integrate environmental protection, reclamation, occupational safety, social responsibility, and community welfare (Sahetapy and Afdhal 2026). The issue is therefore not whether Indonesia should choose "mining" or "the environment," but what institutional conditions are necessary to ensure that mineral development remains subordinate to ecological limits and social justice.

The Kawasi case ultimately exposes a fundamental contradiction in the idea of a green transition based on extractive expansion. Nickel may be strategically important for industrial development and low-carbon technologies, but the transition cannot be considered genuinely "green" if its environmental costs are externalized onto communities with limited political and economic power. The evidence from Obi Island indicates that environmental degradation, water and health concerns, livelihood disruption, and governance weaknesses are interconnected rather than isolated problems (Hartono et al. 2018; Zam Zam and Putrawan 2020; Rakuasa, Rifai, and Wutres 2025). Climate justice therefore requires a broader conception of sustainability—one that evaluates not only carbon emissions and economic efficiency but also distribution, recognition, participation, restoration, and intergenerational responsibility. Kawasi should consequently be understood not as an unfortunate side effect of Indonesia's nickel strategy, but as a critical test of whether the country's mineral-based energy transition can reconcile national development with the rights and ecological security of communities living at the extraction frontier.

Conclusion

The case of Kawasi demonstrates that the environmental vulnerability of small-island communities cannot be explained by climate change alone. Flooding, sedimentation, water-quality concerns, livelihood disruption, and ecological degradation emerge through the interaction between climatic exposure and intensive landscape transformation associated with nickel development. Existing research on Obi Island and other Indonesian nickel-producing regions indicates that mining can generate economic opportunities and infrastructure while simultaneously producing deforestation, environmental deterioration, health risks, and pressure on resource-dependent livelihoods (Hartono et al. 2018; Luckeneder et al. 2024; Rakuasa, Rifai, and Wutres 2025). The central issue is therefore distributive: the benefits of nickel extraction extend to national and global economies, whereas many environmental risks remain geographically concentrated within communities located near extraction and processing areas. From a climate-justice perspective, this unequal distribution challenges the assumption that mineral extraction automatically constitutes sustainable development merely because nickel contributes to low-carbon technologies. A genuinely sustainable transition must account for the ecological and social conditions under which critical minerals are produced.

Kawasi consequently illustrates the paradox of a "green" transition that can reproduce environmental injustice at the extraction frontier. Addressing this contradiction requires more than environmental compliance or post-damage compensation. Indonesia's nickel governance must strengthen preventive environmental protection, independent monitoring, meaningful community participation, livelihood protection, ecological restoration, public-health safeguards, and institutional accountability. Legal recognition alone is insufficient when regulatory implementation and community participation remain weak. The principles of distributive, procedural, recognitional, and restorative justice should therefore become integral to decisions concerning nickel mining and industrial expansion (Schlosberg 2007; Schlosberg and Collins 2014; Heffron 2020). The protection of Kawasi should not be understood as an obstacle to Indonesia's energy transition but as a measure of whether that transition is genuinely just. If decarbonization depends upon concentrating ecological risks in vulnerable small-island communities, it risks reproducing the very inequalities that climate justice seeks to overcome. A just nickel transition must therefore ensure that no community is required to sacrifice its ecological security, health, and livelihood so that others can benefit from a supposedly sustainable future.

References

Adger, W. Neil. 2006. "Vulnerability." *Global Environmental Change* 16 (3): 268–81. https://doi.org/10.1016/j.gloenvcha.2006.02.006.

Aris, Muhammad, and Tamrin. 2020. "Heavy Metal (Ni, Fe) Concentration in Water and Histopathological of Marine Fish in the Obi Island, Indonesia." *Jurnal Ilmiah PLATAX* 8 (2): 221–33. https://doi.org/10.35800/jip.8.2.2020.30673.

Arthur-Holmes, Francis, Thomas Yeboah, and Kojo Busia. 2023. "Women and Artisanal and Small-Scale Mining: Gendered Impacts and Livelihood Strategies." *Resources Policy*.

Bobby, and Basani. 2024. "Perlindungan Hukum terhadap Nelayan Lokal atas Dampak Pertambangan Nikel di Halmahera." *Jurnal Hukum Sehasen* 10 (2): 617–30. https://doi.org/10.37676/jhs.v10i2.6270.

Glynn, Tracy, and Siti Maimunah. 2023. "Unearthing Conscious Intent in Women's Everyday Resistance to Mining in Indonesia." *Ethnography* 24 (1): 23–43. https://doi.org/10.1177/14661381211039372.

Hartono, Budi, Suyud Warno Utomo, Haryoto Kusnoputranto, Andrew Ebeneizer Timanta, Lilies Nurul Husna, and Jeremiah Haryanto. 2018. "Health Risk Analysis of Nickel and Lead Exposure in Drinking Water at Kawasi Village, Obi Island, South Halmahera District, 2015." *Asian Journal of Applied Sciences*. (Universitas Indonesia)

Heffron, Raphael J. 2020. "Energy Justice—The Triumvirate of Tenets Revisited." *Energy Policy* 139: 111349. https://doi.org/10.1016/j.enpol.2020.111349.

Heijlen, Wouter, and Geoffrey Duhayon. 2024. "The Footprint of Nickel Laterite Mining in Indonesia." *Resources Policy*.

IPCC. 2022. *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

La Opi, Hirto, and Jani. 2025. "Relokasi Masyarakat Kawasi dalam Pengembangan Ecovillage di Pulau Obi." *Journal of Administration and Development Management* 2 (3): 372–82. https://doi.org/10.62085/jadment.v2i3.50.

Lampe, M. I., Hendra, and A. Saputra. 2025. "Nickel Mining and the Livelihoods of Coastal Fishing Communities in Indonesia." *Jurnal Ilmu Sosial dan Humaniora*.

Luckeneder, Simon, et al. 2024. "Impact of Nickel Mining on Deforestation and Socioeconomic Well-Being in Indonesia." *Nature Sustainability*.

Pambudi, Priyaji Agung. 2025. "The Paradox of Nickel Investment in Indonesia." *Environmental Pollution Journal* 5 (3): 299–319. https://doi.org/10.58954/epj.v5i3.339. (Ecoton Journal)

Rakuasa, Y. S., A. Rifai, and M. Wutres. 2025. "Environmental and Socioeconomic Impacts of Nickel Mining on Obi Island, Indonesia." *International Journal of Science, Technology and Health*.

Ribot, Jesse C., and Nancy Lee Peluso. 2003. "A Theory of Access." *Rural Sociology* 68 (2): 153–81. https://doi.org/10.1111/j.1549-0831.2003.tb00133.x. (doi.org)

Riyanto, Geger. 2026. "Cultivating Extractive Bodies: Labor Frontiers and the Social Reproduction of Nickel Workers in North Maluku, Indonesia." *The Extractive Industries and Society* 28: 101968, 1–12. https://doi.org/10.1016/j.exis.2026.101968. (ScienceDirect)

Robbins, Paul. 2012. *Political Ecology: A Critical Introduction*. 2nd ed. Chichester: Wiley-Blackwell.

Rosyida, Ismi, et al. 2019. "Livelihood Strategies of Communities in Mining Areas: Evidence from Bangka Island, Indonesia." *Resources Policy*.

Sahetapy, and Afdhal. 2026. "The Principle of Sustainable Development in Good Mining Practice: A Legal Review of Equitable and Beneficial Nickel Mining Governance in Indonesia." *Journal Customary Law* 3 (3.1): 1–19. https://doi.org/10.47134/jcl.v3i3.1.5777.

Schlosberg, David. 2004. "Reconceiving Environmental Justice: Global Movements and Political Theories." *Environmental Politics* 13 (3): 517–40. https://doi.org/10.1080/0964401042000229025.

Schlosberg, David. 2007. *Defining Environmental Justice: Theories, Movements, and Nature*. Oxford: Oxford University Press.

Schlosberg, David. 2012. "Climate Justice and Capabilities: A Framework for Adaptation Policy." *Ethics & International Affairs* 26 (4): 445–61. https://doi.org/10.1017/S0892679412000615.

Schlosberg, David, and Lisette B. Collins. 2014. "From Environmental to Climate Justice: Climate Change and the Discourse of Environmental Justice." *Wiley Interdisciplinary Reviews: Climate Change* 5 (3): 359–74. https://doi.org/10.1002/wcc.275.

Scoones, Ian. 1998. *Sustainable Rural Livelihoods: A Framework for Analysis*. IDS Working Paper 72. Brighton: Institute of Development Studies.

Setyawan, et al. 2026. "Environmental Impacts of Nickel Mining in Indonesia: A Systematic Review." *IOP Conference Series: Earth and Environmental Science* 1580 (1): 012059. https://doi.org/10.1088/1755-1315/1580/1/012059.

Sovacool, Benjamin K., et al. 2020. "Sustainable Minerals and Metals for a Low-Carbon Future." *Journal of Cleaner Production*.

Vitriano, et al. 2026. "Environmental Externalities of Nickel Extraction in Indonesia: Implications for Ecosystems, Biodiversity, and Human Health." *International Journal of Science and Environmental Issues*.

Walker, Gordon. 2012. *Environmental Justice: Concepts, Evidence and Politics*. London: Routledge.

Yanuardi, et al. 2024. "Social-Ecological Violence in Indonesia's Nickel Supply Chain." *Natapraja*.

Yin, Robert K. 2018. *Case Study Research and Applications: Design and Methods*. 6th ed. Thousand Oaks, CA: SAGE.

Zam Zam, and Putrawan. 2020. "Environmental Management Policy Evaluation in Obi Island, North Maluku." *Jurnal Pengelolaan Lingkungan Berkelanjutan*.

Zhou, and Brown. 2024. "Epistemic Justice and Critical Mineral Governance for the Energy Transition." *The Extractive Industries and Society* 18: 101463. https://doi.org/10.1016/j.exis.2024.101463.

Indonesian Legal and Policy Sources

Government of Indonesia. 1945. *The 1945 Constitution of the Republic of Indonesia*. Jakarta: Government of Indonesia.

Government of Indonesia. 2009. *Law No. 32 of 2009 concerning Environmental Protection and Management*. Jakarta: Government of Indonesia.

Government of Indonesia. 2020. *Law No. 3 of 2020 concerning Amendments to Law No. 4 of 2009 concerning Mineral and Coal Mining*. Jakarta: Government of Indonesia.

Government of Indonesia. 2021. *Government Regulation No. 22 of 2021 concerning Implementation of Environmental Protection and Management*. Jakarta: Government of Indonesia.

***

Acknowledgment
None

Funding Information
None

Conflicting Interest Statement
The authors state that there is no conflict of interest in the publication of this article.

Publishing Ethical and Originality Statement
All authors declared that this work is original and has never been published in any form and in any media, nor is it under consideration for publication in any journal, and all sources cited in this work refer to the basic standards of scientific citation.

Generative AI Statement
The authors used generative AI tools to assist with language editing, including correcting minor writing errors, improving sentence clarity, and formatting references. The editor also used generative AI as an editorial aid to identify and correct minor writing and formatting issues. All AI-assisted changes were reviewed by the author and editor, who remain responsible for the accuracy, originality, and final content of the manuscript.