

Sustainable Mining Governance, Social Capital Transformation, and Community Resilience in Indonesia's Nickel Frontiers



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ABSTRACT

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Nickel industrialization has become a central component of Indonesia's strategy for economic transformation and participation in the global energy transition. While downstream mining policies are expected to generate economic benefits, their social implications for rural communities remain insufficiently understood. This study investigates three questions: (1) how nickel industrialization transforms social capital in rural mining communities; (2) how communities adapt to socio-economic changes associated with extractive expansion; and (3) how governance conditions influence community resilience. A qualitative multi-site case study was conducted in six major nickel-producing regions of Southeast Sulawesi, involving 58 participants representing farmers, fishers, village leaders, government officials, mining workers, and civil society organizations. Data were collected through in-depth interviews, focus group discussions, field observation, and document analysis. The findings reveal that nickel industrialization generates governance ambiguity, declining interpersonal trust, weakening collective norms, and increasing social differentiation. At the same time, communities demonstrate adaptive resilience through livelihood diversification, informal cooperation, and locally embedded support networks. The study argues that sustainable mining governance requires not only environmental regulation and economic efficiency but also institutional arrangements capable of protecting social capital and strengthening community resilience. These findings contribute to sustainable development debates by highlighting the social foundations of inclusive extractive governance in mineral-dependent economies.

1. INTRODUCTION

The global transition toward low-carbon development has significantly increased demand for critical minerals that support renewable energy technologies, electric vehicles, and industrial decarbonization. Among these minerals, nickel has emerged as one of the most strategically important resources due to its central role in battery production and energy storage systems. In response to this global demand, many resource-rich developing countries have accelerated downstream industrialization policies to increase domestic value creation and strengthen their position within global supply chains. While such strategies promise economic growth and industrial modernization, the rapid expansion of extractive industries has also generated significant sustainability challenges involving environmental degradation, land transformation, and social inequality [1, 2].

Recent scholarship further highlights that the accelerating demand for critical minerals has created new governance challenges associated with resource security, environmental justice, and community participation. The expansion of mineral extraction to support low-carbon transitions has intensified debates regarding the social sustainability of mining, particularly in regions where local communities bear

disproportionate environmental and socio-economic risks. These concerns suggest that the long-term success of critical mineral strategies depends not only on industrial competitiveness but also on governance systems capable of ensuring equitable and socially inclusive development [3-5].

Beyond national economic objectives, nickel industrialization must also be understood within the broader context of the global mineral transition. The accelerating shift toward low-carbon technologies has intensified global competition for critical minerals, positioning nickel-rich developing countries at the center of emerging green industrial economies. While this transition creates new economic opportunities, it also generates complex sustainability dilemmas related to environmental justice, resource dependency, and governance capacity. In many extractive economies, rapid industrial expansion often produces institutional pressures in which the pursuit of economic competitiveness may exceed the capacity of governance systems to ensure equitable resource distribution, ecological accountability, and long-term community welfare [2, 6, 7]. These dynamics suggest that the sustainability of mineral industrialization depends not only on technological modernization or market integration, but also on the ability of governance institutions to manage the socio-political

consequences of extractive transformation.

The sustainability of mining development is closely linked to the effectiveness of governance institutions that regulate resource extraction, environmental accountability, and social participation. Previous studies have shown that extractive industries often create contested spaces where governments, corporations, and local communities negotiate power, legitimacy, and access to natural resources [1, 8]. Weak governance arrangements, overlapping land claims, and asymmetrical power relations frequently intensify social conflict and undermine institutional legitimacy in resource frontier regions [2]. These conditions indicate that sustainable mining governance cannot be understood solely as a matter of economic efficiency or technical environmental compliance, but must also incorporate institutional justice, public participation, and community inclusion [6].

In addition to economic and environmental considerations, social sustainability has become increasingly central in contemporary mining governance. The legitimacy of extractive development is strongly influenced by the extent to which local communities perceive mining operations as socially acceptable, institutionally accountable, and participatory. The concept of social license to operate emphasizes that mining projects require not only legal authorization, but also ongoing community trust, public legitimacy, and meaningful stakeholder engagement. Studies show that communities are more likely to support extractive development when governance institutions ensure transparency, participatory decision-making, and fair distribution of development benefits [1, 5, 9]. Conversely, when local participation is limited and institutional communication is weak, mining projects often experience declining legitimacy, social resistance, and prolonged governance conflict. Therefore, integrating social sustainability into mining governance has become a critical requirement for achieving long-term sustainable development in resource-dependent regions.

Recent studies emphasize that the benefits of mining development are often unevenly distributed and may not necessarily improve long-term community welfare. This reinforces the need to examine mining governance not only through economic outputs, but also through social sustainability, community participation, and locally experienced development outcomes [4, 5].

One of the most visible consequences of extractive industrialization is the transformation of rural socio-spatial relations. Mining expansion commonly requires land acquisition, infrastructure development, and territorial reorganization that reshape existing agrarian systems and local livelihood structures. Studies on land politics demonstrate that resource expansion often produces new forms of exclusion and unequal territorial control, particularly when state and corporate actors dominate access to land and development benefits [8]. In many rural regions, such transformations create structural vulnerabilities, livelihood uncertainty, and social tensions that may persist long after industrial development has begun [10].

At the community level, the capacity to respond to external economic and ecological pressures is strongly influenced by social capital. Social capital refers to networks of trust, norms of reciprocity, and collective capacities that facilitate cooperation within social groups [11, 12]. In rural societies, social capital functions as a critical resource for conflict resolution, collective action, institutional trust, and adaptive

livelihood strategies. Communities with stronger social networks generally demonstrate greater capacity to cope with environmental uncertainty and economic disruption [13]. However, rapid industrial expansion may also transform local social relations through labor migration, economic differentiation, political patronage, and competition over employment and compensation. These processes may weaken traditional solidarity systems and generate new forms of social fragmentation and distrust [11].

In addition to social capital, resilience has become an important analytical framework for understanding how communities adapt under conditions of structural transformation. Resilience refers to the capacity of social systems to absorb disturbances, reorganize, and maintain essential functions under changing conditions [14]. In extractive regions, resilience is shaped not only by ecological conditions, but also by institutional arrangements, social learning, and access to collective resources [13, 14]. When governance institutions fail to ensure equitable participation and resource distribution, community resilience may become increasingly fragile, particularly in regions experiencing intensive industrial expansion [6].

Indonesia has become one of the world's leading nickel-producing countries and has actively promoted downstream nickel industrialization as a strategic national development agenda. In several mining regions, particularly in eastern Indonesia, industrial expansion has accelerated land-use change, altered livelihood systems, and reconfigured local institutional arrangements. These transformations raise important questions regarding how extractive development affects the social foundations of community sustainability. Although previous studies have examined mining governance, land control, and environmental consequences in extractive economies [1, 2, 6, 8, 10], the social dimensions of industrial transformation remain insufficiently explored in the context of nickel industrialization.

Recent scholarship on Indonesia's nickel sector shows that critical mineral extraction for low-carbon transitions may reproduce socio-environmental injustices when community experiences, procedural justice, and local adaptation are not sufficiently integrated into governance frameworks. These concerns are particularly relevant in mining frontier regions, where rapid industrial expansion often generates tensions between national development priorities and local livelihood sustainability [15].

Existing studies have primarily focused on the political economy of extractive governance, environmental impacts of mining expansion, and land conflicts associated with resource extraction [1, 2, 6, 8, 10]. Other studies have separately examined the role of social capital in community development and adaptive resilience under environmental change [11-14]. However, limited research has integrated these perspectives to examine how nickel industrialization simultaneously transforms social capital and influences community resilience within the broader framework of sustainable mining governance, particularly in rural communities of developing countries. This gap is especially relevant in Indonesia, where extractive industrialization is rapidly reshaping socio-economic structures in resource-dependent regions. Therefore, this study investigates how nickel industrialization transforms local trust, social networks, collective norms, and adaptive capacities, while also analyzing the governance conditions that shape socially inclusive and sustainable mining development.

Unlike previous studies that separately examine extractive

governance, land politics, or social capital, this study develops an integrated analytical framework linking mining governance, social capital transformation, and community resilience under nickel industrialization in rural Indonesia. This integration contributes to sustainable development scholarship by providing a socially grounded perspective on extractive governance in emerging mineral economies.

In this study, social capital is conceptualized as a multidimensional resource consisting of bonding, bridging, and linking dimensions. Bonding social capital refers to trust, reciprocity, and mutual support within close social networks such as kinship groups, neighbors, and local communities. Bridging social capital concerns horizontal connections across different social groups that facilitate cooperation, information exchange, and collective problem-solving. Linking social capital refers to vertical relationships between communities and external actors, including government agencies, mining companies, and other institutions that influence access to resources, decision-making processes, and development opportunities [11, 16]. Examining these dimensions enables a more nuanced understanding of how industrial expansion reshapes social relations and collective capacities in mining-

affected communities.

Community resilience is understood as the capacity of social systems to absorb disturbances, adapt to changing conditions, and transform institutional arrangements in response to long-term structural pressures. Following contemporary resilience scholarship, this study distinguishes between absorptive resilience, which refers to the ability to withstand immediate shocks; adaptive resilience, which involves adjustments in livelihood strategies and social practices; and transformative resilience, which concerns longer-term institutional and social changes that enable communities to respond more effectively to future challenges [13, 14]. This conceptualization provides an analytical basis for examining how governance conditions and social capital transformation influence the resilience of rural communities under nickel industrialization.

Based on the identified research gap and theoretical synthesis, this study develops an analytical framework linking governance transformation, social capital change, and community resilience under nickel industrialization, as illustrated in Figure 1.

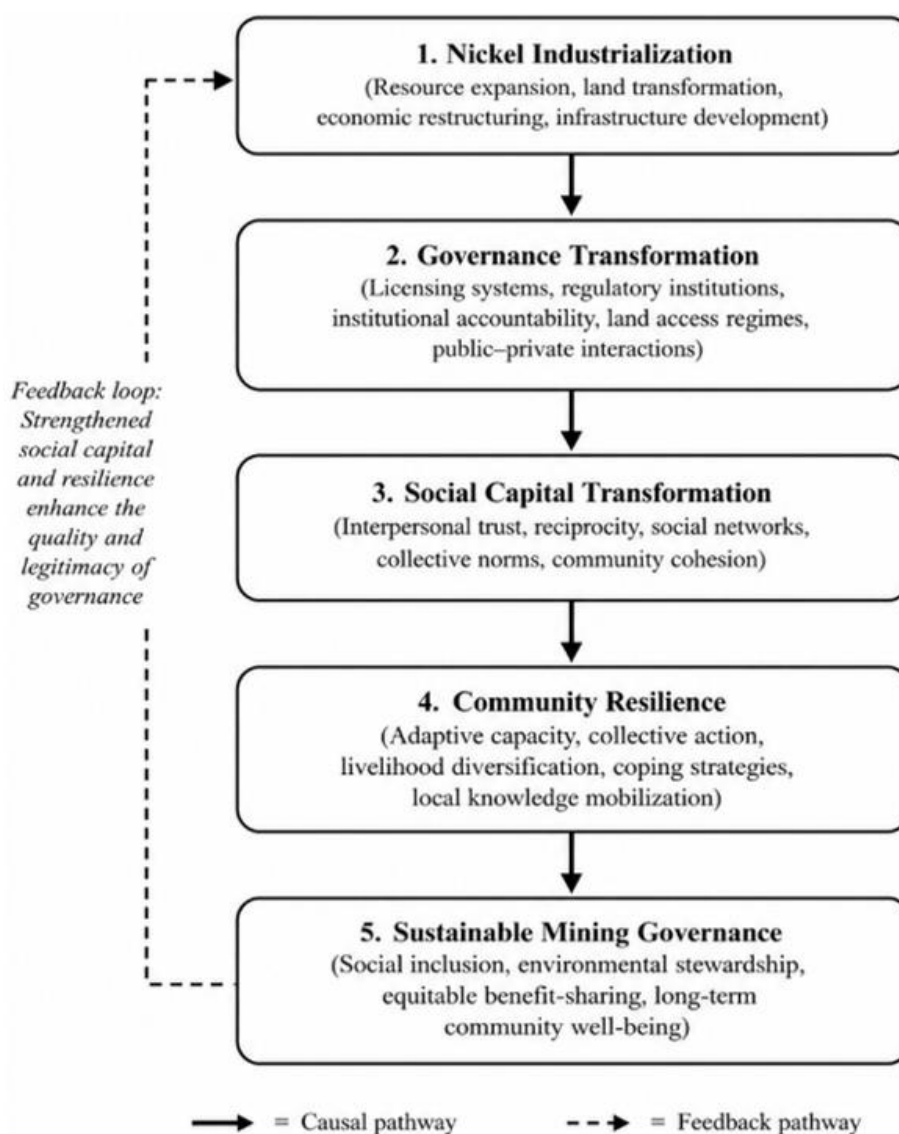


Figure 1. Analytical framework of sustainable mining governance under nickel industrialization

Note: The model illustrates the dynamic and interactive relationships among industrialization, governance, social capital, and community resilience in the context of sustainable mining governance.

Figure 1 presents the analytical framework developed in this study. The framework assumes that nickel industrialization acts as a primary driver of institutional and socio-economic transformation in rural mining regions. Industrial expansion influences governance structures through changes in land access, licensing practices, and institutional accountability. These governance transformations subsequently affect the configuration of social capital, including trust, reciprocity, and community networks. Changes in social capital then shape the capacity of local communities to develop adaptive responses, collective action, and livelihood diversification under conditions of industrial disruption. Through this framework, sustainable mining governance is understood as an outcome of the dynamic interaction between institutional transformation, social relations, and community resilience.

Based on this analytical framework, the following section explains the methodological procedures employed to investigate governance transformation, social capital change, and community resilience in nickel-producing regions of Southeast Sulawesi.

2. MATERIALS AND METHOD

2.1 Research design

This study employed a qualitative multi-site case study design to examine the transformation of social capital and community resilience under nickel industrialization in Indonesia. A qualitative case study is particularly appropriate

for exploring complex social processes, institutional dynamics, and community experiences that cannot be adequately captured through quantitative indicators alone [17]. The multi-site design allows comparative analysis across different mining locations, enabling the identification of recurring patterns as well as contextual variations in governance arrangements, social relations, and adaptive strategies [18]. Through this design, the study seeks to generate a deeper understanding of how extractive industrialization reshapes local institutions and social structures within different socio-political settings.

2.2 Study area

The study was conducted in major nickel-producing areas of Southeast Sulawesi Province, Indonesia, including Konawe, North Konawe, South Konawe, Konawe Islands, Bombana, and Kolaka. These regions were selected purposively due to their strategic roles in Indonesia’s nickel downstream industrialization agenda, the presence of active mining and smelting operations, and the increasing occurrence of land-use transformation and socio-economic restructuring. These regions also represent diverse governance contexts, levels of industrial intensity, and community dependence on agrarian and coastal livelihoods, making them suitable for comparative analysis of social transformation under extractive development. Table 1 summarizes the characteristics of the selected study sites, including their dominant economic activities, levels of mining intensity, and key governance challenges associated with nickel industrialization.

Table 1. Characteristics of study sites

Study Site	Main Economic Activities	Mining Intensity	Key Governance Challenges
Konawe	Agriculture, plantation farming, small trade	Moderate-High	Land conversion, compensation disputes, limited community participation
North Konawe	Agriculture, fisheries, mining-related services	High	Rapid industrial expansion, environmental concerns, unequal access to benefits
Kolaka	Agriculture, fisheries, mining and processing industries	High	Livelihood transition, institutional coordination, social differentiation
South Konawe	Agriculture and coastal livelihoods	Moderate	Land-use change, livelihood adaptation, governance capacity constraints
Bombana	Agriculture, fisheries, small-scale trade	Moderate	Resource competition, uneven development benefits, local participation issues
Konawe Islands	Fisheries, coastal resource utilization	Low-Moderate	Environmental vulnerability, limited institutional access, dependence on external actors

Source: Authors’ fieldwork and secondary data compilation (2026).

The selected sites represent diverse mining frontier contexts characterized by varying levels of extractive intensity, livelihood dependence, and governance challenges. This variation enables comparative analysis of how social capital transformation and community resilience emerge under different institutional and socio-economic conditions associated with nickel industrialization.

2.3 Participant selection

Participants were selected through purposive sampling combined with snowball sampling to identify individuals with direct experience or institutional involvement in mining-related social transformation [19]. The participants consisted of local farmers, fishers, customary leaders, village officials, mining workers, local government representatives, and civil society actors. A total of 58 participants were involved in this

study, comprising 14 farmers, 10 fishers, 12 village leaders, 10 government officials, 7 mining workers, and 5 representatives from civil society organizations. The diversity of participants enabled triangulation of perspectives and improved the credibility of the findings. The participant composition reflects the diversity of stakeholders involved in nickel industrialization and rural governance processes. The distribution of participants is presented in Table 2.

As shown in Table 2, the participant composition reflects the diversity of stakeholders directly involved in or affected by nickel industrialization in rural mining regions. Community-based participants, including farmers, fishers, and village leaders, constituted the largest proportion of respondents, allowing the study to capture local social experiences and livelihood transformations. The inclusion of government officials, mining workers, and civil society representatives also enabled triangulation of institutional perspectives and

strengthened the credibility of the findings.

Table 2. Participant characteristics

Stakeholder Group	Number of Participants
Farmers	14
Fishers	10
Village leaders	12
Government officials	10
Mining workers	7
Non-governmental organization representatives	5
Total	58

2.4 Data collection

Data were collected between March and April 2026 through four primary techniques: in-depth interviews, focus group discussions, limited participant observation, and document analysis. Semi-structured interviews were conducted to explore participants’ experiences related to land transformation, institutional trust, social networks, conflict dynamics, and adaptive livelihood strategies. Focus group discussions were used to capture collective perceptions and social interactions among community members [20]. Participant observation was conducted in village meetings, informal gatherings, and livelihood activities to understand everyday social interactions and institutional practices. Document analysis included mining permits, regional spatial planning documents, environmental impact assessment reports, local regulations, and development policy documents relevant to mining governance.

2.5 Data analysis

Data analysis followed a thematic analysis approach

involving data familiarization, open coding, category development, theme construction, and interpretive synthesis [21]. Interview transcripts, field notes, and documentary materials were manually coded and systematically compared across study sites. The analysis focused on three major dimensions: governance transformation, social capital change, and community resilience. To strengthen analytical rigor, the coding process was informed by social capital theory, institutional governance perspectives, and resilience frameworks [22].

2.6 Trustworthiness and ethical considerations

To ensure trustworthiness, this study applied data source triangulation, prolonged field engagement, peer debriefing, and member checking with selected participants, following established qualitative trustworthiness criteria [17]. These procedures were conducted to improve credibility, transferability, dependability, and confirmability of the findings. Ethical considerations were addressed in accordance with the institutional research guidelines of Halu Oleo University prior to fieldwork. All participants provided informed consent before participation, and confidentiality, anonymity, and voluntary participation were maintained throughout the research process.

3. RESULTS AND DISCUSSION

The thematic analysis of interview transcripts, focus group discussions, field observations, and policy documents identified three major dimensions of social transformation associated with nickel industrialization in rural mining communities. These themes consistently emerged across the six research sites and reveal how extractive industrialization reshapes governance structures, social capital dynamics, and community adaptive capacity.

Table 3. Thematic findings on governance, social capital transformation, and community resilience

Theme	Sub-Theme	Key Evidence	Implications
Governance ambiguity	Limited participation in decision-making	Community members reported restricted involvement in mining-related planning and consultation processes	Weakens procedural legitimacy and reduces local influence over development decisions
Governance ambiguity	Institutional fragmentation	Overlapping responsibilities among government agencies and mining actors created uncertainty in governance implementation	Constrains accountability and effective policy coordination
Governance ambiguity	Unequal access to information	Communities experienced difficulties obtaining timely information regarding mining activities and compensation arrangements	Reinforces asymmetrical power relations and institutional distrust
Social capital transformation	Declining interpersonal trust	Informants reported increasing tensions between households benefiting from mining and those experiencing livelihood losses	Erodes bonding social capital and community cohesion
Social capital transformation	Weakening reciprocity and collective action	Traditional forms of mutual assistance became less frequent as economic competition intensified	Reduces collective capacity for community problem-solving
Social capital transformation	Emerging bridging networks	Youth groups, women’s livelihood associations, and informal labor networks developed new forms of cooperation	Creates alternative mechanisms for social adaptation and resource sharing
Community resilience	Livelihood diversification	Households combined agriculture, fisheries, wage labor, and small-scale trade to manage economic uncertainty	Strengthens adaptive resilience
Community resilience	Informal support mechanisms	Kinship networks and community-based assistance remained important during periods of livelihood disruption	Enhances absorptive resilience
Community resilience	Institutional adaptation	Communities increasingly engaged with government programs, civil society organizations, and mining companies to secure opportunities and support	Contributes to transformative resilience through institutional learning and adjustment

Source: Authors’ analysis based on interviews, focus group discussions, observations, and document review (2026).

The findings demonstrate that the social sustainability of mining development is influenced not only by institutional arrangements and economic opportunities, but also by the capacity of local communities to maintain trust, collective action, and adaptive resilience under conditions of rapid structural change. The main thematic findings are summarized in Table 3.

Table 3 demonstrates that governance challenges, social capital transformation, and community resilience are closely interconnected processes rather than isolated phenomena. Governance ambiguity influences the capacity of communities to maintain trust and collective action, while changes in social capital shape how households respond to economic and institutional pressures. The findings further suggest that resilience is expressed through multiple mechanisms, including absorptive, adaptive, and transformative responses, reflecting the dynamic ways rural communities navigate the opportunities and risks associated with nickel industrialization.

As presented in Table 3, the thematic findings reveal that nickel industrialization generates interconnected social transformations across governance, community relations, and livelihood systems. Governance ambiguity emerged primarily through overlapping permits, unclear institutional authority, and limited community participation in decision-making processes. At the same time, industrial expansion contributed to the transformation of social capital, reflected in declining interpersonal trust, weakened collective norms, and increasing social differentiation. In response to these pressures, local communities developed various adaptive strategies through livelihood diversification, informal cooperation, and socially embedded coping mechanisms.

3.1 Governance ambiguity and institutional fragmentation in nickel mining regions

The findings reveal that one of the most significant social consequences of nickel industrialization is the emergence of governance ambiguity in mining-affected communities. Across the research sites, communities reported uncertainty regarding land tenure recognition, compensation procedures, environmental accountability, and the institutional responsibilities of state authorities. This ambiguity became more visible in areas where mining concessions overlapped with customary territories, agricultural land, and coastal livelihood spaces. In such situations, local communities often experienced difficulty in accessing formal grievance mechanisms or identifying responsible institutions for dispute resolution.

One village leader described this governance uncertainty as follows:

“We often do not know which institution is responsible when land disputes occur. The company refers us to local government, while local officials say the permits have already been approved at the provincial level” (Village leader, North Konawe, April 2026).

These findings are consistent with previous studies showing that extractive industries frequently generate contested governance spaces characterized by overlapping institutional mandates, weak accountability systems, and limited community participation [1, 6]. In mining regions where economic priorities dominate policy implementation, governance often becomes highly centralized and less responsive to local concerns. Similar patterns have been

documented in extractive economies where accelerated resource development weakens local governance capacity and reduces public trust in state institutions [2, 6].

These findings support Owen and Kemp’s [1] argument regarding the importance of social legitimacy in extractive governance, where formal regulatory compliance alone is insufficient to secure long-term community acceptance. However, the present findings differ from recent participatory governance studies that emphasize collaborative institutional engagement between mining corporations and local communities [5]. In the Indonesian nickel frontier, governance remains highly centralized, with limited community influence over licensing, environmental monitoring, and compensation mechanisms. This suggests that the institutional challenges of extractive governance in emerging mineral economies may be more deeply rooted in structural power asymmetries than previously assumed.

In the Indonesian context, the strategic importance of nickel in national industrial policy further intensifies governance centralization. Communities often perceived licensing processes, environmental assessments, and compensation arrangements as externally determined rather than socially negotiated. Such governance asymmetries reinforce structural inequalities and create institutional distrust, which may undermine the long-term sustainability of mining development [5].

The governance ambiguities identified across the study sites extended beyond administrative and regulatory concerns. Uncertainty regarding land access, compensation mechanisms, and institutional accountability also influenced how communities interacted with one another and with external actors. As formal governance arrangements became increasingly contested, local social relations emerged as important mechanisms through which households negotiated risks, accessed information, and mobilized collective responses. These dynamics suggest that the social consequences of nickel industrialization cannot be understood solely through governance structures, but must also be examined through changes in social capital and community relationships.

3.2 Transformation and fragmentation of social capital

A second major theme concerns the transformation of social capital under industrial expansion. Participants consistently described declining interpersonal trust, weakening norms of reciprocity, and increasing social polarization following the arrival of mining operations. Communities that previously maintained strong collective practices through agricultural cooperation, kinship exchange, and customary institutions began experiencing internal divisions associated with unequal access to employment, compensation, subcontracting opportunities, and political affiliations.

This transformation was clearly expressed by one senior farmer:

“Before mining, we worked collectively in agriculture, helped each other during harvest, and shared labor without payment. Now many people focus on individual contracts with mining companies, and social trust has gradually weakened” (Farmer, Konawe, March 2026).

These findings support earlier arguments that social capital is highly sensitive to structural economic transformation [11, 12]. In rural communities, trust and collective norms function as key social resources for cooperation, conflict management,

and livelihood security. However, when industrial development creates uneven access to economic benefits, traditional solidarity structures may weaken and be replaced by individualized economic behavior [16].

The observed decline in trust and collective reciprocity supports Woolcock's [11] argument that social capital is highly vulnerable to uneven economic restructuring and institutional inequality. Likewise, the findings reinforce Pretty and Ward's [12] observation that social capital plays a critical role in sustaining environmental cooperation and community solidarity under conditions of external pressure. However, unlike previous rural development studies that describe social capital primarily as a stable community asset, this study demonstrates that under extractive industrialization, social capital becomes fluid, contested, and increasingly shaped by differential access to industrial opportunities.

This pattern also reflects broader processes of social differentiation often observed in extractive regions. The concentration of economic opportunities among certain households, political brokers, or local elites contributed to new forms of social stratification. Similar findings have been reported in mining communities where extractive development reconfigures local power relations and produces uneven social outcomes [23].

However, in several villages, younger households perceived mining employment as a pathway for economic mobility, indicating that social transformation under industrialization was not uniformly experienced across community groups. Some younger participants associated mining employment with greater income stability, expanded social networks, and increased access to consumption opportunities compared to traditional agrarian livelihoods.

Despite these disruptions, the findings also show that social capital did not disappear entirely. In several communities, new forms of association emerged through youth networks, women's livelihood groups, and informal labor communities. These emerging social networks indicate that industrial transformation does not simply destroy social capital but rather reconfigures it into new institutional forms shaped by changing economic conditions [13].

Viewed through the multidimensional social capital framework, these findings indicate that nickel industrialization affects bonding, bridging, and linking social capital in different ways. Declining interpersonal trust, weakening reciprocity, and increasing social polarization primarily reflect the erosion of bonding social capital within local communities. At the same time, emerging youth associations, women's livelihood groups, and informal labor networks suggest the formation of new forms of bridging social capital that connect individuals across changing social and economic contexts. However, persistent governance ambiguity and limited community influence over mining-related decision-making indicate weaknesses in linking social capital, particularly in relations between local communities, government institutions, and mining corporations. These findings demonstrate that social capital transformation under extractive industrialization is not simply a process of decline, but rather a reconfiguration of social relations across multiple dimensions of community life.

3.3 Adaptive resilience and informal coping strategies

Although industrial expansion generated institutional uncertainty and social fragmentation, communities

demonstrated significant adaptive capacity. Households responded to socio-economic disruption through livelihood diversification, kinship-based resource sharing, informal labor exchange, and community-based negotiation with external actors. Farmers and fishers who previously depended on single livelihood systems increasingly combined agriculture, transportation services, petty trade, wage labor, and service-based activities to reduce vulnerability.

Despite these pressures, community adaptation remained visible. One fisher explained:

"When fishing income declined because of mining activities, we started combining different jobs. In the morning we fish, and in the afternoon we transport materials or sell food near the mining area" (Fisher, Kolaka, April 2026).

These findings align with resilience scholarship emphasizing the ability of communities to reorganize and maintain essential social functions under conditions of disturbance [14]. Adaptive resilience in mining regions was strongly influenced by access to social networks, local knowledge, and collective learning mechanisms [10].

These adaptive responses are consistent with Folke's resilience framework, which emphasizes the capacity of social systems to reorganize and maintain core functions under external disturbance [14]. The findings also support institutional robustness perspectives, showing that resilience is strengthened when communities maintain flexible social institutions and collective learning mechanisms [13]. However, unlike resilience models developed in environmental governance settings, adaptive capacity in mining communities was found to depend more heavily on informal kinship networks, customary leadership, and socially negotiated coping arrangements.

Nevertheless, resilience capacity was not equally distributed. Households with stronger economic resources, political access, or broader social networks demonstrated higher adaptive flexibility compared to landless workers, elderly households, and marginalized agrarian groups. This finding confirms that resilience is socially embedded and shaped by unequal access to material and institutional resources [13, 14].

Importantly, many adaptive strategies developed outside formal governance structures. Communities relied heavily on customary leaders, religious institutions, kinship networks, and informal negotiation channels to address social conflicts and economic uncertainty. Similar findings have been observed in participatory mining governance studies, where local resilience depends strongly on informal institutional arrangements and community voice in governance processes [5, 24].

3.4 Toward socially inclusive sustainable mining governance

The findings suggest that sustainable mining governance requires more than environmental compliance and economic regulation. The long-term sustainability of extractive development depends on institutional accountability, social inclusion, and the protection of community trust. Governance systems that neglect local participation and social capital may unintentionally intensify conflict, weaken adaptive capacity, and undermine development legitimacy.

Consistent with social-ecological governance scholarship, inclusive mining governance should integrate local institutions, customary land systems, and community

participation into policy design and implementation [13, 14]. Transparent compensation mechanisms, participatory environmental monitoring, and stronger accountability frameworks are essential for building trust between mining actors and affected communities [6, 24]. These governance interventions should also be embedded within regional spatial planning and long-term social development strategies to ensure more equitable resource governance.

These findings reinforce recent studies emphasizing the importance of community voice and institutional reflexivity in extractive governance [5, 24]. However, this study extends existing governance scholarship by demonstrating that social sustainability in nickel industrialization cannot be achieved solely through transparency initiatives or procedural participation. Instead, sustainable governance requires institutional mechanisms capable of protecting social trust, reducing local inequalities, and strengthening collective adaptive capacity in resource-dependent communities.

These findings indicate that regional development planning in mining areas should integrate social impact monitoring, participatory land-use planning, and community-based resilience indicators into mining governance frameworks. This study therefore proposes an integrated governance perspective in which mining sustainability is understood through the interaction between governance institutions, social capital transformation, and community resilience. Such an approach provides a socially grounded contribution to sustainable development scholarship in mineral-dependent economies.

These findings also contribute to emerging discussions on critical mineral governance by demonstrating that the sustainability of energy-transition minerals depends not only on technological advancement and economic performance, but also on the capacity of governance institutions to protect social cohesion, strengthen community trust, and ensure equitable participation in development processes. In Indonesia's nickel frontiers, socially inclusive governance therefore becomes a critical condition for balancing national industrial ambitions with long-term community well-being and sustainable rural transformation [3, 15].

4. CONCLUSIONS

This study demonstrates that nickel industrialization in rural Indonesia generates multidimensional social transformation that extends beyond economic growth and environmental change. The findings reveal that rapid mining expansion produces governance ambiguity, weakens institutional trust, fragments traditional social capital, and reshapes local adaptive strategies. At the same time, rural communities actively develop informal resilience mechanisms through kinship networks, customary institutions, livelihood diversification, and collective negotiation in response to industrial disruption.

The main theoretical contribution of this study lies in the integration of mining governance, social capital transformation, and community resilience within a single analytical framework. This study shows that the sustainability of extractive development is not determined solely by environmental compliance or economic performance, but also by the capacity of governance institutions to protect social cohesion, institutional trust, and equitable access to development opportunities. This finding highlights the importance of integrating socially embedded governance

perspectives into sustainable development planning within extractive economies.

From a policy perspective, sustainable mining governance requires stronger transparency in licensing systems, recognition of customary and community land rights, institutionalized community participation, and more accountable compensation mechanisms. Strengthening these dimensions is essential to reduce social conflict, improve development legitimacy, and ensure that mineral industrialization contributes to long-term socially inclusive sustainability.

This study is limited to qualitative evidence from Southeast Sulawesi and may not fully represent social transformation patterns in other mining regions with different institutional and socio-political contexts. Future research may extend this analysis through comparative studies across other nickel-producing regions and by combining qualitative insights with spatial or socio-economic indicators of mining-induced transformation.

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