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Poverty Reduction Based On Innovation And Policy-Socio-Economic Transformation In Mining Areas Southeast Sulawesi Nickel

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Abstract
This study examines poverty alleviation strategies in nickel mining areas in Southeast Sulawesi through an innovation- and policy-based approach. Mining activities, while contributing to economic growth, have simultaneously created new forms of poverty, environmental degradation, and social inequality. Using a multidisciplinary framework, this study integrates quantitative methods (household surveys, linear regression analysis, and multidimensional poverty indices), spatial approaches (GIS and remote sensing), qualitative methods (in-depth interviews, focus group discussions, and participant observation), and policy analysis. The results highlight that poverty in mining areas is not only related to income levels but also to multidimensional deprivation, including education, health, and access to public services. The findings also reveal spatial disparities, with concentrated poverty zones strongly associated with environmental degradation and limited infrastructure. This study proposes an integrated poverty alleviation model that combines economic diversification, local empowerment, sustainable land rehabilitation, and participatory governance. Furthermore, this model emphasizes the importance of policy innovation and inclusive CSR practices to ensure equitable distribution of mining benefits. This research contributes both theoretically and practically by offering evidence-based strategies that can be adapted to various socio-economic and geographic contexts. It also provides a roadmap for policymakers, local governments, and industry stakeholders to design sustainable interventions aimed at poverty reduction and social transformation in mining-affected areas.
Keywords: *Poverty alleviation, Nickel mining, Innovation policy, Southeast Sulawesi*

1. INTRODUCTION

Poverty is a multidimensional problem encompassing economic, social, and environmental aspects. In the Indonesian context, poverty alleviation is not only a national development priority but also a real challenge at the regional level, including Southeast Sulawesi Province. This region boasts unique geospatial characteristics and abundant natural resources, particularly in the mining sector. Ironically, however, this natural wealth has not fully contributed optimally to the welfare of local communities and has instead created new socio-economic inequalities and vulnerabilities. The imbalance in the distribution of mining benefits, environmental degradation, and limited access to basic services have exacerbated structural poverty in the region.

The problem of poverty in mining areas cannot be solved with conventional approaches. There is an urgent need to design innovative, adaptive, and policy-based intervention models that can respond to local complexities. Innovation-based approaches—such as the use of digital technology, economic diversification, community empowerment, and environmental restoration—must be combined with policy governance reforms that support public participation and social sustainability. Furthermore, these approaches should not only focus on increasing incomes but also on strengthening economic resilience, access to health and education services, and reducing social and environmental vulnerabilities.

According to data from the Southeast Sulawesi Central Statistics Agency, poverty trends over the past five years have shown a stagnant or even increasing trend, particularly in areas with high mining activity intensity. This situation reflects the need to re-evaluate existing development strategies and the importance of innovation in formulating more effective poverty alleviation policies. Various studies have shown that mining areas not managed with an inclusive development approach tend to experience this

phenomenon resource curse, where resource exploitation activities actually increase the gap and poverty of local communities.

This research addresses these challenges by proposing a mapping model for an integrated poverty alleviation strategy through a multidisciplinary approach. This research focuses not only on economic aspects but also encompasses social, spatial, environmental, and policy governance approaches. This strategy is expected to address poverty alleviation challenges holistically and evidence-based (evidence-based policy).

This study aims to develop an information system-based value chain innovation model for the cocoa oil industry. Resources Event Agent (REA). To achieve these specific objectives, this research encompasses several key activities, namely analyzing the socio-economic conditions of poor communities affected by mining areas in Southeast Sulawesi, determining a poverty alleviation development model based on innovation and policy, and designing the most effective strategies for addressing poverty in these mining-affected areas. This effort is expected to produce a model that is not only academically relevant but also applicable in addressing the problem of structural poverty in resource-rich areas but poor in development benefits.

The urgency of this research is particularly high given that poverty in the mining areas of Southeast Sulawesi tends not to improve and could even worsen without strategic and systematic intervention. Despite being rich in natural resources, particularly in the mining sector, this wealth has not contributed significantly to the well-being of local communities. Instead, communities face environmental damage, limited access to productive land, and a lack of decent employment opportunities. These conditions demonstrate the existence of missing link between extractive economic activities and equitable distribution of development outcomes. In line with national priorities in the 2025–2045 National Medium-Term Development Plan (RPJPN) and Presidential Regulation No. 15 of 2010 concerning the Acceleration of Poverty Reduction, this research presents a new approach that is adaptive, contextual, and based on participatory data. Thus, the research results can be directly utilized by local governments, industry players, and civil society to formulate sustainable and inclusive poverty alleviation solutions.

2. METHOD

2.1 Research Location

This research will be conducted in mining-affected areas in Southeast Sulawesi province, Indonesia.

2.2 Analysis Techniques

In 2021-2024, several researchers conducted research on the factors and criteria influencing poverty in specific areas impacted by mining. Therefore, the analysis will be conducted in 2025 and will consist of three stages:

a. The first stage involved identifying the socio-economic conditions of affected areas in Southeast Sulawesi, including income, employment, education, health, and access to basic services. The data was then mapped and analyzed using linear regression to determine the relationship between mining activities and poverty. This provided a deeper understanding of the impacts and factors influencing the socio-economic dynamics of the communities, which served as the basis for the next stage.

b. The second phase focuses on determining an innovation- and policy-based poverty alleviation model. GIS and remote sensing analysis produces maps of poverty zones and environmental degradation; multidimensional poverty index analysis determines priority areas for intervention; socioeconomic analysis identifies vulnerable groups and the underlying causes of poverty; environmental and health analysis generates strategies for increasing sustainable economic access; and policy and governance analysis provides evidence-based policy recommendations.

c. The third stage involves developing recommendations through participatory policymaking using focus group discussions to ensure that the research outputs can be implemented in a structured, sustainable, and multi-stakeholder manner, along with a continuous monitoring and evaluation system. This step aims to promote self-reliance and improve the well-being of communities in mining-affected areas.

2.3 Annual Output and Achievement Indicators

This research is designed as a two-year exploratory and applied research program to develop a poverty alleviation strategy model based on policy innovation, spatial data, and local community participation in

mining areas. In the first year (2025), the focus will be on collecting and analyzing baseline data through socio-economic surveys, GIS mapping, and*remote sensing*, interviews, observations, and initial FGDs, accompanied by linear regression analysis and the Multidimensional Poverty Index (MMI), with outputs in the form of poverty zoning maps, initial analysis reports, spatial prediction models, national scientific article manuscripts, and initial policy drafts. The second year (2026) focuses on the formulative and integrative stages through model validation, cross-actor FGDs, the preparation of evidence-based policy recommendations, and the integration of social, economic, and spatial analysis into adaptive strategies, with outputs in the form of a final strategy model, a recommended policy formulation, an international article (Scopus), a GIS dashboard prototype, a policy brief, and a follow-up research proposal. With this two-year design, the research not only produces academic and practical outputs, but also builds a conceptual and methodological basis for inclusive, equitable, and sustainable mining area development.

3. RESULT AND DISCUSSION

3.1 Demography and Population

Collecting demographic and population data is a crucial initial step in this research because it provides a general overview of population characteristics in mining-affected areas, including population size and density, age and gender distribution, household structure, and migration dynamics. Understanding demographic aspects is important because changes in population composition are often early indicators of socio-economic transformation. Increased in-migration in the mining sector can affect the labor market, wage levels, competition for public resources, and impact the dependency ratio, which influences household economic capacity and poverty levels. Demographic analysis also identifies vulnerable groups such as children, the elderly, and people with disabilities who have limited access to employment, education, and health services. In the context of mining in Southeast Sulawesi, changes in settlement patterns, rapid population growth, and changes in social structures due to migration flows are important factors in understanding poverty dynamics.

The data was collected from the Central Statistics Agency (BPS), the Population and Civil Registration Office, and field surveys through interviews and observations. The data was then processed and spatially mapped using a Geographic Information System (GIS) to visualize population distribution and density across the study area. The integration of spatial and statistical analysis facilitates the link between demographic variables and multidimensional poverty indicators and factors influencing community well-being in mining-affected areas.

3.2 Total Population

Based on data from the Central Statistics Agency (BPS) in 2025, the population of Southeast Sulawesi Province reached 2.84 million people with an average growth rate of 2.09% per year. Kendari City was recorded as the region with the largest population, namely 377.3 thousand people or 13.30% of the total provincial population, followed by South Konawe Regency with 334.6 thousand people (11.80%), Konawe Regency with 278.6 thousand people (9.82%), and Kolaka Regency with 251.5 thousand people (8.87%). Meanwhile, the Konawe Islands Regency had the smallest population, namely 40.4 thousand people or 1.42% of the total population. In general, the population density in Southeast Sulawesi reached 78 people per square kilometer, with Kendari City being the most densely populated area (1,419 people/km²) and North Konawe Regency being the lowest (18 people/km²). The province's sex ratio is recorded at 102.6, indicating a slight male-female population. This regional population variation provides important insights for development planning, particularly in the context of poverty alleviation and resource management in mining-affected areas. Below is a list of the 17 regencies/cities in Southeast Sulawesi.

Meanwhile, data on population per village/sub-district in mining-affected areas was obtained using estimates based on district/city population projections. The formula used is as follows.

$$Average\ population\ per\ village\ and\ sub-district\ = \frac{Total\ population\ of\ districts\ and\ cities}{Total\ villages\ and\ sub-districts}$$

..... (2)

This estimate is based on total district/city population data, which is then distributed proportionally based on the percentage of village/sub-district population in the last census. Below is a tabulation of the average village and sub-district population in Southeast Sulawesi.

Table 1 Average Village/Sub-district Population in Southeast Sulawesi in 2025

No.	Name of Regency/City	Number of Villages/Sub-districts	Average Village/Sub-district Population (people)
1.	button	95	1,304
2.	First	150	1,542
3.	Konawe	353	789
4.	Kolaka	135	1,863
5.	South Konawe	351	953
6.	Bombana	145	1,126
7.	Wakatobi	100	1,200
8.	North Kolaka	133	1,138
9.	North Buton	90	784
10.	North Konawe	170	444
11.	East Kolaka	133	972
12.	Konawe Islands	96	421
13.	West Muna	86	1,077
14.	Central Buton	77	1,599
15.	South Buton	70	1,469
16.	Kendari City	65	5,805
17.	Baubau City	43	3,974

Source: Secondary Data Processing

Based on the data above, it is known that the population of Southeast Sulawesi Province is spread across all regencies/cities with varying distribution characteristics. This distribution shows a tendency for higher population concentration in urban areas such as Kendari City and Baubau City, which function as centers of government, trade, and public services. Meanwhile, rural areas, especially in regencies with mining areas such as Konawe, Kolaka, and North Kolaka, have relatively lower population densities but are the main locations of natural resource-based economic activity. This difference in distribution has implications for varying infrastructure needs, public services, and poverty alleviation strategies, where high-density areas tend to face pressure on basic resources and services, while sparsely populated areas face challenges in accessibility and equitable development. Understanding these population distribution patterns provides an important basis for spatial analysis and determining the priorities of policy interventions in mining-impacted areas.

3.4 Migration

Migration patterns in Southeast Sulawesi are closely linked to nickel mining. Regencies with intensive mining activity, such as Konawe, North Konawe, Kolaka, and North Kolaka, receive significant in-migration, particularly among productive-age male workers (Long Form Population Census, BPS Southeast Sulawesi, 2020). This is in line with the high labor demand for mining operations and downstream industries such as smelters. In-migration, both temporary and permanent, influences demographic structure, population density, sex ratios, as well as needs for consumption, housing, public services, and infrastructure. Conversely, out-migration, although smaller, occurs due to declining mining activity or environmental degradation that disrupts agriculture and fisheries. This outflow is primarily from young people seeking economic opportunities outside the region. Thus, migration dynamics are an important indicator of the socio-economic impacts of mining and the basis for policies for poverty alleviation and economic diversification.

3.5 Mining Areas

Southeast Sulawesi has the largest nickel reserves in Indonesia, with primary mining areas in Konawe, North Konawe, Kolaka, North Kolaka, and Bombana. According to the Ministry of Energy and Mineral Resources, mining business permit (IUP) areas span thousands of hectares, encompassing both active

production and exploration prospects. Mines are generally located along coastal and hilly areas with mineral-rich ultramafic geology, yet are vulnerable to erosion and environmental degradation. Administratively, mining areas intersect with coastal and inland villages that previously relied on agriculture, fisheries, or forestry. Land conversion due to mining triggers changes in livelihoods, migration flows, and infrastructure needs. Therefore, understanding nickel mining areas must encompass both technical-geological and socio-economic and spatial planning aspects due to their significant impact on population distribution, land use, and community well-being.

3.6 Socio-Economic Conditions

Nickel mining activities impact the lives of the people of Southeast Sulawesi, creating economic opportunities while simultaneously changing the employment structure, income distribution, and household welfare. Socio-economic analysis is essential to assess the contribution of mining to local quality of life. Indicators used include: (1) the composition of the mining sector workforce compared to traditional sectors; (2) changes in household income; (3) levels of poverty and vulnerability due to land conversion; (4) access to public services; (5) changes in the prices of basic necessities and the cost of living; and (6) asset and housing ownership. This analysis provides a holistic picture of the impacts of mining, revealing potential inequalities between mining and non-mining workers, shifts in livelihoods, and social dynamics resulting from migration. The results provide an important basis for mining management policies that are equitable, sustainable, and support the welfare of local communities.

3.7 Number of Workers from the Mining Sector

According to data from the 2021 Southeast Sulawesi Provincial Mining Directory released by Statistics Indonesia (BPS) of Southeast Sulawesi, the number of workers in the mining and quarrying sector reached 34,987 people, consisting of 30,216 men and 4,771 women, or approximately 2.27% of the total provincial workforce in August 2024. Interviews with village officials, community leaders, and worker representatives indicated a male predominance of approximately 86%, in line with the physical and technical demands of mining work. A community leader in Morosi District stated that women generally only work in administration or catering, with significantly fewer women employed. This situation impacts household structures, where men are the primary economic providers, while women's contributions are relatively small, thus creating potential gender disparities in access to the economic benefits of mining.

Although mining creates job opportunities, the proportion of local workers absorbed remains below 3% of the total provincial workforce. Most affected villagers remain dependent on traditional sectors such as agriculture, fishing, and trade. The village head in Pomalaa District confirmed that only a small number of his villagers work in the mine due to limited certification and skills required by the company. This raises questions about the extent to which the mining industry is truly capable of reducing local unemployment, or whether it is relying more heavily on migrant labor from outside the region.

Furthermore, 2021 local government data recorded approximately 3,200 foreign workers (TKA), the majority from China, working at nickel smelter companies such as PT OSS and PT VDNI in Morosi, Konawe. The presence of these foreign workers has created new dynamics, ranging from concerns about reduced job opportunities for local workers, impacts on wage standards, to potential social tensions due to cultural differences. A local worker at one of the smelters reported that certain technical positions are often filled by foreign workers with higher salaries despite the same working hours, creating a sense of injustice among local workers.

Below is a graph of the workforce in the nickel mining sector.

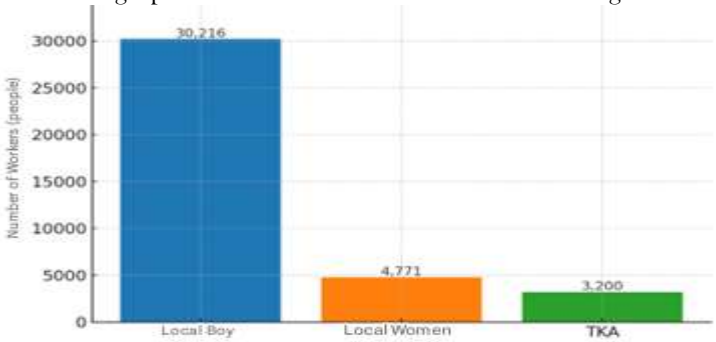

Figure 1. Nickel Mining Sector Workforce

These findings confirm that labor distribution in the nickel mining sector is a crucial variable in mapping regional socioeconomic vulnerability. This data can be used to identify the level of household economic dependence on the mining sector, formulate vocational training programs tailored to industry needs, and develop mechanisms for managing social conflicts that could potentially arise from unequal access to employment between local and foreign workers.

3.8 Main Livelihood

Based on the results of field surveys conducted in several villages and sub-districts in areas affected by nickel mining in Southeast Sulawesi, it was obtained that the structure of community livelihoods is still dominated by traditional sectors. Empirical data shows that around 34.5% of the population works in the agriculture, forestry, and plantation sectors, followed by fisheries at 15.2%, and wholesale/retail trade at 13.8%. The service sector, including education, health, and transportation, contributes 12.7% of total livelihoods, while the mining and quarrying sector, including nickel, only absorbs 2.27% of the total provincial workforce. The remaining 21.53% is spread across other sectors such as construction, non-mining manufacturing, and public administration as shown in the graph below.

Figure 2. Percentage of Population by Industry

The results of an interview with a village head in Pomalaa District revealed,
"Here, most residents still farm and fish. Some do work in the mines, but not many. Those who enter the mines are usually those with skills or who already know someone at the company. "Meanwhile, a fisherman in Morosi District said, *"Since the port and mining activities have been established, there have been additional jobs in transportation and trade, but we still go to sea because that's what we can do."*
These findings indicate that although nickel mining is a leading sector in terms of economic value, its penetration in absorbing the local workforce remains limited. This indicates a gap between mining industry expansion and changes in the community's livelihood structure. From the perspective of this research, these data serve as important indicators for assessing the extent to which the nickel industry contributes to local economic transformation and for identifying opportunities for policy interventions such as vocational training or economic empowerment programs to enable greater involvement and optimal benefit to mining-affected communities.

3.9 Household Income

Based on a primary survey in four nickel mining districts in Southeast Sulawesi—Morosi (Konawe), Pomalaa (Kolaka), Lasolo (North Konawe), and Rarowatu (Bombana)—there was a significant increase in household income after the mines began operating. Before mining activities, the average income of the community was only around Rp 1.85–2.35 million per month, with the main livelihoods being agriculture, fisheries, and small trade. After the mines began operating, incomes increased sharply, for example in Morosi, it jumped from Rp 2.1 million to Rp 4.05 million (92.8%), while Pomalaa, Lasolo, and Rarowatu recorded increases of between 62–64%. This increase was most pronounced in families with members working directly at the mine or in related sectors, such as transportation, catering, and trading of basic necessities.
These results demonstrate that the nickel industry has provided a significant economic boost to some households in affected areas. However, these benefits are unevenly distributed, as families not directly connected to mining operations only benefit indirectly from local economic activity. Therefore, household income is an important indicator for assessing the extent to which mining contributes to community well-being, while also revealing potential economic dependency risks if production declines or the global nickel price declines.

3.10 Poverty Level

The results of the analysis by the Statistics Indonesia (BPS) of Southeast Sulawesi and field verification indicate that poverty rates in several districts/cities remain above the national average, particularly in areas that have not yet experienced the economic benefits of nickel mining. In March 2024, the percentage of poor people in Southeast Sulawesi was recorded at 11.24%, with a poverty line of IDR 583,724 per capita per month. The districts with the highest poverty rates were Konawe Islands (20.11%), South Buton (17.52%), and West Muna (17.04%), while Kendari City (4.71%) and Baubau City (6.12%) recorded the lowest percentages. Field data from six districts representing mining and non-mining areas show significant differences: mining areas (Konawe, Kolaka, North Konawe) had an average poverty rate of 9.87%, lower than non-mining areas (Muna, South Buton, Konawe Islands) which reached 15.56%. The poverty line in mining areas is also higher (Rp. 590,720) compared to non-mining areas (Rp. 565,100) due to the increase in the cost of living following the presence of the mining industry.

Fieldwork findings through interviews and focus group discussions (FGDs) revealed that despite a decline in poverty in mining areas, the economic benefits were not evenly distributed. Households working directly in the mine or in supporting businesses were able to escape poverty, while those relying on traditional agriculture or informal employment remained below the poverty line. This phenomenon suggests two things: first, that mining has a positive impact in creating employment opportunities and reducing poverty; second, that groups not connected to the mining economic chain are at risk of relative poverty due to cost-of-living inflation. Therefore, poverty indicators not only reflect levels of well-being but also serve as an important measure for monitoring socioeconomic disparities and formulating poverty alleviation policies based on the local context of the nickel industry.

3.11 Access to Public Services

Results of household surveys, interviews, and focus group discussions (FGDs) in Southeast Sulawesi's nickel mining enclaves (Morosi, Pomalaa, Lasolo, and Rarowatu) indicate that access to public services has improved in some areas, but also faces new pressures due to population growth and industrial activity. Electricity access is highest, with 96–99% of households connected to PLN (State Electricity Company) thanks to network expansion to meet the needs of smelters and worker housing, despite rising utility bills. Access to clean water remains relatively low (55–72%) and varies in quality; some still rely on shallow wells, and the main complaint is cloudiness during the rainy season. Access to basic health facilities is quite good (78–88% of households within ≤30 minutes' reach), but service burdens have increased by 18–25% in the past two years, particularly for acute respiratory infections (ARI), skin diseases, and minor work-related accidents. In terms of education, access to primary schools is relatively good (92–97%), but junior secondary schools face an increase in the student-teacher ratio from 24–26 to 32–35 due to population growth and limited classroom space.

These findings demonstrate the transmission mechanism of nickel mining on public services: electricity infrastructure is expanding rapidly in line with industrial needs; access to clean water is a weak point due to quality issues and competition for use; while the health and education sectors are experiencing *demand shock* which has the potential to reduce service quality if not balanced by additional facilities and personnel. In this study, four public service indicators—electricity, clean water, health, and education—are used as the main variables to examine the relationship between mining activities and the distribution of public services, and to assess whether the growth of the nickel industry benefits all villages or actually widens the gap between mining and non-mining areas.

3.12 Asset Ownership

Based on a household survey in four nickel mining districts (Morosi, Pomalaa, Lasolo, and Rarowatu) and interviews with community leaders and local business owners, ownership of both productive and consumptive assets has increased over the past five years, although this has not been enjoyed equally by all groups. The proportion of habitable housing in mining areas reached 78–85%, higher than the non-mining average (65–70%), with many families of mine workers and supporting businesses upgrading their homes from semi-permanent to permanent. Vehicle ownership has also surged, with 64–72% of households owning at least one motorcycle and 12–18% owning a car, used for work mobility, small businesses, and the distribution of goods. Land ownership is around 48–55%, but some has been converted to industrial or worker housing, raising concerns about the loss of family land assets.

These findings indicate that nickel mining activities have contributed to increased household assets in the affected areas, including housing, vehicles, and land. However, these benefits are felt more by groups directly connected to the mining sector, creating potential disparities with those not involved. In this study, indicators of home, vehicle, and land ownership are used as measures of material well-being and will be analyzed alongside data on income, poverty levels, and access to public services. This aims to provide a comprehensive picture of the socio-economic transformation and potential inequalities arising from the development of the nickel industry in Southeast Sulawesi.

3.13 Prices of Basic Necessities

The research results show that nickel mining activities in Southeast Sulawesi have had a significant impact on the socio-economic dynamics of local communities. First, a survey of staple food prices indicated increases in the prices of rice, fish, and fuel after the mine began operating. The price of medium-grade rice increased by 18–26%, fish for daily consumption by 20–32%, while local transportation fuel increased by 8–15%, and 3-kg LPG experienced a premium of 10–20% due to scarcity. These price increases were driven by increased demand from mining workers, logistics distribution disrupted by truck traffic, and rising household production and distribution costs. These impacts put pressure on non-mining groups and informal workers whose incomes did not keep pace with local inflation.

Table 2. Basic necessities price indicators

Indicator	**Pre-Mining (t0)**	**Post-Mining (t1)**	**D** (%)	**Field Data Sources**	**Interview/FGD Description**
Price of medium rice (Rp/kg)	11000	13500–14000	+18–26	Market traders, household purchase receipts	Demand increases from miners and contractors; supply is disrupted when truck traffic is heavy
Price of daily consumption fish (skipjack tuna/small pelagic) (Rp/kg)	30000	37000–39000	+20–32	TPI, fish traders, fishermen	Diesel costs rise, fishing locations shift due to smelter port activity
Local transport fuel prices (Rp/liter)	10000	10800–11500	+8–15	Gas station, public transport driver	Long queues at gas stations during heavy mining truck traffic; food distribution costs rise
Price of 3 kg LPG (Rp/cylinder)	20000	22000–24000	+10–20	LPG base, household	Periodic scarcity triggers prices above the HET, especially in mining districts far from the city.

Second, land-use shift analysis shows that 77.8% of respondents lost some or all of their productive land in the past five years due to conversion to mining areas, smelters, and employee housing. The total land conversion reached 1,246.7 hectares, including rice paddies, cocoa/coconut plantations, and fish ponds. This conversion reduced local food production by 32.4% and encouraged a shift in jobs from agriculture/fisheries to the mining sector. Third, economic dependency data shows that 48.7% of household income in directly affected areas comes from the mining sector, significantly higher than in indirectly affected areas (31.2%) and control areas (12.5%). This condition indicates the dominance of a single source of income, increasing the risk of income shock if nickel prices fall or mines cease operations. Furthermore, environmental research findings indicate a decline in water, air, and soil quality in villages surrounding the mine. River water turbidity has increased, air quality is polluted with PM2.5 and PM10 dust above threshold levels, and topsoil degradation with higher heavy metal content is occurring. These

impacts are associated with increased cases of acute respiratory infections (ARI), diarrhea, and decreased agricultural yields. Changes in productive land cover averaged -7% to -18% in four key locations, exacerbating the community's dependence on food supplies from outside the region. Overall, this research indicates that while nickel mining increases incomes for some communities, unequal distribution of benefits, loss of productive land, rising living costs, and environmental pressures pose long-term socio-economic risks. These findings provide an important basis for formulating policies for poverty alleviation, local economic diversification, and environmental impact mitigation in the Southeast Sulawesi nickel mining area.

Public health in the nickel mining areas of Southeast Sulawesi was one of the key issues uncovered during field data collection. Interviews with heads of households, village officials, and health workers revealed that the intensity of mining activities has led to an increase in health complaints, particularly respiratory problems in children due to exposure to mine dust. Furthermore, skin irritation and digestive problems were also identified, linked to the declining quality of well water, the primary source of household needs. Focus group discussions (FGDs) with housewives corroborated these findings, noting an increase in coughing and shortness of breath, as well as the burden of family medical expenses. The elderly are also more susceptible to chronic illnesses such as hypertension and asthma. The challenges are compounded by the limited distance of healthcare facilities from residential areas, leading some residents to resort to traditional medicine or delay treatment until their condition worsens.

Field observations reveal a health disparity between villages adjacent to mining sites and non-mining villages. Rates of infectious diseases and environmental health problems are higher in mining areas, resulting in decreased work productivity and increased household economic burdens. This situation reinforces the cycle of poverty, so health is seen not only as a byproduct but also as a determining factor in community socio-economic resilience.

Field data shows a higher prevalence of disease in mining areas. Cases of respiratory infections (ARI) and bronchitis increase due to exposure to dust and smelter emissions, while dermatitis and skin allergies are common due to declining water quality. Digestive illnesses, such as diarrhea, are also frequently reported in households with limited access to clean water. Furthermore, cases of anemia in pregnant women, low birth weight (LBW), hypertension, and mental disorders such as stress and anxiety are also found to be higher in mining areas than in non-mining villages.

Maternal and child health conditions present serious challenges, including high prevalence of malnutrition, stunting, maternal and infant mortality, and low access to antenatal care services. A lack of healthcare facilities and medical personnel exacerbates this situation, while interviews with medical personnel and integrated health post (Posyandu) cadres confirm the disparity in services. Overall, limited access, poor nutritional quality, and a lack of attention to reproductive health reinforce the cycle of structural poverty around nickel mining areas.

Table 3. Maternal and Child Health Indicators

Maternal and Child Health Indicators	**Field Survey Results**	**National Standards/Targets**
Maternal Mortality Rate (MMR)	280 per 100,000 KH	183 per 100,000 KH
Infant Mortality Rate (IMR)	32 per 1,000 KH	12 per 1,000 KH
Prevalence of Stunting in Toddlers	29,5 %	14 %
Pregnant women who receive ≥4 ANC visits	62,0 %	90 %
Complete Basic Immunization Coverage	68,0 %	85 %
Pregnant Women's Access to Adequate Birthing Facilities	55,0 %	90 %
Ratio of Midwives/Health Workers to Pregnant Women	1,5 per 1.000	2,0 per 1.000

Source: Primary Data Processing

Based on field surveys, maternal and child health conditions in the nickel mining areas of Southeast Sulawesi are still far from national standards. The Maternal Mortality Rate (MMR) reached 280 per 100,000 live births, higher than the target of 183, while the Infant Mortality Rate (IMR) remained at 32 per 1,000, far above the target of 12. The prevalence of stunting in toddlers at 29.5% also indicates

chronic nutritional problems. Access to health services remains limited, with only 62% of pregnant women receiving at least four ANC check-ups and complete basic immunization coverage at only 68%, both still below the national target.

The survey also revealed that access to safe delivery services remains low, at only 55% compared to the 90% target, resulting in a high risk of complications. The limited availability of medical personnel is also evident in the midwife ratio of only 1.5 per 1,000 pregnant women, below the 2.0 standard. This confirms that maternal and child health is a key determinant of the cycle of poverty, where low-quality services, high rates of stunting and maternal-neonatal mortality, exacerbate the socioeconomic vulnerability of communities surrounding mining areas.

In terms of nutrition, data reveals serious problems. The prevalence of malnutrition among school-age children, at 21.5%, is still double the national target of <10%, while anemia among adolescent girls (36%) and pregnant women (28%) is far above the national limit of <20%. Average daily energy consumption is only 1,750 kcal and protein 46 grams, both below the RDA. Food insecurity affects 33% of households, reflecting limited access to nutritious food due to land conversion, low purchasing power, and a shift in consumption patterns toward instant products.

From a policy perspective, local governments, mining companies, and other stakeholders have implemented various poverty alleviation and CSR programs. However, their effectiveness remains limited. CSR focuses largely on short-term assistance, while poverty alleviation policies are not fully adapted to local needs, and regulations remain weak in implementation. Infrastructure and scholarship programs are helpful, but productive economic empowerment is not yet optimal.

Findings on the effectiveness of CSR show variation across districts. In Kolaka, communities have benefited from infrastructure and education development, but economic programs remain minimal. North Kolaka has begun promoting skills training and MSMEs, despite market and consistency constraints. North Konawe and Bombana are still dominated by charitable aid, such as basic food supplies or emergency facilities, which only have a short-term impact. Overall, CSR programs in nickel mining areas have not been fully effective in driving sustainable socio-economic transformation. This underscores the need for a collaborative, multi-stakeholder strategy with an empowerment focus and stronger regulations.

Survey results show that poverty alleviation policies in Southeast Sulawesi's nickel mining areas are still dominated by short-term approaches. In North Konawe, social assistance is quite extensive but hampered by infrastructure and transportation access, while in Bombana, the policy focus is more on emergency needs such as relocation and direct assistance without productive economic innovation. Overall, the structural weaknesses that emerged were the dominance of charitable approaches, weak government-mining company coordination, and low community participation in program planning.

While communities appreciate social assistance for reducing daily burdens, they emphasize the importance of innovative policies that encourage job creation, skills development, and business capital support. These findings underscore the need for a policy shift from simply providing assistance to innovation, multi-stakeholder collaboration, and developing local potential to enhance economic independence for communities in mining areas.

Table 4 Poverty Alleviation Policy

Regency	Policy Focus	Superiority	Obstacle	Impact on Society
Kolaka	Integration of social assistance (PKH, BPNT, BLT) with empowerment of MSMEs and cooperatives	Opening up small business opportunities, increasing access to capital through cooperatives	The program recipients are still limited; it has not been integrated with the local industrial ecosystem.	Some poor families are starting to turn to productive businesses, although dependence on aid is still high.
North Kolaka	Empowerment based on agriculture and fishermen	Support for superior seed programs,	Limited market access; lack of distribution	Farmers' and fishermen's incomes have

		agricultural training, and local fishermen	infrastructure for production results	increased slightly, but the sustainability of the program remains fragile.
North Konawe	Mass social assistance and basic subsidy programs	Reaching poor households in remote areas	Uneven distribution due to poor infrastructure; local economic empowerment has not yet taken place	Aid reduces short-term economic burdens, but does not increase community independence.
Bombana	Emergency response (residential relocation, direct assistance, facility repair)	Respond quickly to communities affected by mining activities	Lack of innovation; only focusing on emergency aspects without long-term empowerment	People feel helped for a moment, but there is no significant change in their economic livelihood.

Table 4 shows variations in policy focus across districts. Kolaka integrates social assistance with the empowerment of MSMEs and cooperatives, although the reach of recipients remains limited. North Kolaka emphasizes empowering the agricultural and fishing sectors through training and superior seeds, but is hampered by distribution and market access. North Konawe remains reliant on basic subsidies, while Bombana focuses more on emergency responses to the impacts of mining. Despite their differences, all districts demonstrate a pattern that remains oriented toward short-term assistance.

Overall, poverty alleviation policies in the four main nickel mining districts face challenges such as the dominance of short-term approaches, limited infrastructure and markets, and minimal community participation in programs. Therefore, future policy direction needs to strengthen synergy between the government, communities, and mining companies, based on innovation, sustainability, and alignment with real needs on the ground, for a more inclusive socioeconomic transformation.

Multiple linear regression analysis was used to measure the influence of socioeconomic, environmental, health, policy/program, and participation and governance factors on the Multidimensional Poverty Index (MMI) and community socioeconomic well-being. From 720 respondents in four nickel mining districts, an R^2 value of 0.684 was obtained, meaning that 68.4% of the variation in the MMI and well-being can be explained by these variables, while the remaining 31.6% is influenced by external factors such as culture, market access, and local politics. This indicates that the model is quite robust in describing the socio-economic realities of mining communities.

The regression coefficient results indicate that socioeconomic factors (B = 0.703, p = 0.000) are the dominant variables that reduce poverty, especially through increased education, access to employment, and asset ownership. Environmental factors (B = 0.298, p = 0.001) are also significant, with improvements in water, soil, and air quality closely related to household well-being. Furthermore, health factors (B = 0.226, p = 0.004) also have an influence through increased access to health services and nutritional status, which can reduce family economic vulnerability due to medical expenses or loss of productivity.

Policy and program factors (B = 0.189, p = 0.006) played a positive role, although their effectiveness was still limited due to implementation, transparency, and sustainability constraints. The role of mining company CSR and local government intervention was quite significant, particularly in infrastructure provision and economic empowerment. Meanwhile, participation and governance factors (B = 0.154, p = 0.020), although the smallest, remained significant, confirming that multi-stakeholder involvement and transparency in benefit distribution contribute to poverty alleviation.

Overall, these findings indicate that socioeconomic factors are the primary key to improving community welfare post-mining, followed by the environment and health as supporting factors, and policy and

governance as reinforcing factors. The negative constant (-2.145, p = 0.011) confirms that without the contribution of these factors, poverty tends to increase. Therefore, poverty alleviation strategies in nickel mining areas need to emphasize innovations based on education, health, environmental improvement, and multi-stakeholder governance to achieve sustainable socio-economic transformation.

A socio-economic analysis of four areas impacted by nickel mining in Southeast Sulawesi reveals significant regional disparities. Districts A (mining center) and D (semi-urban) are more prosperous, with middle-to-upper incomes (15–20%), high asset ownership, and better access to education and healthcare. Conversely, District C (remote rural) is the most vulnerable, with 60% of households having low incomes, only 30% owning permanent housing, and an average schooling of 6.5 years. This disparity reflects how proximity to the mine contributes to increased incomes but also widens the gap.

The employment structure also differs between regions. District A is dominated by mining workers (50%), while District C still relies on subsistence agriculture (50%) and informal employment. District D is more diverse, with a combination of mining, trade/services, and agriculture, making it more resilient to economic fluctuations. These differences demonstrate that job diversification is key to economic resilience, while reliance on the primary sector increases vulnerability in remote areas.

In terms of access to basic services, District C has the lowest achievement. Child education participation is only 65% and routine healthcare access is only 45%, with 70% of households having to travel more than 10 km to a health facility. The prevalence of mining-related diseases, such as respiratory and skin disorders, is quite high in this area. Meanwhile, Districts A and D, although more economically advanced, still face health risks from exposure to mine dust and water pollution. This suggests that environmental aspects exacerbate socioeconomic vulnerability in all areas, especially those far from service centers.

Overall, the findings indicate that nickel mining brings economic benefits to areas close to mining centers, but increases inequality in remote areas. Community well-being is determined not only by proximity to the mine, but also by job diversification, asset ownership, and access to basic services. Therefore, poverty alleviation strategies need to be based on innovative policies that encompass income redistribution, increased access to education and health, local economic diversification, and environmental risk mitigation to achieve sustainable socio-economic transformation.

4. CONCLUSION

This study examines the socio-economic conditions of poor communities impacted by nickel mining areas in Southeast Sulawesi, focusing on innovation- and policy-based poverty alleviation efforts. The analysis includes identifying structural challenges, community access to economic resources, and the potential for developing socio-economic transformation strategies. The results indicate that despite the development of infrastructure supporting mining, most local communities still face limitations in access to formal employment, education, and basic social services. This underscores the need for innovation-based interventions combined with targeted policies, so that any poverty alleviation strategy can be effective, sustainable, and adaptive to the dynamics of mining areas.

The analysis results show that communities affected by mining face obstacles in the form of low incomes with informal employment, limited access to education and skills, and unequal distribution of economic benefits, so that innovative interventions and strategic policies are needed to encourage sustainable socio-economic transformation. Based on these conditions, the study formulated a poverty alleviation model that integrates community capacity development through skills training, local economic diversification based on MSMEs and simple technology, and policy support in the form of mining company incentives, benefit distribution regulations, and monitoring systems. From this model, an effective strategy is formulated by emphasizing collaboration between the government, companies, and communities to expand employment opportunities, empowerment through training and entrepreneurship, and sustainable benefit distribution policies, so that the research objectives are achieved by reducing poverty and improving community welfare in a targeted manner.

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