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The Influence of Mining Impacts and the Green Economy on Community Welfare: A Case Study of Communities Surrounding Nickel Mining Areas in Southeast Sulawesi, Indonesia

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ABSTRACT : This study aims to analyze the multidimensional impacts of mining activities on community welfare by considering the role of the green economy as a sustainable transformation approach. A mixed methods design was employed, involving data collection through Likert-scale questionnaires, and in-depth interviews, participatory observations, and secondary data analysis. The respondents consisted of local communities, mine workers, and related stakeholders living and operating within the vicinity of mining activities. Quantitative analysis was conducted using Structural Equation Modeling (SEM) to examine the causal influence of environmental, health, socio-economic, and socio-cultural impacts on community welfare mediated by the green economy. The findings indicate that mining activities contribute positively to improving community welfare, particularly through increased employment opportunities, income enhancement, and better access to education and health services. However, environmental degradation and socio-cultural risks remain significant challenges that require proper management. The SEM results confirm that the application of green economy principles significantly strengthens the positive contributions of mining to community welfare. Therefore, sustainable mining management requires stronger regulations, intensive monitoring, environmentally responsible practices, and inclusive community empowerment programs.

KEYWORDS: *mining, green economy, SEM, sustainability, community welfare*

1. INTRODUCTION

Mining activities have become one of the strategic sectors that contribute significantly to the economies of many countries, both nationally and locally. The mineral resources extracted through mining operations often serve as essential raw materials for manufacturing, energy, and infrastructure industries, thus driving economic growth. However, behind its economic benefits, mining also poses complex impacts on various aspects of community life, including health, environment, socio-economics, and socio-cultural conditions (Yıldız, 2023; Leuenberger et al., 2021). One of the most evident consequences concerns public health, particularly for communities residing near mining sites (Worlanyo & Jiangfeng, 2021). Air pollution caused by mining dust and chemical emissions, as well as water contamination from mining waste, can trigger health problems such as respiratory diseases, skin disorders, and even chronic illnesses (Katariya et al., 2024). Moreover, mining activities contribute to environmental degradation, including deforestation, soil deterioration, and the loss of wildlife habitats, which ultimately disrupt ecological balance (Berenguer et al., 2021; Zhang & Zhang, 2020).

Environmental impacts often extend to socio-economic dimensions. Land conversion for mining purposes frequently restricts community access to natural resources that previously supported livelihoods such as agriculture, fisheries, and forestry (Bansah et al., 2024; Shackleton et al., 2020). In some cases, local communities are displaced from ancestral lands without adequate compensation, leading to long-term economic losses and social tensions. Mining operations may also alter the structure of the local economy, creating disparities between local workers and migrants, and widening the gap between those who benefit directly from

mining and those who bear its negative impacts. Therefore, developing an assessment framework capable of capturing the full scope of mining impacts is crucial to ensure that economic gains do not compromise community well-being. Research further indicates that mining impacts vary depending on socio-cultural contexts and regulatory governance in different countries (Yeboah et al., 2024; Jiang et al., 2024; Kuzior et al., 2022).

Developed countries tend to enforce stringent regulations that minimize negative impacts, whereas developing countries often face challenges in implementing similar standards due to limited resources and capacity. This disparity highlights the need for an evaluation model that not only considers environmental aspects but also encompasses socio-economic and socio-cultural dimensions across different national contexts. Cross-country studies can provide broader insights into the determinants shaping mining sustainability worldwide. Additionally, mining often threatens the continuity of local cultural identity. Horowitz et al. (2024) argue that the presence of large-scale mining companies may lead to shifts in social structures, including the erosion of local traditions due to accelerated modernization. At the same time, conflicts between Indigenous communities and corporations frequently arise due to differing interests in natural resource management (Horowitz et al., 2024).

Social-cultural impact assessments are thus essential to ensure that development does not undermine local identities and social sustainability. Through a multidimensional approach, this study seeks to provide a deeper understanding of how economic development can be integrated with cultural preservation and community well-being. The urgency of this research is supported by numerous cases worldwide that demonstrate the need for a comprehensive evaluation of mining impacts. A holistic assessment that includes health, environmental, socio-economic, and socio-cultural dimensions will help generate more inclusive and sustainable policy recommendations. By comparing experiences across countries, this study aims to establish an evaluation model that is not only theoretically robust but also practically applicable in diverse global contexts.

II. LITERATURE REVIEW

2.1. Nickel Mining Impacts

In assessing the impacts of nickel mining, various aspects must be considered to obtain a comprehensive understanding of the consequences arising from mining activities. The environmental aspect becomes a major concern as mining can lead to land degradation, water pollution caused by tailings, air pollution from dust and gas emissions, and the loss of biodiversity. Additionally, microclimate changes due to deforestation and inadequate management of acid mine drainage may further worsen overall environmental conditions. Therefore, post-mining land rehabilitation is essential to ensure environmental sustainability.

Health impacts on communities are also critical, particularly due to exposure to heavy metals that may contaminate water sources and agricultural products. Respiratory diseases caused by nickel dust and occupational health risks for mine workers are serious concerns. Psychosocial effects such as stress due to social conflicts or loss of livelihood also influence community well-being. Thus, adequate healthcare services and corporate social responsibility (CSR) initiatives focused on health are vital to mitigating the health impacts of mining.

From the socio-economic perspective, nickel mining can contribute positively by creating jobs and increasing local income. However, it can also generate social inequalities and changes in local livelihoods, especially among communities dependent on agriculture or fisheries. Land and housing prices around mining sites tend to increase, leading to gentrification. Although infrastructure developments such as roads, electricity, and clean water can enhance quality of life, their long-term sustainability after mining operations cease must be addressed.

Socio-cultural impacts are equally important, as mining activities often alter the way of life of local communities, shifting traditional values and local wisdom. The influx of migrant workers may lead to changes in social structures and even social conflicts between local residents, the company, and the government. Meaningful community participation in planning and decision-making processes is crucial to ensure social sustainability and prevent marginalization of local groups.

From a regulatory perspective, the effectiveness of enforcing policies such as Environmental Impact Assessment (EIA/AMDAL) plays a significant role in reducing negative mining impacts. Regulations on CSR, transparency, protection of indigenous rights, and compliance with mining permits are key in ensuring that mining operations adhere to principles of justice and sustainability. The government has an important role in supervising regulatory implementation and imposing sanctions for violations. Furthermore, global and technological factors influence the dynamics of the nickel mining industry, particularly due to increasing global demand for nickel as a key component in electric vehicle batteries. Fluctuations in global market prices may affect corporate operations, while the adoption of environmentally friendly mining technologies remains a challenge in minimizing ecological damage. Compliance with international standards such as ISO 14001 in environmental management and contributions to the Sustainable Development Goals (SDGs) serve as important indicators of sustainable mining.

Lastly, stakeholder participation is essential in assessing the impacts of nickel mining. The level of community involvement in licensing, monitoring, and mitigation processes significantly influences social acceptance of mining activities. NGOs, academics, and the media play supportive roles in advocacy and scientific assessment of mining impacts. The availability of grievance mechanisms and community consultation forums is also vital to ensure transparency and corporate accountability.

Considering these multidimensional aspects, the assessment of nickel mining impacts can be conducted more holistically and accurately. This approach enables stakeholders to better identify risks and opportunities, design effective mitigation policies, and develop more sustainable solutions for the future of responsible mining practices.

2.2. Green Economy

The concept of the green economy has been widely discussed in recent sustainability and development literature as a transformative approach that reconciles economic growth with environmental protection and social well-being. Loiseau et al. (2022) conceptualize the green economy as more than an environmental policy instrument; rather, it represents a structural transition in economic systems aimed at improving resource efficiency, reducing carbon intensity, and promoting social inclusiveness. Their synthesis highlights that the green economy serves as an operational bridge between sustainable development goals and practical economic policy, emphasizing the importance of institutional capacity, cross-sectoral policy integration, and equitable distribution of economic benefits. This perspective underscores that the green economy framework is inherently multidimensional, combining economic performance, environmental integrity, and human welfare within a unified policy paradigm.

Empirical evidence further demonstrates that the implementation of green economy principles has measurable implications for environmental quality and community welfare. Wang, Zhao, and Zhang (2023) show that higher levels of green economy efficiency measured through composite indicators integrating economic output, environmental performance, and social outcomes are significantly associated with improvements in social welfare and reductions in environmental pressure in developing countries. Complementing these findings, Sun et al. (2024) provide robust evidence that green economy development contributes positively to environmental quality and human well-being, particularly through mechanisms such as green job creation, enhanced public health, and reduced ecological risks. However, both studies emphasize that the positive effects of the green economy are not automatic; they are contingent upon governance quality, policy coherence, and local socioeconomic conditions. Consequently, the literature suggests that the green economy holds strong potential as a pathway to improved community welfare, including in resource-intensive regions such as mining areas, provided that its implementation is inclusive, well-governed, and context-sensitive.

2.2. The Concept of Community Welfare

The concept of community welfare encompasses several interrelated dimensions: social, economic, environmental, and institutional. Rela et al. (2020) suggest that corporate social responsibility toward the environment represents both a strategy for long-term business sustainability and a moral obligation that promotes social, economic, and environmental well-being. This relationship highlights the importance of integrating community welfare into corporate strategies, as companies that successfully engage stakeholders are better positioned to create shared value, positively impacting both their operations and surrounding communities (Lopez, 2020).

III. RESEARCH METHODS

This research employs a mixed methods approach to obtain a comprehensive understanding of the multidimensional impacts of mining activities. The research location was selected based on empirical evidence of mining impacts on public health, the environment, socio-economic conditions, and socio-cultural dynamics, as well as stakeholder openness and accessibility for field data collection. Quantitative respondents consisted of local residents living within a 5–10 km radius from the mining area, mine workers, and local government officials, while qualitative informants included traditional leaders, religious figures, representatives of vulnerable groups, government authorities, company representatives, and NGOs/academics with expertise in mining issues.

Data were collected through Likert-scale questionnaires (1–5), secondary data analysis (EIA reports, public health statistics, and regional economic data), in-depth interviews, focus group discussions (FGDs), and participatory observation to capture non-quantifiable aspects. Quantitative data were statistically analyzed using Structural Equation Modeling (SEM) to examine causal relationships among environmental, health, socio-economic, and socio-cultural impact variables, as well as the mediating role of policies within the context of green economy transformation. Meanwhile, qualitative data were analyzed thematically to enrich interpretation and provide contextual understanding of the quantitative findings.

IV. RESULTS AND DISCUSSION

4.1. Mining Activities

The mining sector serves as one of the key drivers of economic growth and national development in Indonesia (Fahrul Razi, 2021). Mining activities generate various impacts on miners and surrounding communities. Every operation inherently brings both positive and negative consequences (Dikgwatlhe & Mulenga (2023). In line with Shub & Ye (2023), the presence of mining companies can produce beneficial as well as adverse effects on the social and economic conditions of nearby populations, and in many cases also encourages community-based mining both legal and illegal in the surrounding areas.

Mining activities are not solely technical operations of resource extraction, but also a political arena for policy implementation. Government regulations should not only function as control mechanisms, but also as instruments of structural transformation that ensure social justice, environmental sustainability, and national economic sovereignty. This perspective is supported by the results of community perception assessments related to mining activities, which are presented in the following table.

Table 1. Community Perceptions of Mining Activities by Villages/Sub-districts in Langgikima District, North Konawe Regency, 2025.

No.	Statement	SD (%) (Strongly Disagree)	D (%) (Disagree)	N (%) (Neutral)	A (%) (Agree)	SA (%) (Strongly Agree)	Mean	Std. Dev.
1	Mining activities in this area are carried out in a well-planned manner.	0.00	27.45	16.34	48.37	7.84	3.33	0.99
2	Mining activities provide a significant contribution to the regional economy.	0.00	5.88	25.49	49.67	18.95	3.83	0.80
3	Mining operations comply with existing regulations.	0.00	14.38	31.37	48.37	5.88	3.46	0.82
4	The company ensures environmental sustainability in its operations.	0.00	22.22	39.87	33.33	4.58	3.22	0.84
5	The company prioritizes occupational safety.	0.00	0.65	23.53	62.75	13.07	3.88	0.64
6	Mining activities create employment opportunities for local communities.	0.00	0.65	12.42	47.71	39.22	3.64*	0.64

Note: SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree. **Category Criteria (Mean):** Low (1.00–2.32), Moderate (2.33–3.65), High (3.66–5.00)

Based on the results of community perception analysis regarding mining activities, several important findings can be identified that reflect the current implementation of mining operations in the study area. The planning aspect of mining activities obtained a mean score of 3.33 with a standard deviation of 0.99, indicating that most respondents agreed that mining operations are relatively well planned (48.37% agree), although a

considerable portion expressed disagreement (27.45% disagree and 16.34% slightly disagree). This suggests that mining planning is perceived as not fully transparent and inconsistent.

The contribution of mining to regional economic development received a more positive assessment, with a mean score of 3.83 and a standard deviation of 0.80. The majority of respondents (49.67% agree and 18.95% strongly agree) believe that mining provides significant economic benefits to local communities. The presence of mining companies has generated employment opportunities and stimulated local business growth. These opportunities have driven economic progress in Langgikima compared to the period before mining operations began. This finding emphasizes the role of the mining sector as a key economic driver in the region.

The regulatory compliance aspect achieved a mean score of 3.46 (SD = 0.82), where 48.37% of respondents agreed that mining operations comply with existing laws. However, a notable proportion expressed doubt or disagreement (14.38% disagree and 31.37% slightly disagree), indicating that adherence to regulations remains a concern among local communities.

The environmental sustainability aspect scored the lowest (mean = 3.22, SD = 0.84). Respondents expressing negative perceptions were dominant (22.22% disagree and 39.87% slightly disagree), while only 33.33% agreed and 4.58% strongly agreed. This reflects a high level of community concern regarding potential environmental degradation caused by mining operations. The occupational safety aspect obtained a mean score of 3.88 (SD = 0.64), with 62.75% agreeing and 13.07% strongly agreeing that companies prioritize worker safety. This implies that safety standards are perceived as being relatively well enforced.

Furthermore, the local employment creation dimension showed a strongly positive trend, with 47.71% agreeing and 39.22% strongly agreeing, indicating that mining activities provide real job opportunities for residents living near the mining site.

Overall, the community perception obtained a mean score of 3.54 (SD = 0.86), categorized as *moderate*. This means that mining activities are considered fairly beneficial, particularly in economic and employment aspects, although fundamental issues persist regarding planning transparency and environmental protection. These findings align with Chen et al. (2023), who argues that mining industries should contribute to regional development by expanding employment opportunities, increasing community income, and supporting entrepreneurial initiatives. Likewise, mining companies are expected to serve as key economic pillars that drive regional prosperity, including in the Langgikima District.

4.2. Green Economy

The green economy refers to the implementation of economic production processes aligned with environmental sustainability. Long-term environmental degradation triggered by production activities has raised public concern. The concept emphasizes the integration of economic development with the protection of the environment and social well-being as primary determinants of sustainable growth (Nugroho et al., 2024). The green economy emerged as a response to environmental crises such as climate change, ecosystem destruction, and pollution (Arjayanda et al., 2025).

Mining operations inherently pose a high risk of environmental degradation; therefore, the adoption of environmentally friendly practices is required to minimize negative impacts on ecosystems and public health. These practices encompass preventive, mitigative, and rehabilitative efforts integrated throughout the entire mining lifecycle, from exploration and exploitation to post-mining recovery. The results of community perceptions are presented in Table 2.

Table 2. Community Perceptions of Environmentally Friendly Mining Practices in Langgikima District, North Konawe Regency (2025)

No	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	SD
1	Mining companies apply environmentally friendly technology.	0.00	27.45	29.41	42.48	0.65	3.22	0.82
2	Mining companies conduct post-mining land reclamation.	0.00	6.54	51.63	29.41	12.42	3.50	0.81
3	Mining companies reduce carbon emissions.	2.61	30.07	26.80	34.64	5.88	3.15	0.99
4	Mining companies properly manage waste.	0.00	10.46	32.68	47.71	9.15	3.55	0.82
5	Mining companies use renewable energy.	1.31	24.84	41.18	27.45	5.23	3.14	0.87
6	Mining companies reduce hazardous chemical use.	0.65	24.84	31.37	38.56	4.58	3.46*	0.87

Note:
STS = *Strongly Disagree*, TS = *Disagree*, SD = *Neutral*, S = *Agree*. SS = *Strongly Agree*
Scale Category: Low (1.00–2.32), Moderate (2.33–3.65), High (3.66–5.00)

The survey shows moderate community perceptions toward environmental compliance by mining companies. Waste management (M = 3.55) and land reclamation (M = 3.50) received relatively higher scores, while renewable energy use (M = 3.14) and carbon emission reduction (M = 3.15) were perceived weakly. This highlights that mitigation efforts are progressing but uneven across indicators. **These results align with Wiradinata et al. (2025),** emphasizing the increasing enforcement of sustainability policies including reclamation, better waste governance, and stricter environmental monitoring.

4.3. Community Well-Being

Welfare can be interpreted in several ways. In general terms, welfare refers to a condition in which individuals live in prosperity, health, and peace. In an economic context, welfare is associated with the benefits obtained from goods or resources (Taftazani, 2018). Overall, community welfare can be assessed through various indicators including housing, health, education, and purchasing power. Housing is considered a fundamental need that must be fulfilled before achieving higher levels of welfare, as having a home represents access to a place to live and social stability (Elwan et al., 2018). This conceptual understanding is reflected in the survey findings presented in the table below.

Table 3. Community Perceptions of Welfare Conditions Resulting from Mining Impacts in Langgikima District, North Konawe Regency (2025).

No.	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean	Std. Dev.
1	Communities have access to proper education.	0.65	0.00	3.27	67.32	28.76	4.24	0.58
2	Communities have access to good health services.	0.00	0.65	9.80	54.90	34.64	4.24	0.66
3	Communities have access to decent employment.	0.00	0.00	3.27	59.48	37.25	4.35	0.55
4	Communities have adequate income levels.	0.00	0.65	8.50	51.63	39.22	4.31	0.64
5	Communities feel safe and protected.	0.00	0.65	14.38	58.82	26.14	4.10	0.67
6	Communities have access to proper housing.	0.65	2.61	18.95	52.29	25.49	4.25*	0.67

Note:
STS = *Strongly Disagree*, TS = *Disagree*, SD = *Neutral*, S = *Agree*. SS = *Strongly Agree*
Scale Category: Low (1.00–2.32), Moderate (2.33–3.65), High (3.66–5.00)

The survey results regarding the impact of mining activities on community welfare indicate that mining has contributed significantly to improving living standards. Access to quality education and health services received a high perception score (mean = 4.24), suggesting that mining activities support the fulfillment of basic social needs. Access to decent employment and adequate income also scored highly (mean = 4.35 and 4.31), indicating strong economic benefits derived from mining operations.

Safety and security perceptions reached a mean score of 4.10, while access to decent housing achieved a mean of 4.25, reflecting a broad improvement in overall quality of life. Collectively, the community's perception of welfare enhancement due to mining falls into the **high** category (overall mean = 4.25; SD = 0.63), demonstrating that mining activities positively influence education, health, security, and economic stability in the operational areas.

These findings align with Omotehinse & Ogunlade (2022), who emphasize that the mining industry plays a substantial role in poverty alleviation, welfare improvement, infrastructure development, reduction of unemployment, expansion of job opportunities, and enhancement of life expectancy in mining regions.

4.4. The Influence of Mining Impacts on Community Welfare through the Green Economy

This study examines the influence of mining impacts on community welfare through the green economy in mining-affected areas. Mining impacts refer to all forms of consequences arising from mining activities, including social, economic, cultural, health, and environmental dimensions. In this study, the mining impacts were measured through the variables of social, economic, cultural, socio-political, environmental, and public health aspects.

The green economy is a development concept that emphasizes economic growth and community welfare while ensuring environmental sustainability. In this study, the green economy was assessed based on dimensions of environmentally friendly practices, social inclusion and justice, as well as a sustainable economic transition.

Community welfare refers to the condition in which basic human needs are fulfilled, including social, economic, education, health, and environmental dimensions. Welfare is not solely measured by income level or asset ownership; instead, it also includes quality of life, fairness, employment opportunities, access to public services, and participation in development programs. In this study, community welfare was measured through indicators of access to proper education, access to quality healthcare, decent housing, decent employment, and adequate income levels.

The analysis of the influence of mining impacts on community welfare through the green economy was conducted using the SEM-PLS approach, based on the bootstrapping output generated from SmartPLS software. The results of this analysis are presented in Table 10.

Table 4. The Influence of Mining Impacts on Community Welfare through the Green Economy

Konstruk	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Mining Impacts (X1) → Green Economy (X2) → Community Welfare (Y)	0,348	0,348	0,060	5,798	0,000

Source: Primary Data (Processed), 2025..

Table 10 presents the analysis of the influence of mining impacts on community welfare through the green economy in the mining area. The results indicate that the P-value of 0.000 < 0.05, meaning that the indirect effect of mining impacts via the green economy is positive and statistically significant (path coefficient = 0.348). This implies that mining activities, when aligned with green economy principles, contribute positively to improving community welfare in the surrounding region.

Mining activities inherently have the potential to produce negative consequences for both society and the environment. However, mining operations managed under the green economy framework tend to yield more beneficial outcomes, although potential issues may still arise. In Indonesia, several initiatives have been implemented in which the impacts of mining are managed through green economy policies to enhance community welfare based on sustainability principles. These efforts include mining downstream policies, post-mining land reclamation, and CSR programs oriented toward sustainable development.

Community welfare can be achieved when mining impacts are properly managed based on green economy principles emphasizing social equity, sustainability, and environmental protection. Basu and Mishra (2024) and Carvalho (2017) assert that mining practices oriented toward waste management, energy efficiency, and post-mining land reclamation can increase community incomes while maintaining environmental quality. Additionally, Pratama and Risdarmawan (2024) emphasize that the green economy is a crucial bridge to transform negative mining impacts into opportunities for communities through job creation and improved quality of social services, ultimately enhancing welfare. The government also plays a major role in implementing the green economy in mining areas. Welfare improvement can only be achieved with strong policy support and consistent regulation to ensure responsible and sustainable mining governance.

V. CONCLUSION

This study confirms that mining activities have the potential to provide significant economic benefits and improve community welfare in surrounding operational areas through job creation, increased income, and enhanced access to education and health services. However, negative impacts particularly on environmental conditions and socio-cultural values remain persistent challenges that require serious and continuous management. The SEM findings demonstrate that the green economy plays a crucial role in transforming mining impacts into real contributions to community well-being. The implementation of environmentally responsible mining practices, post-mining land reclamation, resource efficiency, and fair and sustainable policies is essential in minimizing risks and strengthening the long-term benefits of development in the mining sector. Therefore, the future direction of the mining industry should increasingly focus on transitioning toward a green economy that maintains a balance between economic, social, and environmental priorities.

Recommendations

Based on the research findings, several strategic recommendations are proposed to ensure that mining activities deliver optimal benefits for communities while minimizing negative impacts on the environment and local culture:

1. Strengthening Green Economy Implementation
   Governments and companies must accelerate the adoption of sustainable mining practices through energy efficiency, strict waste management, environmentally friendly technologies, and consistent land reclamation and restoration efforts.
2. Enhancing Regulatory Compliance and Monitoring
   Local governments need to reinforce mining governance by improving monitoring capacity, ensuring compliance with environmental impact assessments (EIA), and enforcing strict sanctions against violations affecting the environment and community rights.
3. Developing More Inclusive and Targeted CSR Programs
   CSR initiatives should be directed toward sustainable social development, including local economic empowerment, improved education and health services, and protection for vulnerable groups.
4. Optimizing Public Participation
   Transparent and inclusive mechanisms are required in mining licensing, planning, and evaluation processes to ensure that community voices—especially those of Indigenous leaders and women—are considered in decision-making.
5. Diversifying the Local Economy
   Communities around mining sites must be supported in developing alternative livelihoods to reduce long-term dependence on the mining sector and strengthen regional economic resilience.
6. Strengthening Health and Environmental Monitoring Systems
   Continuous monitoring of air and water quality, along with public health surveillance, is necessary to rapidly identify and address negative impacts while ensuring responsive health services.
7. Promoting Multi-Stakeholder Collaboration
   Collaboration between government, mining companies, academia, and NGOs should be enhanced to support innovation, community assistance, and data improvement for evidence-based policy formulation.

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