

Gold Mining in Peru: Between development, conflict and deforestation - Amazon rainforest series by Essex Equity Fund students' group of Essex University – N° 2

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- Peru has established itself on the international scene as a major gold extractor, to the cost of close to 140 hectares of the Amazon Rainforest lost to deforestation and the pollution of hundreds of water bodies with heavy metals.
- Developments projects are tools for improving citizens lives and public services, but they come at a great cost.
- There is some debate as to the qualification of Peru's gold mining as a development project and therefore its potential benefit in the long run but still brings major consequences to local communities.

This paper is part of a special series of letters by Réseau EDEN.i. This aims to shed light on works by Essex Equity Fund student's group of Essex University.

"The Essex Equity Fund is a student led initiative that aims to hone student's professional skills and prepare them for the workplace. Our newest department, Legal, Ethics and Sustainable Investment (LESI), looks to familiarise our members with research papers and critical analysis around lenses of law, sustainability and economics. It is with great pride that we associate, this term, with the French initiative EDEN.i through a series of paper around the Amazon rainforest and the different types of anthropic pressures it faces".



KEYWORDS:

Gold Mining # Heavy Metals # Development # Amazon Rainforest

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I. Introduction

This paper is part of a series of papers published in partnership with Réseau EDEN.i. In it, our members examine different anthropic influences in the Amazon rainforest and both legal and economic angles of analysis that can be drawn from them.

This specific edition looks at Peru's gold mining in the region of Madre de Dios. This will be the occasion for us to discuss development projects and controversial ways of enhancing citizens' general quality of life.

I.A) Context

The Amazon's soil is known for being rich in precious metals such as gold, which has driven less developed countries, such as Peru, to mine them whether legally or illegally.

To this day, most of the mining activity is concentrated in the region of Madre de Dios (97.5% of the total activity on national soil, according to the MAAP Program, 2025) in southern Peru. Mining has cleared a total of approximately 139,2 hectares and is estimated to have impacted around 225 water bodies.

Beyond the pure climatic concern, these activities have created civil conflicts. Indeed, most illegal mining practices are operated by armed groups and the poisoning of water leads to violent disagreements between communities.

As the price of gold increases, mining is encouraged and it brings question to an indirect way of enriching a country. Development projects more generally are potentially interesting to explore when they mean actively destroying communities' environment and way of life, while increasing their chances of a better life (through states' finance, we could increase access to healthcare, education...).

This duality raises the question of a fragile balance between economic and sociological issues against environmental concerns.

1.B) The questions that are to be explored

Discussions about Peru's gold sector typically start with indicators such as export revenue, foreign investment, and job creation, using a country development approach. However, in Madre de Dios and the Amazon, gold mining functions less like a regular economic sector and more like a force that changes territory, labour, ecosystems, and state power. Considering these elements allow us to deduce that national output data alone cannot determine whether mining constitutes development. If development boils down to generating financial profit, any profitable activity would be promoted without integrating social and environmental impacts. Sustainable development, though, needs strong institutions, protection of rights, long-term stability, and the enhancement of human abilities without undermining ecological foundations for short-term profit.

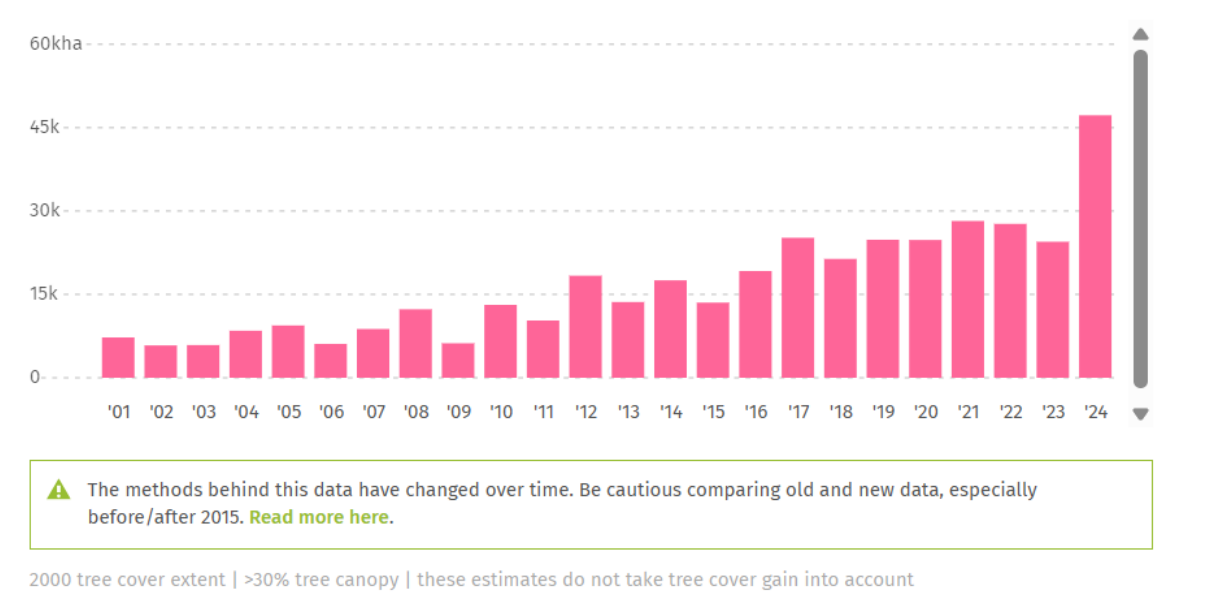
This leads to an delicate but necessary question: if a sector expands rapidly yet leaves landscapes degraded, institutions weakened, and communities exposed to risk, should it still be described as development at all? The continued use of the word "development" in this context suggests that it may sometimes operate less as a neutral analytical concept and more as a political justification for resource extraction.

In the Peruvian Amazon, the growth of gold mining, particularly illegal and informal operations, challenges what we consider development. The expansion of mining has caused rapid deforestation,

mercury pollution, violent territorial disputes, and ongoing conflicts among Indigenous communities, local authorities, and the central government. These issues are not one-time events; they are part of a recurring pattern.

Satellite monitoring information is helpful in understanding the extent of these environmental transformations. For instance, between 2001 and 2024, approximately 400,000 hectares of tree cover were lost in Madre de Dios, representing 5% of its total forest cover. This forest loss is estimated to have led to 280 million tonnes of CO2 equivalent emissions, thus underscoring the impact of these mining activities on the environment.

FIGURE 1: Tree cover loss between 2001 and 2024 in Madre de Dios, Peru



SOURCE: *Global Forrest Watch*

Figure 1 demonstrates the long-term pattern of forest loss in Madre de Dios. Over the past thirty years (1984), gold mining in Madre de Dios has been at the origin of the deforestation of 135,939 hectares (see MAAP Program’s 2025 report) of the Amazon rainforest. It is one of several causes of the total loss of tree over represented above. However, the extraction of resources is perhaps the most illustrative form of deforestation that can almost be linked directly to a country’s economic development (as opposed to ‘simple’ agriculture which takes time to develop to a profitable activity). To put gold mining’s obvious perks next to the long-term consequences on the local biodiversity begs the question of its actual pertinence.

The issue is not, of course, whether Peru should mine for gold at all, but rather whether what is occurring on there can accurately be said to constitute a process of development.

Another issue that is rarely addressed directly is whether the Amazon is effectively being treated as a peripheral sacrifice zone within Peru’s national economy. Economic benefits from gold extraction circulate through national and international markets, yet the environmental damage remains geographically concentrated in the region where extraction occurs. In this sense, the Amazon risks becoming less a participant in development and more a territory that absorbs its costs.

We will therefore look at the general question of balance between development and its potential undesirable consequences, to then move on to a more precise study of Peru’s case.

II. A general problem: the hard conciliation between development projects in the amazon and local rights

This section looks to explore both the need for a country to develop and the problematic consequences that follow.

II.A) The undeniable need for development project

Economic development remains a key priority for countries such as Peru, where significant inequalities persist within essential services such as healthcare, education, and infrastructure (*around 20% of Peru's population lives in poverty – World Bank*). Development is generally understood as a process that improves the overall quality of life for citizens, and economic growth is often seen as a necessary part to achieve this goal.

In theory, an increase in a country's GDP provides governments with greater financial resources, allowing them to invest in public services and infrastructure. This can lead to improved living standards, reduced poverty, and greater social stability (*countries with sustained GDP growth have reduced poverty rates significantly – World Bank data*). For resource-rich countries, industries such as mining offer a relatively quick way to generate this economic growth as they can produce substantial export revenues with comparatively limited initial investment.

In the case of Peru, development is particularly important in addressing regional inequalities. Rural and Amazonian areas which have historically been less developed than urban centres, with limited access to basic services (*rural poverty rates are nearly double urban rates – World Bank*). Mining projects are often presented as a way to bring economic activity, infrastructure, and employment to these regions. However, this model assumes that the benefits of growth are effectively distributed, which is not always the case. As a result, while development is clearly necessary the methods used to achieve it play a crucial role in determining its success.

II.B) The difficult consequences

Despite its potential economic benefits, gold mining in the Amazon is associated with significant environmental and social costs. One of the most visible impacts is deforestation as large areas of rainforest are cleared to access gold deposits (*over 100,000 hectares of forest have been lost in Madre de Dios due to mining – WWF*). This leads to the destruction of ecosystems, loss of biodiversity, and contributes to global climate change. Unlike other forms of land use, mining often leaves long-lasting damage making it difficult for forests to regenerate.

Another major concern is mercury pollution, which is commonly used in the gold extraction process (*artisanal gold mining is the largest source of mercury emissions globally – UNEP*). Mercury contaminates rivers and enters the food chain which poses a serious health risks to local communities. Prolonged exposure can result in severe neurological damage particularly among populations that rely on fish as a primary food source (*high mercury levels have been found in up to 78% of local populations in mining regions – WHO*). This creates long term public health challenges that extend beyond the immediate economic benefits of mining.

The social consequences are equally significant. Mining activities, particularly illegal operations, are often linked to the displacement of indigenous communities and the erosion of traditional land rights (*thousands of indigenous people have been affected by mining expansion – Amnesty International*). In addition, workers in informal mining sectors frequently face dangerous working conditions, lack of legal protection, and exploitation (*informal miners often work without safety standards – ILO*). These issues are compounded by weak governance in remote regions where regulation is difficult to enforce.

Overall, these impacts highlight a fundamental contradiction that while development projects aim to improve living standards, they can simultaneously create environmental degradation and social harm that undermine long-term wellbeing. However, countries keep aiming to develop and, from a euro-centrist standpoint, it is hard to argue that it is a completely senseless aspiration. Our question now is whether or not the negative consequences we can witness today are somewhat balanced out by the objective.

II.C) Conciliation of immediate suffering for potential long-term improvement

One of the arguments in development economics is that natural resource exploitation is a stage of economic growth that must be gone through (as developed by Malone et al., 2023). The state needs resources to fund healthcare and education systems and integrate remote areas into national markets. Diversification of the economy also requires capital accumulation. Therefore, gold mining is not only justified but also necessary. Roads are constructed to connect scattered populations. Rivers become channels of transport. Investment is a symbol of modernisation. In this context, ecological degradation like deforestation is seen as a sacrifice on the road to modernisation.

However, this argument assumes a limited view of development as primarily economic output. Gross Domestic Product (a tool used to evaluate a country's economic status) measures the value of the export of gold; it does not account for the loss of ecosystem services, the loss of soil fertility, the destabilization of hydrological systems, and the cost of poor law enforcement. The Amazonian ought to be recognised as the ecological system that regulate the climate, store carbon, and support biodiversity. The replacement of forests with mines and pits does not simply provide neutral terrain for future opportunity; it changes the ecosystem and its capacity to support future livelihoods.

Indeed, GDP offers an immediate evaluation of a country's economy, and the lens is not large enough to incorporate wider concerns. The real question is therefore not whether mining generates revenue, but whether that revenue supports long-term prosperity. If a sector produces immediate financial returns while eroding the ecological systems that sustain agriculture, fisheries, and climate stability, its contribution to development becomes far less certain.

Development also implies predictability and security. Communities must be able to rely on rivers for fishing, on soil for cultivation, and on public authorities for protection. Mercury-based extraction techniques, commonly used in artisanal and small-scale gold mining because they are inexpensive and effective, introduce persistent toxic elements into waterways and sediments (Malone et al., 2023). Even when contamination does not immediately reach catastrophic levels, the mere uncertainty surrounding exposure changes behaviour. Fishing becomes a calculated risk. Agriculture becomes an experiment in degraded soils. Development, properly understood, should reduce risk for citizens, not multiply it.

Economically, mercury use represents a classic example of a negative externality. Miners capture the value of gold, while the environmental and health consequences are displaced onto communities and ecosystems that receive none of the financial benefits (Kumi et al., 2023) What appears efficient at the level of individual profit becomes profoundly inefficient at the level of society.

This brings us to the distributive aspect of development. We need to ask who benefits and who pays the costs. Profits from resource frontiers are often highly concentrated, whereas costs are dispersed over large populations. Thus, whereas the gold extracted in remote Amazonian districts flows into global markets and financial circuits, the costs of environmental degradation remain. Informal and illegal activities often evade formal taxation and regulatory systems, and thus a large fraction of economic benefits is not returned to public coffers. Under these circumstances, the promise of development is uneven, costs are socialised, and benefits are privatised.

This creates a paradox: mining can increase national export revenue while leaving local economies fragile and environmentally damaged. The wealth generated by the resource is real, but it does not necessarily remain where the resource is taken.

To conclude, development is heavily dependent on institutional capacity and governance. Environmental laws are in place, protecting forests, mandating environmental impact assessments, and ensuring Indigenous peoples are consulted. However, the real test of development is whether these laws are consistently applied, even when inconvenient. When enforcement is episodic, characterized by dramatic crackdowns followed by gradual re-entries, the message sent to economic agents is unmistakable: extraction is risky but doable; regulation is temporary. Over time, this undermines the rule of law and promotes opportunistic economic behaviour. A government that governs intermittently undermines the very institutional foundation on which development depends.

III. In Peru's case

Peru maintains a key position within the global economy as one of the world's leading producers of mineral resources, particularly gold (*Peru is among the top 10 gold producers globally, producing around 100–120 tonnes annually – World Gold Council*). Over recent decades the country has increasingly relied on extractive industries such as mining to drive economic growth and boost export revenue (*mining accounts for roughly 60% of Peru's total exports – World Bank*). Gold as well as other minerals such as copper and silver represents a significant share of Peru's exports making it a key source of foreign income.

The reliance on natural resources places Peru within the global commodity markets, where economic performance is closely intertwined with international demand and price fluctuations. During periods of high global uncertainty, gold remains a highly valuable asset (*gold prices increased by over 25% during global uncertainty periods such as 2020 – World Gold Council*), which benefits producing nations such as Peru. However, it can also create vulnerability. Indeed, any decline in global prices can directly impact national income and government revenue which in turn can have wider repercussions upon the country in areas such as public services.

In addition, Peru's economic model reflects a broader pattern seen in developing countries where growth is largely based on the export of raw materials rather than the production of higher value goods such as jewellery (*over 80% of Peru's mineral exports are unprocessed raw materials – UNCTAD*). While this strategy can generate immediate financial returns, it often limits long-term economic diversification and increases dependence on external markets to maintain economic stability. As a result, Peru's role in the global economy helps to explain why industries such as gold mining are so central to its development strategy.

III.A) Can we qualify gold mining as a development project?

Any attempt at thorough evaluation has to make a distinction between formalised mining and the informal or illegal mining, which is characteristic of some areas in the Amazon. Formalised mining, in theory, can be compatible with developmental goals in the sense that, in some cases, it can produce public revenue, operate under environmental regulation and create employment within a regulated labour framework. The problem, in Amazonian gold mining, is that much of the production operates outside formal regulation (Easton-Calabria et al., 2026). The question, therefore, is what happens when informal mining is the dominant form in a region, and can we speak of development in such a context? Development is associated with regulation, and illegality is associated with the absence or failure of regulation.

At a deeper level, the persistence of illegal mining is not simply a moral failing; it is also a function of incentive structures. The high global gold prices, relatively low technological barriers, limited territorial control in remote areas, and availability of mercury amalgamation techniques all serve as a rational economic calculus. The extraction of resources is economically attractive precisely because the costs of damage are not fully internalized and because enforcement is uncertain.

Similarly, infrastructural projects that improve access, whether for legitimate development goals or not, lower logistical costs for legal and illegal actors alike. In such a context, illegality is not simply something outside of or beyond the development model; it is a predictable extension of it.

The growth of illegal mining activity, therefore, may tell us less about individual wrongdoing than it does about the economic logic of the system itself. When high returns are matched with low enforcement, opportunistic extraction seems like rational behaviour.

Thus, gold operates not only as a commodity but as a narrative. It offers governments a visible and measurable sign of economic dynamism without requiring slower, more complex reforms such as land titling, anti-corruption restructuring, or diversification into less environmentally intensive sectors. Extraction is immediate. Institutional reform is incremental. The temptation to equate the former with the latter is powerful. Yet development built primarily on rapid extraction without parallel institutional strengthening risks becoming extractive growth rather than structural transformation.

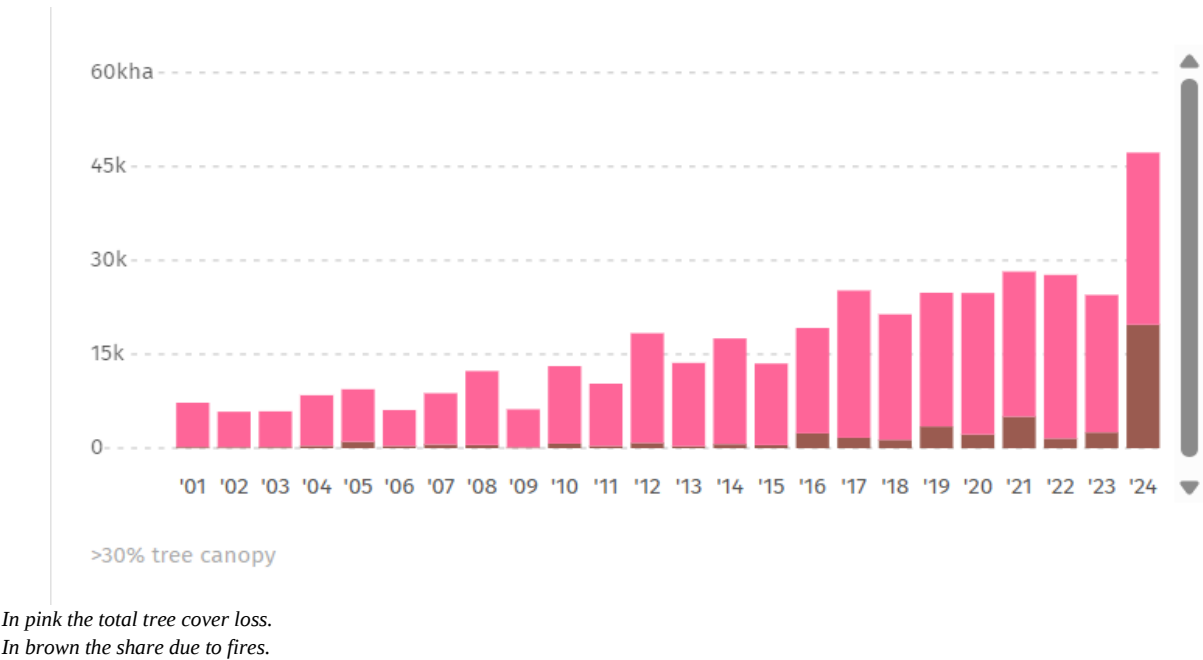
Part of mining's political appeal lies in the speed with which it produces visible economic results. Gold exports can rise within months, while improvements in education systems, infrastructure quality, or governance capacity may take decades. Yet the speed with which extraction produces visible economic indicators should not be confused with the slower, more demanding process of building durable prosperity.

III.B) The immediate consequences: truly inevitable?

The environmental consequences of mining in the Amazon are not random. Clearings along rivers, sediment plumes, excavated pits, and degraded soils all follow the logic of cost minimisation. Miners concentrate operations near waterways and transport routes because these locations reduce operational costs.

What is striking about these landscapes is not only their scale but their permanence. Once forests are replaced by mining pits and contaminated sediments, restoration becomes technically difficult and economically unattractive. The landscape is not merely used; it is fundamentally transformed.

FIGURE 2: Share of tree cover loss due to fires between 2001 and 2024 in Madre de Dios, Peru



SOURCE: Global Forrester Watch

Figure 2 shows the contribution of fires to tree cover loss in Madre de Dios over time. Between 2001 and 2024, approximately 47,000 hectares of forest were lost due to fires, compared with roughly 350,000 hectares from other drivers of forest loss. Although fires represent a smaller share of total loss, they often occur in already disturbed landscapes, accelerating environmental degradation and making ecological recovery more difficult. This dynamic illustrates how initial deforestation can trigger secondary ecological damage, increasing the long-term environmental costs associated with extractive activities.

Deforestation under such conditions is not seen as inevitable, but rather as being structurally incentivised. When there is limited capacity to enforce and high commodity prices, the rational strategy is to extract as quickly as possible before pressure increases. The problem is not seen as the lack of environmental regulations, but rather the state’s ability to consistently enforce them (UNEP).¹

Mercury contamination introduces a subtler but equally consequential dimension. The chemical properties that make mercury attractive for amalgamation, its ability to bind easily with gold particles, also make it environmentally persistent. Once released, mercury can enter aquatic systems, transform into more toxic forms, and bioaccumulate. The resulting contamination is not always immediately catastrophic; it is often chronic and diffuse. Yet chronic exposure undermines the long-term health of ecosystems and potentially of human populations (Moreno-Brush et al., 2018).

In this sense, mercury pollution functions as a form of environmental debt. The economic benefits of extraction are realised immediately, while the ecological and health costs accumulate gradually and may persist long after the mining boom has ended.

The same applies to the social consequences that unfold in these territories. High- value commodities in territories with low governance attract people who want to make quick profits, and this includes criminal

¹ UNEP : ‘Dramatic growth in laws to protect environment, but widespread failure to enforce, finds report’, 24 january 2019.

groups. Informal settlements grow rapidly, and there are few labour protections in place, as well as increased conflicts in territory use. It does not necessarily mean that mining communities are violent communities, but rather that when profitability and low governance intersect, informal governance can occur, and violence can become a tool for resolving conflicts and controlling markets. Certainty is necessary in development, and uncertainty can breed parallel governance structures.

When this occurs, the mining frontier begins to resemble a parallel political economy where informal power structures compete with or replace state authority. At that point, mining ceases to be merely an environmental issue and becomes a question of governance and territorial control.

Indigenous and rural communities face vulnerabilities (Amido, 2017). Land rights may be formally recognised yet practically undermined by insufficient enforcement. Consultation processes may exist legally yet be bypassed or inadequately implemented. The result is not only environmental intrusion but institutional delegitimization. When rights exist on paper but not in practice, trust erodes. Development cannot be sustained where legitimacy is fragile.

The most pernicious effect, perhaps, is that of learning by institutions. Economic actors respond to observed incentives. If there is a cycle in enforcement and sanctions are not uniform, the optimal strategy is to extract in the short term and not reinvest much. This process, over time, creates perceptions about what to expect. The state is seen as episodic, intervening in a big way but only fleetingly.

Over time, this dynamic reshapes the relationship between economic actors and the state itself. Instead of viewing regulation as a stable framework, actors begin to treat it as an obstacle to be navigated. When that perception takes hold, rebuilding institutional authority becomes far more difficult.

III.B.1) Are These Consequences Inevitable?

The harms associated with gold mining in the Amazon are not structurally unavoidable. They are contingent upon incentives. Three structural drivers repeatedly converge: improved access infrastructure, limited enforcement capacity in remote territories, and a global market that absorbs gold without fully pricing environmental and social costs (Elera-Gonzales et al., 2025; Morillo Cano, 2025). When these factors align, environmental degradation and informal expansion become highly probable. Change the incentives, and outcomes can shift.

Yet acknowledging that these outcomes are driven by incentives forces a deeper and more uncomfortable question: why have those incentives remained largely unchanged for decades? If the drivers of environmental destruction are widely understood, their persistence suggests not only institutional weakness but also a certain degree of political tolerance. In practice, the continuation of these incentive structures may reflect the fact that the benefits of extraction are immediate and visible, while the costs are slower, geographically distant, and politically easier to ignore.

There is also a broader global contradiction embedded in this system. Gold extracted from degraded Amazonian landscapes ultimately enters international markets where it is transformed into financial assets, luxury goods, and central bank reserves. At that stage, the environmental conditions under which the gold was produced become almost invisible. In this sense, the Amazonian mining frontier is not simply a local governance problem; it is part of a global economic chain that rarely accounts for the ecological origins of the resources it consumes.

However, altering incentives requires more than isolated interventions. It demands durable territorial governance, predictable enforcement, technological transition away from mercury, and fiscal mechanisms that ensure extraction revenues genuinely circulate back into public goods. Without structural reform, mitigation remains fragile.

Crackdowns may temporarily reduce visible activity, but unless the underlying calculus changes, extraction will re-emerge where conditions allow.

This raises a final dilemma for policymakers. Governments often rely on enforcement operations to demonstrate control over illegal mining, yet enforcement alone cannot solve a problem that is fundamentally economic. If mining remains one of the most profitable activities available in remote regions with limited alternatives, the incentive to return will remain strong. In that sense, repression without structural reform risks becoming a cyclical performance rather than a lasting solution.

Ultimately, the question is not simply whether illegal mining can be controlled, but whether the broader development model surrounding Amazonian extraction can reconcile economic ambition with ecological limits. If the incentives driving deforestation and contamination remain embedded in the system, the expectation that enforcement alone will solve the problem may itself be unrealistic.

III.B.2) Realistic Mitigation Strategies

Effective mitigation must be grounded in institutional realism. Continuous satellite monitoring of forest loss provides valuable early warning, but monitoring without rapid prosecutorial follow-through becomes symbolic. Enforcement chains must connect detection to credible legal consequences. Land tenure clarification, particularly for Indigenous communities, strengthens territorial defence and reduces vulnerability to invasion. Infrastructure planning must incorporate environmental risk assessment not as a procedural formality but as a binding constraint. Mercury substitution programmes must address cost barriers and provide viable technological alternatives rather than simply prohibiting use without support.

Restoration initiatives can rehabilitate degraded landscapes, yet restoration without secure territorial control risks becoming cyclical, forests replanted only to be cleared again when gold prices rise. Long-term success requires stability of governance at least as much as ecological expertise.

Conclusion

In conclusion, we have explored the harsh consequences of illegal mining in Peru. This study allowed us to consider both the economic framework which allows for such activities to take place as well as the environmental stakes at play. After reviewing these, we concluded our research with some possible mitigation strategies and determined that heavier governance over the landscape's maintenance is essential for future conservation.

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