ARTISANAL GOLD COUNCIL

Research Paper

THE ECONOMICS OF ARTISANAL AND SMALL-SCALE GOLD MINING (ASGM) IN GUYANA

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The Economics of Artisanal and Small-scale Gold Mining (ASGM) in Guyana

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ABOUT THE ARTISANAL GOLD COUNCIL

The Artisanal Gold Council (AGC) is a Canada-based non-profit organization dedicated to improving the livelihoods, health, and environment of people working in the artisanal and small-scale gold mining (ASGM) sector. AGC has worked in over 35 countries, partnering directly with mining communities and local experts to develop integrated, practical, and sustainable solutions that address the unique challenges of ASGM.

Since its founding in 2008, AGC has led global efforts to promote a formalized, environmentally responsible, and socially inclusive ASGM sector. Through partnerships with local and national governments, academic institutions, civil society, media, and international development agencies, AGC advances mercury-free technologies, policy development, and responsible supply chains that benefit both people and the planet.

For more information, visit: www.artisanalgold.org

AGC demonstrates the helicoidal gold recovery method to miners during a capacity development training in Guyana. Photo by AGC.

Introductory Overview

By Rene Roger Tissot, Executive Director, Artisanal Gold Council

In a recent article, Dr. Doi Ra[1] described artisanal and small-scale gold mining (ASGM) as an almost idyllic rural practice: "For me, artisanal mining always brings me back to traditional livelihoods. In my context, a mostly agriculture-based economy, mining is always a supplement. In artisanal mining, people go to the river in their leisure time, panning for gold. Children also participate. It is like a family affair. The term 'artisanal mining' recalls this happy lifestyle." However, as Ms. Giselle Vela Benites pointed out in the same interview, this description is no longer valid—if it ever was: "I would say that the type of artisanal mining that belongs to this idyllic landscape no longer exists. Not because the artisanal methods are not in place, but because the environment has been dramatically changed by mining itself." I agree with Ms. Vela Benites.

The World Gold Council (WGC) [2] has documented fundamental structural changes in ASGM over the past three decades. In the 1990s, ASGM accounted for less than 4% of the global gold supply, with gold prices around US$250 per ounce. Today, with gold prices exceeding US$4,000 per ounce, ASGM is estimated to contribute 20% of the global gold supply, representing a US$55-65 billion industry. Although estimates vary, ASGM is believed to employ approximately 20 million people directly and potentially up to 100 million indirectly. These figures, notwithstanding their uncertainty, underscore the sector's significant transformation.

I argue that three primary forces have driven this transformation, moving ASGM away from the traditional practices described by Dr. Ra: climate change, demographic shifts in low-income countries (particularly in the Sahel), and the escalating price of gold.

The Sahel region, covering parts of Mauritania, Mali, Niger, Chad, Sudan, Eritrea, and Nigeria, faces increasingly unpredictable rainy seasons and severe droughts due to climate change, as highlighted in a recent publication by GlobalHealth[3]. These conditions undermine traditional farming and livestock raising, pushing more farmers towards ASGM as a primary income source, thereby exacerbating social and environmental tensions. This trend is mirrored in other parts of the Global South, where farming is becoming unsustainable.

Africa's demographic transition, characterized by a surge in the working-age population coupled with declining fertility rates, presents both opportunities and challenges. A 2015 World Bank[4] study questioned whether this transition would result in a dividend or a disaster, emphasizing the need for improved institutions—an unmet need. With limited employment prospects and restricted migration options, many young Africans are drawn to ASGM, fueled by the allure of high gold prices and the perceived ease of wealth acquisition.

Since the 1990s, gold prices have grown at an annual rate of 46%[5], making gold mining an increasingly attractive option for those lacking reliable employment or migration opportunities. However, these "new miners" often differ significantly from the traditional,

[1] https://www.tni.org/en/article/artisanal-and-informal-mining
[2] The Role of Gold Processing Plants in Artisanal and Small-Scale Mining World Gold Council May 2025 https://www.gold.org/esg/artisanal-and-small-scale-gold-mining.
[3] Climate Change, Conflict, and Resource Extraction: Analyses of Nigerian Artisanal Mining Communities and Ominous Global Trends. GlobalHealth March 2022. https://pmc.ncbi.nlm.nih.gov/articles/PMC8916050/
[4] Africa's Demographic Transition Dividend or Disaster? World Bank and AFD. 2015. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/131891468179371220/africa-s-demographic-transition-dividend-or-disaster
[5] CAGR

part-time farmer-miners of the past. They are frequently migrants with limited ties to the land or local communities, prioritizing short-term gains over long-term sustainability.

Given these new realities, the development community, international organizations, donor countries, and non-profits like the Artisanal Gold Council must reassess their approach to ASGM. Initial efforts focused on formalization and cleaner technologies, viewing ASGM as a potential avenue for small-scale entrepreneurship; however, these efforts have proven complex.

Current trends in ASGM emphasize market-driven solutions centered on privately-owned processing facilities acting as aggregators. These models offer attractive solutions for "market-ready" ASGM operations with mineral titles, environmental permits, and organizational structures that attract risk-averse private investors. However, the vast majority of ASGM operations—perhaps 90%—lack these prerequisites. By concentrating solely on the "market-ready" segment, the donor community risks disproportionately benefiting those best positioned to attract private investment. The Artisanal Gold Council is particularly interested in supporting this underserved 90%, not necessarily to transform them into gold mining operations, but to foster environmentally sustainable communities.

The environmental risks associated with ASGM are well-documented, and numerous initiatives aim to eliminate mercury use. The Artisanal Gold Council supports the development of mercury-free processing technologies[6]. However, a purely technical approach to what is fundamentally an institutional problem may not be the most effective strategy. Understanding the underlying economic drivers of ASGM is crucial for developing viable economic institutions that can offer sustainable environmental solutions while providing dignified livelihoods for artisanal miners.

These underserved communities should be viewed as ecosystems, with success measured not by private investment metrics, but by the social and environmental benefits of thriving rural communities. Supporting these communities through secure land management plans, mineral rights, access to finance, clean processing technologies, and adherence to standards like the CRAFT Code can transform negative social and environmental externalities into positive ones.

In this context, the Artisanal Gold Council is proud to share research by Professor Thomas Singh from the University of Guyana, developed in close coordination with the Artisanal Gold Council Guyana team and funded by the U.S. State Department. Professor Singh's research addresses a critical issue: the real prices of gold for artisanal miners. His research highlights that miners often receive only 60-85% of the global market price due to exploitation through purity assessments and information asymmetry. The paper further suggests that approximately 70% of the ASGM sector's dredges are operated by landless tributors who bear exploration risks without tenure security.

The paper presents a series of practical yet innovative policy initiatives that we, as an organization, are pleased to share with development agencies, government regulators, policymakers, and the gold supply chain industry. This effort is a modest contribution towards the betterment of the artisanal gold mining community.

[6] Strategic partnership with manufacturing OroSinu of Colombia.
https://www.artisanalgold.org/blog/new-partnership-for-the-growth-of-artisanal-and-small-scale-mining

Executive Summary

The Hidden Crisis in Guyana's Gold Mining

Guyana's artisanal and small-scale gold mining (ASGM) sector employs between 17,000 and 35,000 people and generates US$234-548 million annually in revenue. Yet beneath these impressive figures lies a troubling reality: the sector operates under profound institutional distortions that systematically extract value from those who need it most—the miners themselves.

This study reframes the economics of ASGM through the lens of **net price discovery**—examining not just the gross revenues or aggregate output, but the actual value miners receive after deducting production costs, environmental damage, and rent transfers to more powerful actors. The findings reveal a sector in crisis, where the net price received by miners is often depressed by up to 40% below what economic theory might predict.

Key Findings

- **Price-Taking Without Power**: All ASGM gold is sold at the global market price, yet miners often receive only 60-85% of this value due to systematic exploitation through opaque purity assessments, information asymmetries, and rent extraction by traders and intermediaries.

- **The Landless Majority:** Approximately 70% of the sector's 2,200+ dredges are operated by landless tributors who shoulder exploration risks without tenure security. They are frequently evicted after making viable discoveries, transferring wealth to absentee claim-holders in what amounts to institutionalized appropriation.

- **Overinvestment and Resource Depletion**: Open-access conditions have created classic "tragedy of the commons" dynamics. Excessive competition drives extraction costs up and net returns down, pushing the sector toward zero-profit equilibria while accelerating environmental degradation.

- **Information Asymmetries:** In Amerindian and hinterland communities, miners routinely receive 5-15% below market value due to manipulated purity assessments by traders who control testing technology and market information.
- Strategic Subordination: ASGM operators function as a constrained competitive fringe relative to large miners, who extract rents through equipment rentals, gold trading, and upstream service provision while small operators bear the production risks.

- **Intertemporal Inefficiency:** Current extraction rates exceed optimal paths by an estimated 25-40% due to insecure tenure, short planning horizons, and the absence of mechanisms to save gold rents for future generations.

The Amerindian Village Paradox

The analysis reveals that Amerindian Villages—some of which act as "common pool institutions"—offer natural experiments in alternative governance. Under certain conditions, these communities can avoid the tragedy of the commons and achieve sustainable equilibria. However, poverty and external pressure often force Village Councils to accept mining agreements that undermine long-term sustainability.

Policy Implications

The study's central insight is that **structural distortions in net price discovery**—especially those linked to information asymmetry and open access—are at the heart of the ASGM sector's fragility. Without addressing these fundamental issues, the sector will continue to generate impressive gross statistics while trapping thousands of miners and their families in vulnerable livelihoods.

The paper concludes with five concrete recommendations: community-owned purity grading units, controlled access to prevent resource depletion, equity-based contracts for tributors, value chain diversification including domestic refining, and shared environmental responsibility through reformed bonding mechanisms.

Why This Matters

This is not merely an academic exercise. The ASGM sector serves as a critical source of employment for thousands of families, often in the most remote and vulnerable communities in Guyana. Understanding the true economics of the sector—the complex interplay of uncertainty, risk, information asymmetries, and institutional failures—is essential for designing policies that can transform ASGM from a poverty trap into a genuine pathway for sustainable development.

The window for such transformation may be narrowing. As more accessible deposits are depleted and environmental costs escalate, the sector risks locking itself into an unsustainable boom-bust cycle that will leave communities worse off than before. This analysis provides the analytical foundation for a different path—one that respects ecological limits, embeds local governance, and captures the full value of Guyana's subterranean wealth for those who extract it.

A miner pans for gold in Mahdia, Guyana, using traditional artisanal techniques. Photo by AGC.

1. Introduction

This paper reconsiders the economics of the ASGM sector by returning to first principles—focusing not on production, but on the **(expected) net price realised**[7] in the ASGM sector. This expected net price is the key determinant of livelihoods of artisanal and small-scale miners. How does the expected net price - defined as the global gold price less the marginal private and social costs of extraction *duly adjusted for the sector's extensive uncertainties, pervasive appropriation and intertemporal externalities, and extreme informational asymmetries* – evolve given the complexity of outputs, outcomes and institutions?

The study's central finding is that structural distortions in net price expected by ASGM operators lie at the heart of the ASGM sector's fragility. While the sector contributes significantly to employment, rural livelihoods, and national revenue, it operates within a structure that distorts both value and incentives. Current estimates suggest the sector employs 17,000-35,000 people directly and generates US$234-548 million annually in revenue. Yet these aggregate figures mask a more troubling reality: the actual net returns received by miners—particularly landless tributors who comprise 70% of operators—are systematically depressed through multiple channels of value extraction, made worse by the oil-driven cost inflation.

Screenshots from planetGOLD's video "Bringing #MercuryFree Methods to the Amerindian Village of Karrau in Guyana."

By shifting the focus from net price to expected net price, the various economic models that have been developed for, or can be applied to, the natural resources sector could be used to better understand the economics of the ASGM sector. Calculating expected values involves multiplying the net price that would be received by ASGM operators in a perfect world by the likelihood or probability that this is what they will actually receive given the sector's 'imperfections.' Sections 2 and 3 of this paper attempt to flesh out the sector's main imperfections due to fundamental geological uncertainties, other risks and uncertainties due to the informality[8] and complexity of the sector, as well as the informational asymmetries and

[7] The **expected net price realised** is calculated by miners as they weigh these compounded uncertainties. Formally, this can be represented as: ENPRt=i=1NpiPt1-i-Ci-λDi, where (per ounce at time *t*) Pt**:** world gold price (treated as known at *t*); ***δ***, ***C***, ***D*****:** random proportional deductions; marginal extraction costs; external damages that may affect livelihoods; ***λ*** ∈ **[0,1]:** incidence parameter giving the share of ***D*** borne by miners/households; pi**:** probability of outcome *i* (ipi= 1); and i**,** Ci**,** Di**:** realizations under outcome *i*.

[8] While the ASGM sector in Guyana might appear to be significantly more formalized than might be the case in other parts of the world, simply having more regulations and more paperwork to operate in the sector does not translate into more formal agreements among economic agents within the sector. The absence of formal agreements, or even norms that support some

the negative externalities that make it more likely that costs will exceed the full economic cost of extracting the resource. The expected net price for ASGM operators is also the fundamental determinant of the livelihoods of producers and therefore mining communities, making those livelihoods essentially dependent on the economics of the sector, adding further importance to the analysis presented in this paper.

More specifically, at an economic governance level, the economics of ASGM is best presented as an ideal case of an Amerindian Village closed to third-party miners. This model is then progressively relaxed to capture the realities of mining in Guyana such as common pool resources and open access features of different institutional arrangements. Amerindian Villages provide natural experiments in governance that partially resist the tragedy of the commons and, under certain conditions, sustain stag-hunt equilibria. Two analytical models are also considered: First, the strategic positioning of ASGM operators as a "competitive fringe" relative to larger firms, examined through the cartel–fringe model; and second, intertemporal efficiency addressed via the Hotelling framework, showing how current extraction paths deviate from optimal trajectories due to high discounting and tenure insecurity.

Early global accounts (Hentschel, et al., 2003) documented informality and environmental impacts but did not attempt any formal economic modelling with the result that the incentives, risks, effects of policy and the dynamics of the sector could only be described and major analytical gaps remain. The contributions made by this paper to the literature and to our understanding of the sector are as follows. Similarly, while valuation frameworks (Gasparinnetti, et al., 2024) sought to monetize externalities, it did so outside of any attempt to model the sector. Designing and effective meaningful change require more than a description of the status quo, however.

Left to right: A backhoe excavates soil and feeds it into a sluice box for gold recovery in Guyana. A crushing machine processes gold ore to extract valuable minerals. Photos by AGC

In Guyana, (Hilson & Liang, 2017) took an aggregate look at the gold industry, characterising it as a "unique resource curse," while (Bulkan & Palmer, 2016) described landlordism and patronage, and (Hook, 2019) detailed how landless tributors – about 70% of operators—face systematic exclusion. (Janki, 2007) and (Griffiths & Anselmo, 2010) analyzed Amerindian rights under the Amerindian Act, while (Liang & Moonsammy, 2021) quantified ASGM's costs (mercury, deforestation, malaria). Regional perspectives such as (Baena & Mart, 2021) underscore environmental and livelihood vulnerabilities in Colombian ASGM, and (Saldarriaga-Isaza, et al., 2013) framed mercury use as a public goods dilemma, but neither

informal agreements over others, making them emerge as best practices in the sector, introduces great uncertainty into what an operator might expect regarding costs and benefits.

engaged appropriation externalities or rent extraction. But while these studies were important, they do not address the analytical gaps.

To do so, we turned to various strands of the resource economics literature. (Ostrom, et al., 1994) and (Ostrom, 2010) established CPR theory, which challenged the view that government intervention was always required to address market failures, which, in the case of a CPR had been expected to end in a 'tragedy of the commons' which was fundamentally misconstrued by (Hardin, 1968) as being open access. while (Dasgupta, 2005) clarified how the fundamental appropriation externalities noted by Ostrom could be integrated into an economic model of renewable resources that discussed the profitability of extractive activities under different governance frameworks and social institutions. The classic (Hotelling, 1931) model defined the efficient intertemporal path for non-renewable resources, but has rarely been applied to decentralized artisanal mining. Industrial-organization models of resource cartel–fringe markets explain rent extraction, but rarely address non-price channels—equipment rentals, purity manipulation, and claim monopolies—that dominate in Guyana.

This paper also attempts to address a fairly neglected issue in the literature on the ASGM sector, i.e., the behaviour of the various stakeholders and economic agents. Behavioral approaches provide further insight: Fudenberg & Maskin's (1986) Folk Theorem and Skyrms' (2001) stag-hunt analysis show how repeated interaction and coordination can sustain cooperation, though these insights remain underused in ASGM studies.

This paper therefore advances the literature by (i) centering analysis on *expected net price* as the sufficient statistic for miner livelihoods; (ii) formalizing the channels of rent transfer via information asymmetries and market power; (iii) modeling institutional alternatives, from Amerindian exclusion rights to open access, with explicit profit outcomes; and (iv) integrating environmental and intertemporal externalities with game-theoretic and industrial-organization perspectives. This synthesis—combining CPR theory, Hotelling dynamics, cartel–fringe logic, and coordination games—offers a more rigorous economic framework for understanding ASGM in Guyana.

A miner displays a chip with raw gold found during the crushing process. Photo by David Papannah.

1.1 The ASGM Sector in an Era of Oil Wealth

Guyana's ongoing oil boom, which began with first production in 2019, provides a critical context for this analysis. The petroleum sector's demand for skilled labor and equipment has driven up wages and costs across the economy, with ripple effects throughout the mining supply chain. Equipment rental costs have increased substantially as machinery owners pivot to more lucrative oil sector contracts. Food, fuel, and transportation costs in mining areas have risen sharply, reflecting broader inflationary pressures.

These "Dutch Disease" effects compound the existing challenges facing small miners, who often lack the capital and connections to benefit directly from oil sector opportunities while bearing the full burden of increased operating costs. This oil-driven cost inflation squeezes already thin margins, making the capture of a sufficient expected net price from gold sales more critical than ever for miner survival.

Conversely, this period of unprecedented oil revenue also creates a unique opportunity. It provides the Guyanese state with previously unavailable resources to fund the institutional reforms, technical assistance, and infrastructure investments necessary to transform the ASGM sector. The central question becomes whether oil wealth will be used to perpetuate the existing, extractive structures within ASGM, or whether it can be leveraged to fund a transition towards a more efficient, equitable, and sustainable sector—one where miners can realise a fair expected net price for their labor and risk.

1.2 Outline of the Paper

Sections 2-4 examine the input-output transformation process under uncertainty, market failures, and institutional complexity. Section 5 models alternative institutions for resource management. Section 6 analyzes social norms and trust in Amerindian Villages as mechanisms for collective governance. Section 7 locates ASGM within the broader gold economy, applying the Hotelling rule and cartel-fringe models through the lens of the expected net realised price. Section 8 provides conclusions and policy recommendations.

Alluvial operations using zigzag sluice in Guyana. Photo by UNEP

2. Understanding ASGM: Outputs, Outcomes, and Institutional Complexity

A miner demonstrates river gold panning techniques to AGC staff in Guyana. Photo by AGC.

2.1 What ASGM Really Produces

Understanding the ASGM sector requires moving beyond simple measures of gold output to examine the full range of what mining activities actually produce—both intended and unintended consequences. These outputs and outcomes form an interconnected web that determines the sector's ultimate impact on miners, communities, and the environment.

The sector's outputs and outcomes include gold as the primary marketable output, environmental and health impacts that function as negative externalities, resource depletion and rising extraction costs that create fundamental externalities affecting current and future miners, individual and family livelihoods as the primary development outcome, and community well-being and development as broader social outcomes.

Table 1: Analytical Classification of ASGM Outputs and Outcomes

		Subtract-ability of use	
		High	**Low**
Difficulty of excluding potential beneficiaries	**High**	*Common Pool Resources (CPR)*: 1. Local Rivers 2. Local Forests 3. Identified but Unextracted Gold Reserves	*Public Goods (PuG)*: 1. Environment & Health; 2. Community Well-being; 3. Expected but Unconfirmed Gold Deposits
	Low	*Private Goods (PrG):* 1. Extracted Gold	*Toll/Club Goods (TG):* 1. Individual/family livelihoods

Source: Adapted from Ostrom (2010)

Of these outputs, gold serves as the instrumental output that enables livelihood and community development outcomes. However, the negative environmental and health impacts should be viewed as harmful by-products that are systematically underpriced in current market arrangements, thereby artificially inflating the short-term **expected net price** while creating long-term costs that undermine sustainable livelihoods.

The taxonomy also identifies two fundamental types of externalities that have received insufficient attention in ASGM analysis. **Appropriation externalities** occur when one miner's extraction reduces the remaining stock available to others in the same area, forcing them to expend more time, effort, and resources to extract remaining deposits. **Intertemporal externalities** arise because gold is non-renewable, so today's extraction reduces the stock available for future extraction on a one-for-one basis, creating inefficiencies prevent Guyana from maximising the total social surplus from its gold. Both externalities distort the **expected net realised price** by forcing miners to discount future returns heavily and over-invest in current extraction.

2.2 The Complexity Challenge

The ASGM sector exhibits extraordinary complexity in how different outputs and outcomes interact. Unlike conventional industries where inputs are transformed into outputs through relatively straightforward production processes, ASGM operates through complex webs of formal and informal institutions, each with different rules about access, exclusion, and benefit-sharing. This institutional complexity directly impacts how miners form expectations about their net returns.

Table 2: Amerindian Villages in Gold-Rich Regions of Guyana

Mining District	Amerindian Village	Key Details
Cuyuni-Mazaruni (Region 7)	Isseneru	Near the Cuyuni River; impacted by alluvial and hard-rock gold mining.
	Arau	Located along the Arau River; active gold mining in surrounding areas.
	Paruima	Upper Mazaruni region; gold deposits with ongoing land-rights disputes.
	Jawalla	Kamarang River area; historic and current small-scale gold mining.
	Waramadong	Close to Kamarang; affected by both legal and illegal mining operations.
Potaro-Siparuni (Region 8)	Phillipai	Near the Potaro River; within the Mahdia gold district.
	Chenapou	Potaro River basin; impacted by nearby mining concessions.
	Micobie	Proximity to former Omai gold mine; active mining zones nearby.
	Campbelltown	Adjacent to Mahdia; artisanal and commercial mining pressures.
	Princeville	Near Mahdia; gold mining influences local land use.
Barima-Waini (Region 1)	Santa Rosa	Arawak community near Arakaka's emerging gold zone.
	Chinese Landing (Tassawini)	Titular lands encroached by gold miners; major land-rights conflict area.

Source: Compiled by author (subject to verification)

Consider extracted gold, which appears straightforward as a private good. Yet even this seemingly simple output becomes complex when we consider who has the authority and capability to assess gold purity and how transparent these assessments are, whether miners can sell directly to international buyers or must work through intermediaries, and whether miners receive full world market prices or face systematic deductions. These questions have become more pressing as oil-driven inflation increases the importance of capturing full value from gold sales.

Local rivers, forests, and identified but unextracted gold reserves function as common pool resources within Amerindian Villages and other bounded communities. These resources can be used by community members but exclude outsiders—at least in theory. However, the

reality is more complex, particularly as oil wealth creates new pressures and opportunities. Amerindian Villages can grant permission to external miners, and the state can override community protections for large-scale operations. This creates a hybrid system where resources are neither fully communal nor completely open-access, with oil revenues potentially enabling stronger enforcement of community rights or, conversely, creating greater incentives for external exploitation.

2.3 Institutional Complexity: Rights, Permits, and Power

The legal and institutional framework governing ASGM in Guyana creates multiple layers of complexity that systematically favor those with superior information, capital, and political connections. This framework directly shapes the **expected net realised price** by determining who bears costs, who captures value, and under what conditions.

The permit system creates a complex maze that must be navigated before anyone can legally mine for gold in Guyana. Prospective miners must obtain prospecting permits (small-scale for less than 150 acres, medium-scale for 150-2000 acres), secure land or river claims (27.5 acres for land claims, 1 mile for river claims), apply for mining permits (required for medium-scale operations), register their equipment including dredges and specified equipment, obtain operating permissions to use registered equipment, and if working on others' claims, secure mining privileges that allow tributors to operate on another's claim.

This complexity creates multiple opportunities for rent-seeking and exclusion. Those with the resources to navigate bureaucratic requirements—including literacy, capital for fees, and time to manage applications—gain systematic advantages over those without such resources. The transaction costs of compliance are regressive, falling most heavily on small-scale operators and directly reducing their **expected net realised price**.

Beyond administrative complexity, the sector operates under multiple, sometimes conflicting systems of rights. The legal framework encompasses prospecting and mining operations, trading and dealing in gold, export and revenue collection, environmental and social safeguards, and occupational health and safety requirements.

An alluvial mining site in Guyana. *Photo by AGC.*

Figure 1: Rights and Permits in Guyana's Gold Mining Sector

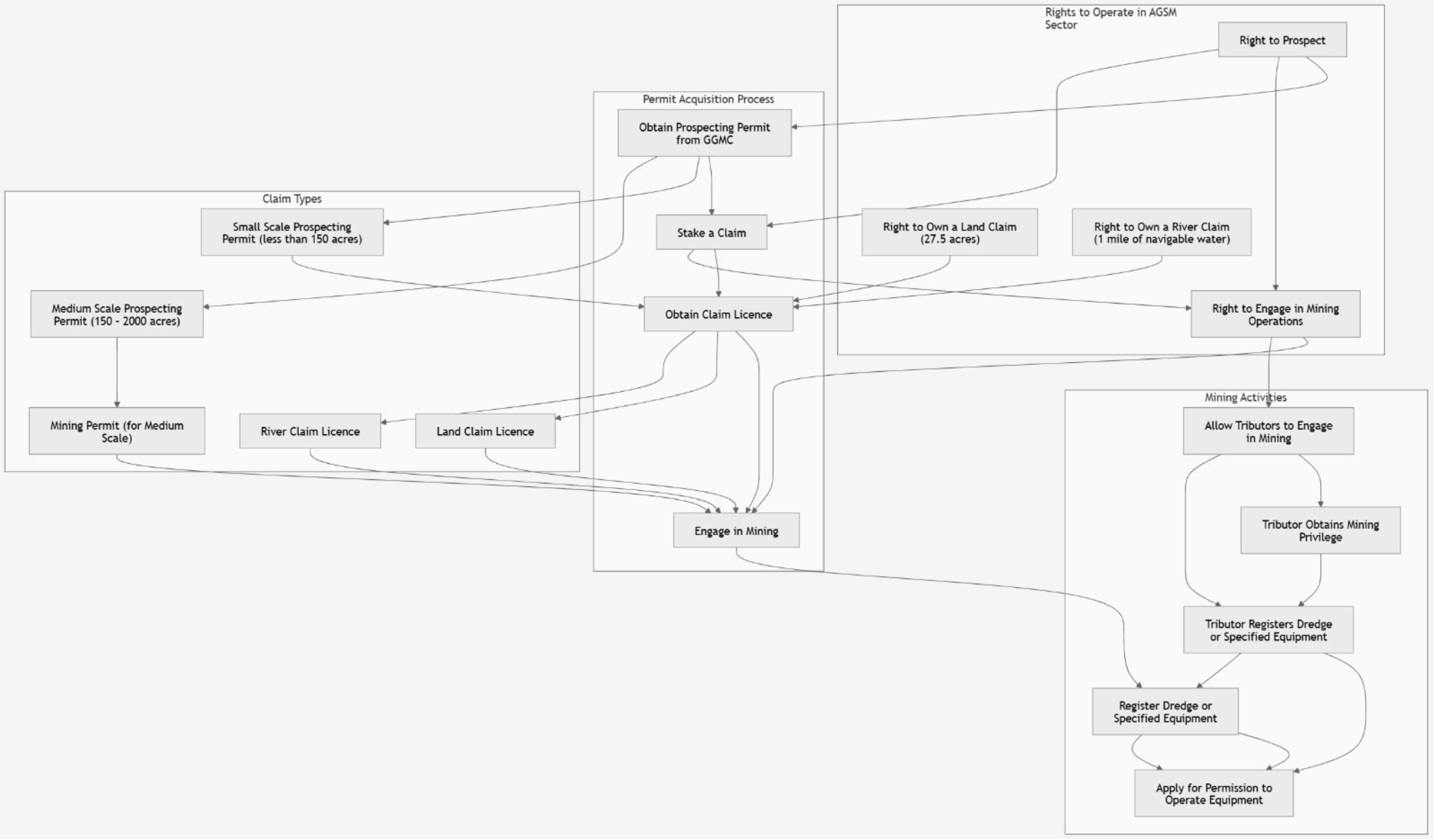
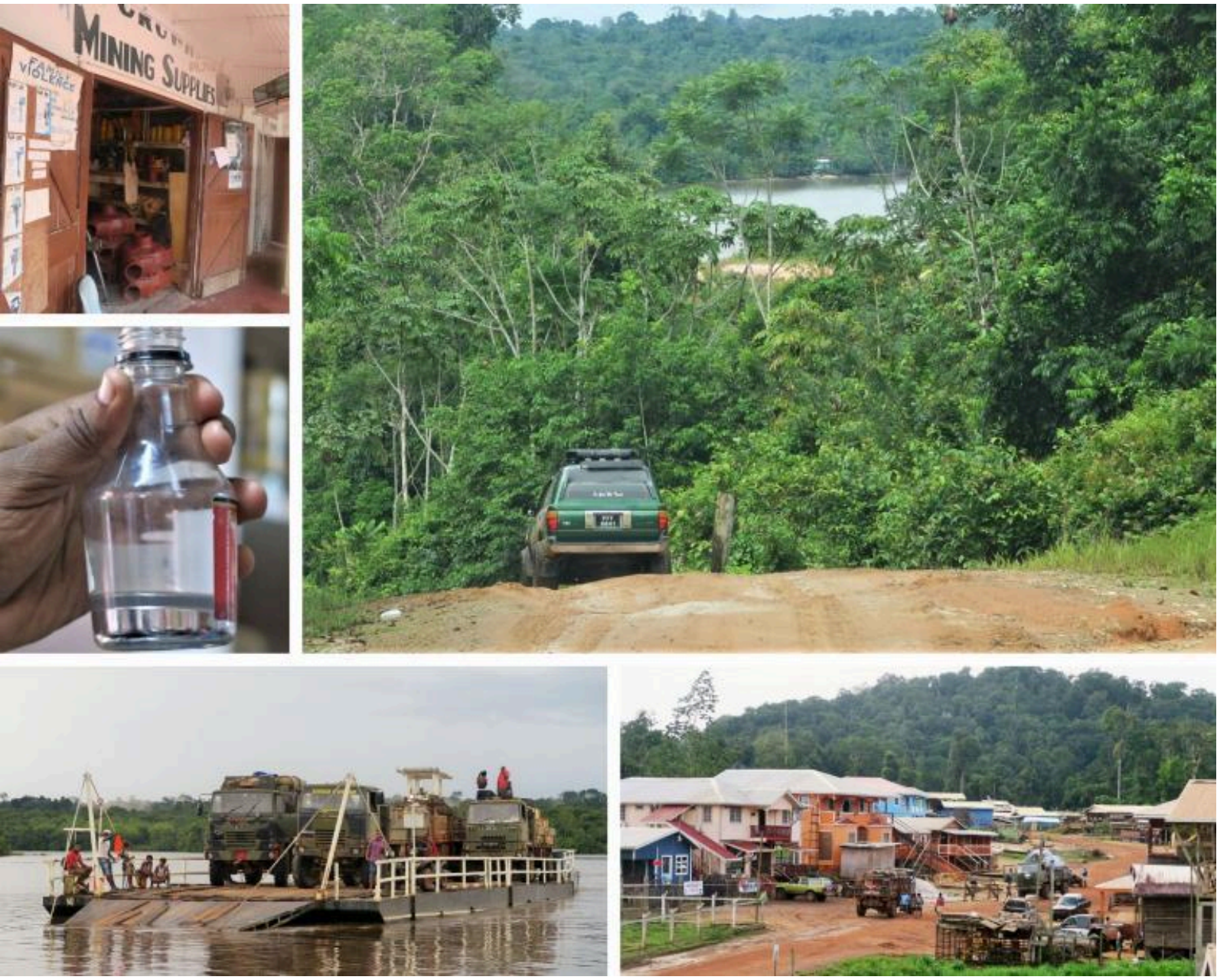


Table 3: The Legal Framework and Various Rights

Category	Legal Framework	Key Requirements	Ostromian Framework Analysis
Prospecting	Mining Act 1989, Amerindian Act 2006, Environmental Protection Act 1996, Forestry Act 2009	Prospecting licenses issued by GGMC; land access requires GGMC permission and FPIC on titled Amerindian lands	**Access Rights:** Prospecting Permit holders can explore but cannot mine; unauthorized miners risk expulsion
Recovery (Mining Operations)	Mining Act 1989, Environmental Protection Act 1996, Forestry Act 2009	Mining permits issued by GGMC; compliance with environmental obligations including rehabilitation; FPIC required on titled Amerindian lands	**Withdrawal Rights:** Only claim owners or authorized miners can extract minerals; requires registered equipment and operation permit
Trading and Dealing in Gold	Mining Act 1989, Guyana Gold Board Act, Environmental Protection Act 1996	Gold trading licenses issued by GGMC; all gold must be sold to Guyana Gold Board; traders must maintain records	**Management Rights:** GGMC regulates claim sizes, fees, and compliance; claim owners manage their claim's use
Export and Revenue Collection	Guyana Gold Board Act	Guyana Gold Board has monopoly over gold exports; ensures royalties and taxes are collected	**Alienation Rights:** Claim owners can transfer claims through sale or lease but cannot sell land ownership
Environmental and Social Safeguards	Environmental Protection Act 1996, Amerindian Act 2006, Forestry Act 2009	EIAs required for larger operations; pollution control measures; FPIC required for Indigenous communities	**Exclusion Rights:** Claim owners can exclude unauthorized miners; GGMC can cancel claims for non-compliance
Occupational Health and Safety	Mining Act 1989	Ensuring safe working conditions and proper handling of gold to prevent accidents and contamination	-

Source: Compiled from Laws of Guyana

The interaction between formal mining law, environmental regulations, forestry requirements, and Amerindian rights creates a complex institutional environment where success often depends more on navigating bureaucratic and political networks than on mining skill or geological knowledge. This situation systematically disadvantages ASGM operators, reducing their **expected net realised price** by introducing costs and uncertainties that are unrelated to productive efficiency.



From top left: a mining supply store, a back road towards Puruni, mercury sold over a counter in El Dorado rum bottle, a water transport over the multiple backwaters of Guyana interior, Puruni - the mining hub. Photo by UNEP.

3. How Gold Gets Produced: Uncertainty, Risk, Information Asymmetries and Expected Net Price

Miners working at the foot of Mazoa Mountain. Photo by David Papannah.

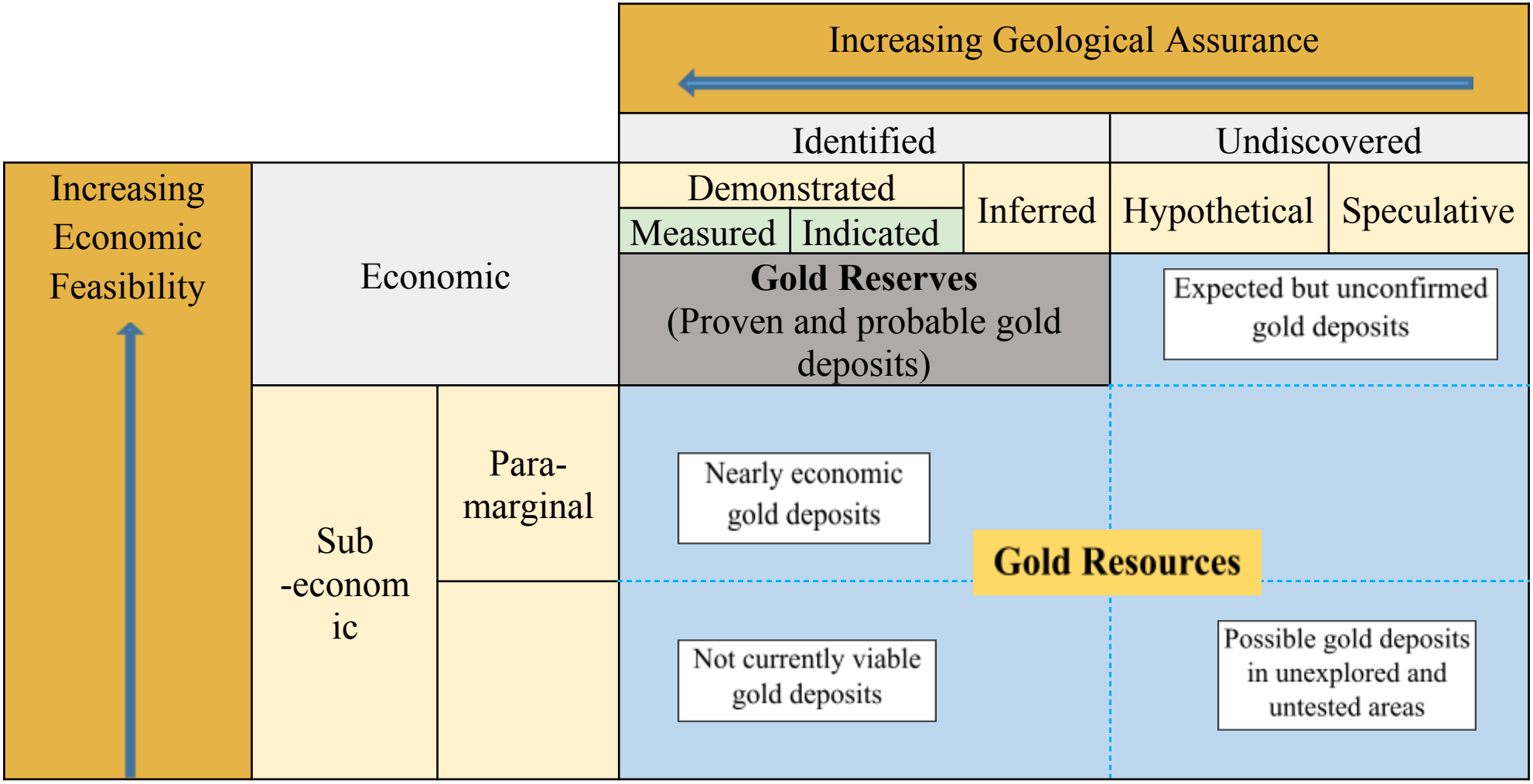
3.1 The Fundamental Uncertainties

Unlike most productive sectors where input-output relationships are relatively predictable, ASGM operates under profound uncertainty about both geological and economic factors. These uncertainties have been compounded by Guyana's oil boom, which has introduced new sources of economic volatility while potentially providing resources to reduce some traditional uncertainties through better geological surveys and infrastructure development.

The McKelvey Box framework in Figure 2 helps illustrate these uncertainties by classifying minerals based on their geological assurance and the economic feasibility of extraction.

Geological uncertainty exists even in Guyana's known gold districts, where actual gold deposits must be discovered through prospecting activities. This uncertainty is reduced through exploration, but the ASGM sector typically combines prospecting and mining seamlessly, creating ongoing uncertainty about deposit quality and extent. Economic uncertainty affects even discovered deposits, as their viability depends on multiple factors including global gold prices, local extraction costs (which have risen substantially due to oil sector competition), equipment availability, weather conditions, and regulatory requirements. These factors can change rapidly, turning viable deposits into uneconomic ones and vice versa.

Figure 2: The McKelvey Box



Source: Adapted from McKelvey (1976)

3.2 How Information Asymmetries Depress the Expected Net Price

The transformation of inputs into gold output occurs through complex webs of informal arrangements that create systematic opportunities for exploitation. These asymmetries directly depress the **expected net realised price** by transferring value and risk to the most vulnerable participants.

Labor mobilization in the ASGM sector involves two distinct but interdependent systems that interact in ways that systematically disadvantage the most vulnerable participants. Claim holders control mineral rights but typically lack operational capacity, instead engaging tributors—mobile dredge owners who prospect and extract gold under profit-sharing agreements lacking formal enforcement mechanisms. This arrangement creates inherent principal-agent tensions where tributors bear exploration risks but can be displaced when deposits prove viable, while claim holders retain long-term rights but depend on prospectors' specialized knowledge.

Capital formation presents another layer of complexity. Unlike formal mining operations with access to capital markets, ASGM producers rely on informal rental markets for critical machinery. Dredges, excavators, and processing equipment are obtained through verbal agreements with highly variable terms, creating significant transaction costs. Price dispersion across equipment providers exists for similar machinery, while availability fluctuates seasonally with weather patterns and mining cycles.

Input markets exhibit similar irregularities. Mercury supplies face increasing price variance due to regulatory interventions in global supply chains and local cost pressures. Fuel costs incorporate both official market prices and informal premiums for smuggled alternatives. Basic consumables such as food, water, and spare parts command location-specific premiums that can be significantly above standard market rates in remote areas.

Financial intermediation occurs through personalized trade credit rather than formal banking channels. Gold traders provide working capital that is repaid in physical output, effectively creating embedded forward pricing mechanisms. While repeat transactions typically show lower effective interest rates than one-time arrangements, the entire system lacks risk-pooling mechanisms and exposes miners to commodity price fluctuations during repayment periods.

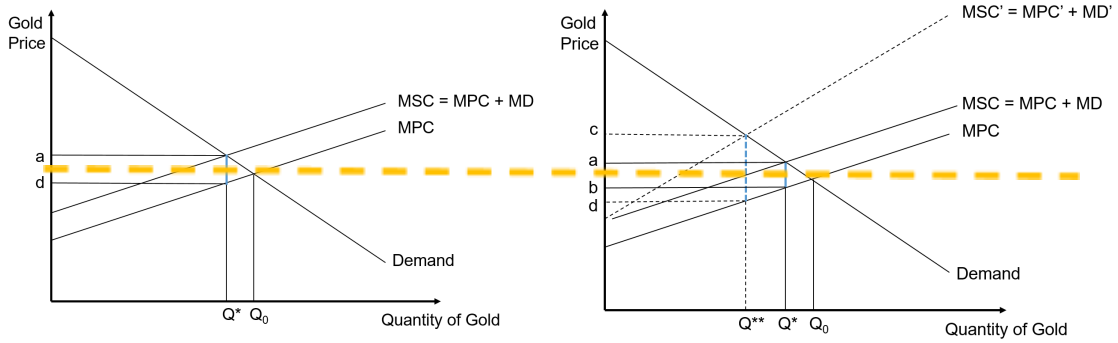
Perhaps the most systematic exploitation occurs through gold purity determination, where information asymmetries directly reduce the **realised price** component of the expected value calculation. Traders and dealers—especially in Amerindian villages without certified processes—possess superior knowledge and control over purity assessment technology and techniques. They unilaterally assess purity, often underpricing output through arbitrary or unverifiable deductions. Miners lack the technical capacity, equipment, or market knowledge to challenge these assessments, creating fundamental information asymmetry that transfers value from producer to trader.

3.2 Environmental and Social Costs: The Externality Problem

The environmental and health issues associated with ASGM represent classic negative externalities—costs imposed on third parties who are not directly involved in production decisions. These externalities create a systematic divergence between private costs (borne by miners) and social costs (borne by society as a whole), leading to systematic overproduction of both gold and environmental damage. Indeed, All the impacts noted in *Table 5*, below, taken together can in summary be said to be the (negative) production externalities that cause a divergence between Marginal Private and Marginal Social Costs.

The basic economics of externalities shows how market failures occur when producers do not bear the full costs of their activities. In ASGM, miners make decisions based on private costs and benefits, but their activities impose additional costs on others through environmental degradation, health impacts, and resource depletion. Because these external costs are not reflected in market prices, too much mining occurs from society's perspective. *Figure 3* illustrates the ideas in the very basic diagram:

Figure 3: Negative Externalities in ASGM



(a) (b)

In panels (a) and (b) of *Figure 3*, the market equilibrium output is Q_0. The price of gold that elicits this output level is the spot world gold price, shown by the horizontal gold line, which is taken as given in Guyana.[9] Marginal Private Costs (MPC) are equal to marginal private benefits (the demand curve) at Q_0, because if that were not the case, rational economic agents would produce and consume more or less gold. But economic efficiency requires marginal social benefits (also the demand curve) and marginal social costs (MSC) to be equal, because if that were not the case, society as a whole would be better off with more or less gold. This distinction is reflected in *Fig. 3* as a divergence between MPC and MSC on account of "externalities" that cause marginal damage (MD).

Panel (a) shows the case of a constant MD caused by the market's inability to reflect all social costs. As a result, "too much" will be produced, and the market outcome Q_0 will be greater than the socially optimal quantity of gold $Q.*$ From the perspective of economic efficiency, the market outcome is socially sub-optimal because more is being produced of both gold and the negative externalities imposed on third parties.

[9] All gold produced in Guyana must be sold to the Guyana Gold Board, or its agents. The Guyana Gold Board purchases gold at the US Dollar value of the 8:00am and 10:15am (Guyana time) prices fixed by the London Bullion Market Association.

As Panel (b) shows, the inefficiency of the market outcome is even greater with the MSC' curve that is associated with increasing marginal damages MD" in the sense that the socially optimal output level Q^{**} is even less than the Q^{*} associated with constant MD. Increasing marginal damages and increasing marginal external costs arise fundamentally because of spatial appropriation and intertemporal externalities, where current extraction not only depletes resources but makes future extraction progressively more difficult and expensive. This creates a case of "increasing marginal damages" where environmental and depletion costs accelerate as mining intensity increases. These fundamental externalities have to do with reduced gold extraction possibilities, but in the case of appropriation externalities the affected parties are other miners who are also operating at the same time; while in the case of intertemporal externalities the affected parties are those who will be operating in the future.

Current estimates suggest the ASGM sector generates approximately US$72 million annually in environmental costs from mercury contamination alone, plus additional costs from deforestation (US$9.1 million annually) and other impacts. Yet these costs are not reflected in market prices, leading to systematic overproduction of both gold and environmental damage.

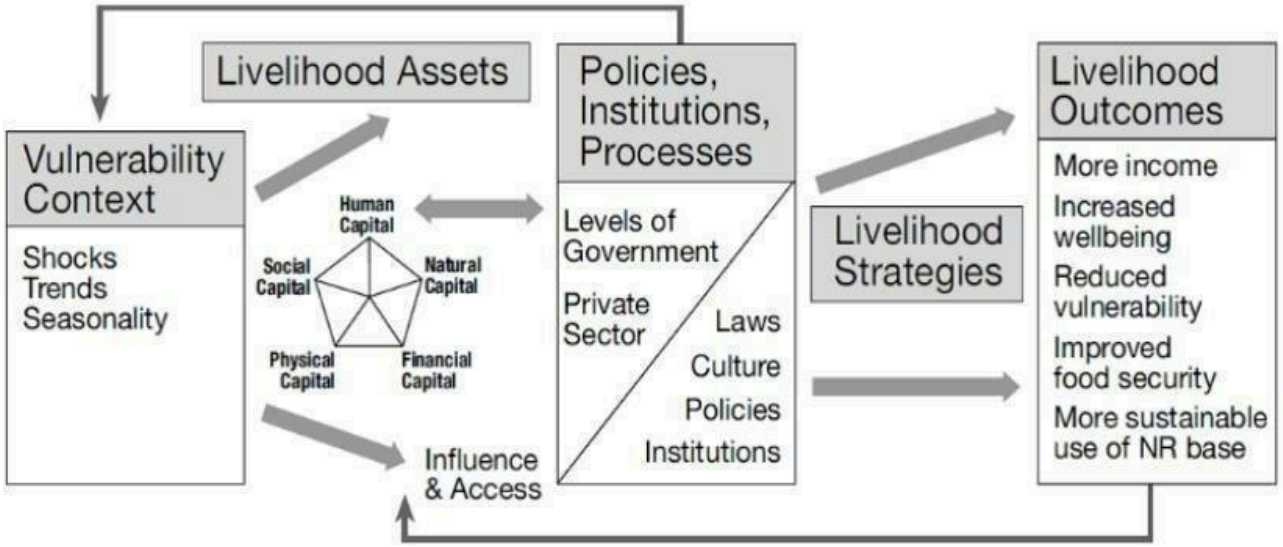
3.4 The Livelihood Sustainability Challenge

When we focus on livelihoods rather than just gold production, the complexity multiplies considerably, particularly in an economy where oil wealth is reshaping traditional patterns of employment and income generation. The Sustainable Livelihood Framework reveals how ASGM affects multiple forms of capital that households and communities use to build sustainable livelihoods.

The vulnerability context facing ASGM operators includes compounding uncertainties from gold price volatility, equipment failures, resource depletion, regulatory changes, and seasonal rainfall disruptions, all occurring within an economy where oil sector growth has fundamentally altered traditional patterns of risk and opportunity. Operators work predominantly in the "sub-economic" and "undiscovered" portions of the McKelvey Box, where incomplete geological information exacerbates investment risks. The oil boom has added new dimensions to this vulnerability by creating inflationary pressures that increase operating costs while potentially providing new opportunities for those able to access them.

Recovered gold nuggets. Photo by AGC.

Figure 4: The Sustainable Livelihood Framework



Source: Adapted from Hans-Georg (2007)

Institutional mediation occurs through formal and informal rules that systematically favor those with superior information, capital, and political connections. Formal institutional barriers such as GGMC permitting and FPIC requirements impose complex transaction costs favoring capitalized actors with resources to navigate bureaucracy, while landless dredge owners (70% of operators) rely on verbal tributor agreements lacking formal contracts or recourse against post-discovery termination. The oil economy has worsened these dynamics by creating new bureaucratic priorities and drawing skilled administrators away from mining sector services.

The feedback loops between environmental degradation and livelihood outcomes create cascading vulnerabilities that have been intensified by oil-driven economic changes. Environmental externalities degrade different forms of capital in interconnected ways, creating self-reinforcing cycles of vulnerability.

AGC visits a mining site in Guyana. Photo by AGC.

Table 4: The Effect of Negative Externalities on Capital in the SLF

Capital	Impact	Empirical Evidence
Natural (N)	Mercury contamination (28,790 kg/year), deforestation (45,000 Ha), topsoil erosion (130 tonnes/day/dredge)	US$72M annual environmental costs; habitat/fisheries loss
Human (H)	Mercury poisoning, malaria (13,936 cases in mining zones), substance abuse (92% alcohol use)	Health costs: US$110K–$1.5M/year (Table 2)
Financial (F)	Rising costs + price volatility → debt traps via trader credit	Effective interest rates: 5–7% for repeat borrowers
Social (S)	Land conflicts (e.g., Chinese Landing), gender disparity (13:1 male/female ratio)	Royalty disputes; weakened community cohesion

Source: Compiled from Liang & Moonsammy (2021)

These dynamics generate self-reinforcing loops that trap communities in unsustainable patterns. Resource depletion leads to higher extraction costs, driving expansion into marginal lands and amplifying environmental damage. Health crises divert income from productive investment, reducing productivity and intensifying poverty. Dependence on gold suppresses economic diversification, heightening vulnerability to price volatility.

The **expected net realised price** is at the center of these dynamics. When miners face a low and uncertain expected return, they rationally shorten their planning horizons, discount future environmental costs heavily, and prioritize immediate extraction over sustainable practices. This individually rational response to a depressed expected net price leads to collectively suboptimal outcomes that undermine the very foundations of sustainable livelihoods.

4. Alternative Institutions: Lessons from Amerindian Villages

Small-scale gold mining sustains livelihoods in Karrau, an Amerindian settlement along the banks of the Essequibo River. Screenshot from planetGOLD's video "Bringing #MercuryFree Methods to the Amerindian Village of Karrau in Guyana."

4.1 The Theoretical Potential of Community Management

To understand how different institutional arrangements might perform in addressing the challenges facing the ASGM sector, we can model mining activities as occurring within different governance structures. Beginning with an idealized case helps identify the potential gains from institutional reform, particularly in terms of how they affect the expected net price realised by miners.

The theoretical analysis begins with a "closed off" Amerindian Village model where the community successfully excludes external miners and residents make individual decisions about mining activities. Even in this decentralized scenario, the presence of appropriation externalities means that individual profit-maximizing decisions will not maximize community welfare. However, community boundaries create sufficient internalization of externalities to sustain viable livelihoods and support a stable expected net price.

Using standard economic modeling techniques, we can demonstrate that such villages would generate positive profits for all residents, avoiding the zero-profit "tragedy of the commons" outcome that occurs under pure open access conditions. The key insight is that community boundaries create sufficient internalization of externalities to sustain viable livelihoods, even when individual miners make independent decisions about their operations.

If the same village operated as a cooperative—maximizing total community profits rather than individual profits—it would achieve even better outcomes. The cooperative solution internalizes appropriation externalities more effectively, using fewer dredges to generate higher total profits and better livelihoods for each resident. This finding has particular relevance as it demonstrates how institutional arrangements can directly enhance the expected net price realised by creating more stable and predictable returns.

> **Result 1**: *Amerindian Villages that successfully exclude external mining would achieve positive profits for all residents, even with decentralized decision-making by individual miners.*

> **Result 2**: *Cooperative management would achieve higher profits than individual maximizing decisions because appropriation externalities are more effectively internalized at the village level.*

4.2 Real-World Complications

The reality facing Amerindian Villages is considerably more complex than these theoretical models suggest. Several factors undermine the theoretical potential for sustainable community management and depress the expected net price realised by community members.

Incomplete exclusion remains a persistent problem, as villages can grant permission to external miners while the state can override community protections for large-scale operations. This creates hybrid arrangements where resources are neither fully communal nor completely open-access, creating uncertainty that reduces the expected net price for all users.

Poverty pressure continues to force Village Councils to accept mining agreements that provide short-term cash flows at the expense of long-term sustainability. Miners typically pay tribute to Village Councils, which can be substantial enough to override longer-term sustainability concerns, particularly when community needs are urgent. This creates a situation where immediate financial pressures lead communities to accept arrangements that systematically lower their long-term expected net price.

Capacity constraints persist as villages often lack the technical expertise to assess the true value of their resources or negotiate favorable agreements with external miners. This information asymmetry systematically disadvantages communities, allowing external actors to capture most of the value from community resources and reducing the expected net price realised by community members.

The regulatory framework creates additional complications, as communities must navigate complex requirements from multiple agencies while lacking the resources to comply fully with all regulations. This regulatory burden falls disproportionately on communities with limited administrative capacity, further reducing their expected net price through compliance costs and lost opportunities.

> **Result 3**: *The proliferation of landless dredge owners (70% of all operators) has created near-open-access conditions that drive profits toward zero through overinvestment in the sector, creating extremely vulnerable livelihoods for many ASGM operators and systematically depressing the expected net price realised across the sector.*

4.3 Social Institutions and Trust

The potential for sustainable community management depends heavily on social capital—particularly trust among community members and effective mechanisms for coordination. These social foundations have been both challenged and potentially strengthened by the changes accompanying Guyana's oil boom.

Theoretical analysis suggests that resource management in close-knit communities is better represented as a coordination problem rather than a pure conflict situation. In coordination games, both cooperation and defection can be stable equilibria, but cooperation yields higher payoffs for all participants when it can be sustained. The challenge lies in coordinating expectations so that everyone chooses the cooperative strategy.

Figure 5: The Stag Hunt Game

		Player 2 hunts	
		Stag (S)	**Hare (H)**
Player 1 hunts	**Stag (S)**	7.5, 7.5	4, 7
	Hare (H)	7, 4	5, 5

where Stag = cooperation (sustainable mining), Hare = defection (intensive mining)

In the Stag Hunt framework, mutual cooperation (both players hunt stag) yields the highest combined payoff but requires trust that the other player will also cooperate. Mutual defection (both hunt hare) provides lower payoffs but is less risky because it doesn't depend on the other player's choice. The mixed strategy equilibrium involves each player cooperating with probability 2/3, reflecting medium levels of trust.

Long-term relationships in Amerindian Villages create several conditions that favor cooperation over defection. Repeated interactions reduce the appeal of short-term exploitation because community members must continue living and working together. Cultural values emphasizing reciprocity and community welfare provide additional support for cooperative behavior. Informal monitoring and enforcement mechanisms allow communities to observe behavior and respond to violations of cooperative norms. Shared vulnerability to resource depletion creates common interests in sustainable management practices.

However, external pressure and economic desperation can undermine these cooperative arrangements, pushing communities toward less sustainable equilibria. Traditional ecological knowledge systems in many Amerindian communities provide additional support for sustainable resource management practices. These knowledge systems, developed over generations of interaction with local environments, often embody principles of sustainable use that align with modern conservation objectives.

The role of trust in maintaining cooperative equilibria extends beyond individual relationships to encompass trust in institutions and governance systems. Communities with strong traditional governance institutions are better positioned to maintain cooperative arrangements that support a higher expected net price, while those with weakened or divided leadership face greater challenges in sustaining the institutional stability necessary for long-term planning and investment.

From top left: a miner washing sediment, a miner using a pressure pump, a natural swamp in the mining area, an excavator. Photo by UNEP.

5. ASGM in Guyana's Broader Gold Economy

A miner panning in the river. Photo by planetGOLD Guyana.

5.1 Strategic Interactions: The Competitive Fringe Problem

ASGM in Guyana does not operate in isolation but exists alongside medium and large-scale mining operations that enjoy economies of scale, better access to capital, and deeper integration with formal institutions. This creates a two-tiered system with important strategic interactions that directly affect the expected net price realised by small-scale operators.

The relationship between large and small producers resembles a cartel-fringe model where, although both groups take global gold prices as given, large firms exert market power through non-price channels. Large firms often control prime territories through superior access to capital and regulatory processes, forcing small operators into marginal areas or tribute arrangements. Equipment and fuel markups imposed by large firms who own rental businesses and supply chains charge ASGM operators significant premiums. Gold purity assessment systems controlled by large firms and traders systematically underprice ASGM output. Regulatory capture has intensified as large firms use their superior capacity to navigate complex permitting requirements and influence policy.

ASGM operators function as a constrained competitive fringe, extracting gold under precarious conditions while transferring significant rents to dominant players through multiple channels. These transfers occur upstream through equipment rentals and input supply arrangements, downstream through gold trading and purity manipulation systems, through regulatory processes via complex permitting requirements, and through information systems where superior market and geological knowledge create systematic advantages for larger operators.

This systematic transfer of value from those who bear the physical risks and environmental costs of extraction to those who control capital, information, and institutional access has allowed large firms to institutionalize their position relative to small operators. The result is that while ASGM operators are nominally price-takers in the global gold market, their expected net realised price is systematically depressed through these non-price channels of rent extraction.

5.2 Intertemporal Efficiency: The Hotelling Problem

For non-renewable resources like gold, optimal extraction paths should follow the Hotelling Rule, which requires that the net price (market price minus extraction cost) should rise at the rate of interest. This ensures that the opportunity cost of current extraction—foregone future earnings—is properly accounted for. However, this analysis must be reframed around the core concept of the expected net realised price.

Under ideal conditions, gold extraction would follow a path where the net price equals market price minus marginal cost, the rate of net price increase equals the real interest rate, and extraction occurs when current net benefits exceed discounted future benefits. This optimal path ensures that resource wealth is allocated efficiently across time, preserving resources when their future value exceeds current value and extracting them when current uses are more valuable.

Current extraction patterns in Guyana's ASGM sector violate the Hotelling Rule in multiple ways that have to do with the fact that the relevant price for miner decision-making is precisely the expected net realised price, which is systematically lower than the theoretical "market price minus extraction costs.".

The fundamental distortion is that the Hotelling rule is violated because the *expected net realised price* is too low and too uncertain:

$$\frac{d}{dt}\left(P_t - C_t\right) < r\left(P_t - C_t\right)$$

Where the relevant net price for ASGM operators is the depressed *expected net realised price* rather than the theoretical (P - C). This results in extraction rates that exceed optimal paths, leading to several problematic outcomes. Premature depletion of accessible reserves reduces the total value that can be extracted from known deposits. Movement into increasingly marginal and environmentally sensitive areas occurs as easily accessible deposits are exhausted. Rising extraction costs squeeze miner livelihoods as they are forced to work lower-grade deposits with higher processing costs. Insufficient resources are preserved for future generations, violating principles of intergenerational equity.

The over-extraction problem created by these factors fundamentally stems from the depressed expected net realised price that forces miners to prioritize immediate survival over long-term optimization. Addressing intertemporal inefficiency therefore requires institutional reforms that enhance the expected net price by extending planning horizons and creating mechanisms for capturing future value.

6. Environmental and Social Impacts: Measuring the True Costs

A gold dore. Photo by Artisanal Gold Council

6.1 Quantifying the Damage

The ASGM sector generates substantial environmental and social costs that are systematically excluded from market calculations, creating a significant underestimation of the true economic costs of current mining practices. These external costs are not reflected in the expected net price realised by miners, leading to a fundamental divergence between private optimization and social welfare.

Based on (Liang & Moonsammy, 2021), Table 5 below provides quantitative estimates of the external costs imposed by ASGM activities across multiple dimensions of human and environmental well-being. Health impacts include 13,936 malaria cases annually from mining areas, creating public health costs ranging between US$110,000 and US$1.5 million. Mercury contamination affects indigenous people at levels up to 5 times WHO limits, creating social costs of approximately US$43-98 million annually. HIV prevalence in mining areas has decreased from 6.4% to 3.9%, showing improvement but still reflecting elevated rates compared to national averages. Substance abuse rates remain high, with 92% alcohol use, 49.6% marijuana use, and 8.3% cocaine use among miners.

Environmental impacts create costs that compound over time and across ecosystems. Mercury emissions of 28,790 kg annually create environmental costs of approximately US$72 million, affecting water quality, soil health, and biodiversity in ways that will persist long after mining operations end. Deforestation of 45,000 hectares annually represents lost ecosystem services valued at US$9.1 million. Topsoil removal by dredges can reach 130 tonnes per day per dredge, creating environmental costs of US$2,470 per day per operating dredge and representing irreversible loss of agricultural potential in affected areas.

Table 5: Impacts from ASGM Mining with Values and Empirical Evidence

Impact	Value/Empirical Evidence
Prevalence of malaria cases in mining areas	13,936 cases with estimated public health cost of US$110,000–US$1.5 million annually
Mining areas as HIV and STD transmission hubs	HIV prevalence decreased from 6.4% to 3.9%
Substance abuse among miners	92% alcohol use, 49.6% marijuana, 8.3% cocaine
Mercury impacts on surrounding communities	Mercury levels up to 5× WHO limits; social cost US$43–98 million annually
Gold smuggling from illegal mining	Estimated US$1 billion worth smuggled annually
Gender disparity in mining employment	13:1 male to female worker ratio
Deforestation from mining activities	45,000 Ha annual forest loss; estimated value US$9.1 million
Topsoil removal and habitat destruction	130 tonnes/day/dredge; environmental cost US$2,470/day operation
Mercury emissions affecting ecosystems	28,790 kg annually; total environmental cost US$72 million
National revenue generation	US$234–548 million generated annually
Employment provision	17,000–35,000 persons employed in sector
Foreign exchange earnings	US$411 million annually (1998-2019)
Government taxes and royalties	US$14–40 million paid annually

Source: Compiled from Liang & Moonsammy (2021)

Economic benefits provide important context for evaluating these costs but should not obscure the fact that current arrangements systematically undervalue environmental and social impacts. The sector employs 17,000-35,000 people directly, generates US$234-548 million in revenue annually, provides US$411 million in foreign exchange earnings, and contributes US$14-40 million in taxes and royalties to government revenues. However, these figures do not account for the external costs listed above, nor do they reflect how the distribution of these benefits systematically disadvantages those with the lowest expected net realised price.

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6.2 The Feedback Problem

These environmental and social impacts create cascading effects that undermine the sustainability of livelihoods and communities. The feedback loops between different types of impacts create self-reinforcing cycles that can trap communities in unsustainable patterns, further depressing the long-term expected net price realised by current and future miners.

Environmental degradation leads to rising costs as easily accessible deposits are depleted and environmental damage accumulates, forcing expansion into more remote and environmentally sensitive areas. This process accelerates as pressure for income maintenance pushes miners to work increasingly difficult areas, thereby increasing their costs and reducing their net returns. Health impacts reduce productivity as mercury poisoning, malaria, and other health problems affect worker capacity while diverting household income toward medical expenses rather than productive investment.

Social disruption undermines institutional capacity as mining camps become centers for gang violence, drug trafficking, and prostitution, weakening social cohesion and traditional governance structures that might otherwise support sustainable practices. Resource depletion creates livelihood vulnerability as communities that become economically dependent on gold mining face severe adjustment problems when deposits are exhausted, often lacking alternative livelihood options.

These feedback loops create a vicious cycle where a low expected net price forces miners to prioritize short-term extraction, which degrades the resource base and institutional environment, which in turn further depresses the long-term expected net price. Breaking this cycle requires interventions that simultaneously address both the immediate determinants of the expected net price and the longer-term institutional and environmental factors that sustain the low-equilibrium trap.

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6.3 The Distributional Problem

The benefits and costs of ASGM are not evenly distributed, creating patterns of inequality that reveal why market mechanisms alone are insufficient to address the sector's problems and why institutional reforms are needed to ensure more equitable outcomes in terms of the expected net price realised by different participants.

Benefits flow primarily to landowners and claim holders through tribute payments and lease fees, equipment owners and traders through rental margins and trading spreads, government through taxes and royalties that support general spending, and the national economy through foreign exchange earnings that support overall economic stability. These beneficiaries are often well-positioned to capture value without bearing proportional risks.

Costs fall disproportionately on landless tributors and workers who face low wages and dangerous working conditions, local communities that bear environmental and health impacts without receiving proportional benefits, indigenous peoples who experience land degradation and cultural disruption, and future generations who will inherit depleted resources and environmental damage. These groups typically have the lowest expected net realised price and bear the greatest vulnerability to sector volatility.

This distributional pattern creates a classic problem where those who capture the economic benefits are not those who bear the environmental and social costs. Without mechanisms to internalize these costs or redistribute the benefits, the sector will continue to generate private profits through the systematic exploitation of common resources and vulnerable populations. The persistently low expected net price for the majority of actual producers represents both a moral failure and an economic inefficiency that undermines the sector's long-term sustainability.

A miner excavates gold ore for processing in Guyana. Photo by AGC

7. Recommendations: Toward Net Price Recovery and Sustainable Livelihoods

The future of Guyana's ASGM sector depends on its ability to recover the expected net value of gold for those who extract it, rather than allowing systematic value transfers to more powerful actors. This requires addressing the fundamental distortions that currently undermine both efficiency and equity in the formation of the expected net price realised. The current period provides an unprecedented opportunity to fund institutional reforms while the urgency of cost pressures makes such reforms essential for sector survival.

Small-scale mining activities at Mazoa Mountain. Photo by David Papannah.

7.1 Community-Owned Certified Purity Grading Units

The systematic exploitation of miners through opaque purity assessments represents one of the most direct and addressable sources of value loss in the ASGM sector. Traders exploit information asymmetry by underpricing gold through arbitrary assessments, especially in Amerindian villages and remote areas lacking certified testing facilities.

The solution involves deploying GNBS-certified assay laboratories owned and operated by communities or cooperatives of small miners. These facilities would provide independent, transparent purity assessments that eliminate arbitrary deductions by traders, create competitive pressure for fair pricing throughout the sector, and build technical capacity within communities.

Implementation should begin with pilot programs in major mining communities, combining government support with community investment to ensure local ownership and sustainability.

Certification standards and training programs for local operators would need to be developed, along with quality control systems that maintain credibility with gold buyers.

The expected impact includes restoring informational symmetry between miners and traders, improving the expected net price realised for participating communities, redistributing value to local producers rather than outside traders, and creating local employment in technical services.

7.2 Controlling Open Access and Preventing Tragedy of the Commons

Excessive dredge densities in open-access zones drive down marginal returns through appropriation externalities while depleting resources unsustainably. The proliferation of landless dredge owners operating under precarious arrangements has created near-open-access conditions that dissipate resource rents while creating vulnerable livelihoods.

The solution requires implementing area-based caps on dredge density based on carrying capacity assessments, strengthening exclusion rights under the Amerindian Act, and formalizing tenure security for productive tributors. Specific measures would include maximum dredge density standards derived from scientific assessments of sustainable extraction rates, strengthened community rights to exclude external miners backed by enhanced enforcement mechanisms, formal tenure options for landless tributors who demonstrate productive capacity and environmental compliance, and graduated access fees that internalize congestion costs and fund resource management.

Implementation challenges include coordinating between GGMC, the Ministry of Amerindian Affairs, and local communities while balancing access rights with sustainability objectives. Success requires developing technical capacity for carrying capacity assessments, enforcement mechanisms for density limits, and dispute resolution systems for tenure arrangements.

Expected impacts include reducing appropriation externalities that currently dissipate resource rents, stabilizing yields per operator by reducing excessive competition, enhancing long-term income prospects by extending the productive life of mining areas, and ultimately supporting a higher and more stable expected net price realised by reducing competitive pressures that drive returns toward zero.

7.3 Equity Shares and Profit-Sharing for Tributors

Landless tributors bear exploration risk and provide specialized knowledge but are systematically excluded from the returns to successful discoveries, creating perverse incentives against sustainable prospecting and trapping productive miners in vulnerable positions.

The solution involves institutionalizing equity-based contracts that give tributors formal shares (15-25%) in the future revenues from deposits they discover, with these arrangements registered with GGMC and backed by legal enforcement. Contract elements would include formal prospecting agreements registered with GGMC that establish clear rights and responsibilities, graduated profit-sharing based on discovery value and development investment that aligns incentives for both exploration and development, dispute resolution

mechanisms through an expanded mining tribunal system, and protection against arbitrary termination after discovery backed by legal penalties for violations.

The legal framework requires modifying the Mining Act to recognize and enforce tributor equity rights, establishing standard contract templates that reduce transaction costs, and creating specialized mining courts for dispute resolution. Implementation would be phased, beginning with new arrangements and gradually extending to existing operations through incentive programs.

Expected impacts include correcting principal-agent failures that currently discourage optimal exploration, reducing exploitative displacement that wastes human capital and geological knowledge, aligning incentives for optimal prospecting by ensuring that discoverers share in the benefits, and providing income security for productive miners that enables longer-term planning and investment. By giving tributors a stake in successful discoveries, this reform directly enhances their expected net price realised from exploration activities.

7.4 Value Chain Diversification Including Domestic Refining

Guyana currently exports unrefined gold, losing substantial value-added opportunities while enabling illicit flows that evade taxation and reduce benefits to local communities.

The solution involves developing modern gold refining capacity that meets international standards, potentially leveraging existing infrastructure and technical expertise while creating synergies with other economic sectors. Strategic components would include a modern gold refinery capable of processing both large-scale and artisanal production, jewelry manufacturing and crafts industries that build on traditional skills while accessing international markets, technical training programs for value-added processes, export promotion for refined products and crafts, and integration with the tourism industry through gold jewelry, crafts, and cultural heritage experiences.

Financing could combine public revenues with international development finance and private sector partnerships, potentially structured as a public-private partnership with international refining companies that brings technical expertise while maintaining local ownership. The refinery could be designed to process both formal and informal sector production, providing incentives for formalization while capturing value currently lost to smuggling.

Expected impacts include capturing 30-70% more value from gold production by eliminating the discount for unrefined exports, creating skilled employment opportunities, supporting economic diversification that reduces dependence on primary exports, and improving export revenue tracking while reducing illicit flows. By moving up the value chain, Guyana can significantly increase the expected net price realised at the national level while creating more stable and higher-value employment opportunities.

7.5 Environmental Bonds with Shared Responsibility

Environmental degradation costs the country US$72 million annually, but current bonding mechanisms are inadequate and place full responsibility on claim holders regardless of who actually operates mines. This arrangement fails to internalize environmental costs while creating perverse incentives for both claim holders and operators.

The reformed bonding system would substantially increase environmental bond levels while requiring tributors to contribute proportionally through deferred deductions from gold sales, creating shared responsibility that aligns incentives for environmental protection. System elements would include bonds scaled to environmental risk and impact potential based on scientific assessments, shared responsibility between claim holders (60%) and operators (40%) that reflects their respective roles and capabilities, performance-based bond reductions for proven restoration that creates incentives for good practices, community compensation funds for irreversible damages that ensure affected populations receive benefits, and independent monitoring and enforcement that maintains system credibility.

Implementation requires phased introduction beginning with new permits to avoid disrupting existing operations, graduated requirements for existing operations that allow time for adjustment, and technical assistance for small operators to meet requirements. The system should include provisions for cooperative arrangements where multiple small operators share bonding costs and technical expertise.

Expected impacts include internalizing environmental costs in production decisions, incentivizing sustainable practices by linking financial returns to environmental performance, providing funds for restoration activities, and ensuring appropriate liability allocation that matches responsibility with capacity. By making environmental costs explicit and shared, this reform ensures they are incorporated into the expected net price realised calculation, leading to more efficient extraction decisions.

A mining site in Guyana where miners extract gold from alluvial deposits. Photo by AGC

Implementation Roadmap

The implementation of these reforms requires coordinated action across multiple institutions and sustained political commitment. The roadmap balances the need for immediate action on critical problems with the longer-term institutional development required for sustainable solutions.

- **Short-term priorities (1-2 years)** focus on establishing pilot programs and building institutional capacity. Purity grading pilots would be implemented in selected communities to demonstrate feasibility and refine operational procedures. Dredge density studies would provide the scientific foundation for sustainable extraction limits. Stakeholder consultations would build support for reforms while identifying implementation challenges. These activities would be led by GNBS, GGMC, and Village Councils.
- **Medium-term goals (3-5 years)** involve institutionalizing successful pilots and implementing major reforms. The equity contract framework would be established through Mining Act amendments and GGMC regulatory changes. Environmental bond reform would be implemented with phased introduction and technical assistance programs. Value chain development would begin with feasibility studies and investment planning for refining capacity. These activities would be led by the Ministry of Natural Resources working with Parliament on legislative changes.
- **Long-term objectives (5-10 years)** focus on completing the transformation to a sustainable and equitable sector. Gold refinery construction and operation would create the infrastructure for value-added production. Integrated value chains would link mining, processing, manufacturing, and marketing activities. Sustainable mining zones would demonstrate how institutional reforms can support both environmental protection and community development. These activities would be led by the Guyana Gold Board working with private sector partners.

AGC staff demonstrate how to use a helicoidal machine to extract gold without using mercury. Photo by AGC.

8. Conclusion

Guyana's ASGM sector stands at a critical juncture where the challenges of traditional mining meet the opportunities of economic transformation. Current institutional arrangements systematically extract value from those who bear the physical risks and environmental costs of gold mining, while concentrating benefits among those who control capital, information, and market access. The result is a sector that generates impressive aggregate statistics while trapping thousands of miners and their families in vulnerable livelihoods.

Vision of the Guyanese National Mining Syndicate. Photo by UNEP.

This analysis has demonstrated that the core problem lies not in the global gold market or the geological characteristics of Guyana's deposits, but in the structural distortions that prevent miners from capturing the full expected net value of their production. The concept of the **expected net price realised** provides a powerful analytical lens through which to understand these distortions. Information asymmetries allow traders to systematically underprice gold through opaque purity assessments. Insecure tenure creates incentives for rapid resource depletion while preventing productive miners from capturing the returns to their discoveries. Open access conditions drive excessive competition that dissipates resource rents while accelerating environmental damage. Regulatory complexity favors those with superior capital and connections while excluding vulnerable miners from formal sector opportunities.

However, the analysis also reveals significant reasons for optimism. Amerindian Villages and other community-based institutions demonstrate that alternative governance arrangements can achieve better outcomes under appropriate conditions. The theoretical models show that even modest institutional reforms could substantially improve both efficiency and equity in the sector. Most importantly, the five recommendations outlined in this paper represent a

coherent strategy for expected net price recovery that could address the fundamental causes of sector dysfunction.

Community-owned purity grading would eliminate one of the most direct forms of exploitation while building local technical capacity. Controlled access mechanisms would address the tragedy of the commons while preserving opportunities for productive miners. Equity-based contracts for tributors would align incentives for sustainable exploration while providing income security for those who bear the greatest risks. Value chain diversification would capture more value from gold production while creating skilled employment opportunities. Environmental bonding with shared responsibility would internalize environmental costs while providing funds for restoration and community compensation.

The window for such transformation may be narrowing as easily accessible deposits are depleted and environmental costs escalate, but the current period provides an unprecedented opportunity to invest in institutional reforms. The choice facing policymakers is clear: continue with business-as-usual arrangements that generate impressive statistics while perpetuating vulnerable livelihoods, or embrace institutional reforms that unlock the sector's true potential for sustainable development.

Success will require coordinated action across multiple institutions and sustained political commitment to reform, but the potential rewards justify the effort. By reengineering the institutional environment around the expected net price realised, Guyana can transform ASGM from a poverty trap into a viable development strategy that respects ecological limits, embeds local governance, and captures the full value of its subterranean wealth for those who extract it. The analysis provided here offers both the theoretical foundation and the practical roadmap for achieving this transformation.

The stakes could not be higher. As Guyana navigates its economic transition, the treatment of traditional sectors like ASGM will determine whether resource wealth becomes a foundation for inclusive development or simply another source of inequality and environmental degradation. The reforms outlined in this paper offer a path toward the former outcome, but only if implemented with the urgency and commitment that the sector's challenges demand. The opportunity is unprecedented; the question is whether it will be seized.

Miner participants during a capacity development training on mercury-free processing method organized by AGC in Guyana. Photo by AGC

Glossary of Terms

Appropriation Externality	The negative impact on other resource users when one person extracts from a common pool resource, increasing costs for everyone else.
ASGM (Artisanal and Small-scale Gold Mining)	Small-scale, labor-intensive mining operations typically using basic equipment like dredges and employing fewer than 20 people.
Cartel-Fringe Model	An economic model where dominant firms (cartel) have market power while smaller firms (fringe) act as price-takers, commonly applied to resource industries.
Common Pool Resource (CPR)	A resource system where users can subtract from the resource stock (rivalry) but it's difficult to exclude potential users (non-excludability).
Dutch Disease	Economic phenomenon where resource boom (like oil) leads to currency appreciation and wage increases that make other tradable sectors less competitive.
Externality	A cost or benefit that affects parties not directly involved in an economic transaction, often leading to market inefficiency.
FPIC (Free, Prior, and Informed Consent)	The right of Indigenous peoples to give or withhold consent to projects affecting their territories, as required under international law.
GGMC (Guyana Geology and Mines Commission)	The government agency responsible for regulating mining activities in Guyana.
GNBS (Guyana National Bureau of Standards)	The agency responsible for establishing and maintaining standards, including for gold purity assessment.
Hotelling Rule	Economic principle stating that the net price of a non-renewable resource should rise at the rate of interest for optimal intertemporal allocation.
Information Asymmetry	A situation where one party in a transaction has superior information compared to another, often leading to exploitation.
Intertemporal Externality	The impact of current resource extraction on future availability, particularly relevant for non-renewable resources like gold.

McKelvey Box	A framework classifying mineral resources based on geological assurance (certainty of existence) and economic feasibility of extraction.
Nash Equilibrium	A game theory solution where each player's strategy is optimal given other players' strategies, and no player wants to unilaterally change.
Net Price Discovery	The process by which the effective price received by producers (global price minus all costs and rent extractions) is determined through market and institutional mechanisms
Principal-Agent Problem	conflict arising when an agent (tributor) acting on behalf of a principal (claim holder) has different incentives and may not act in the principal's best interest.
Prisoner's Dilemma	A game theory scenario where individual rational choices lead to suboptimal outcomes for all participants.
Stag Hunt	A coordination game where players can achieve better outcomes through cooperation but face risks if others don't cooperate.
Sustainable Livelihood Framework (SLF)	An analytical approach examining how people use various capital assets (human, natural, financial, social, physical) to build sustainable livelihoods.
Tragedy of the Commons	A situation where individual rational behavior in exploiting a shared resource leads to overuse and depletion, harming collective welfare.
Tributor	A miner who operates equipment on someone else's claim, typically sharing profits with the claim holder under informal agreements.

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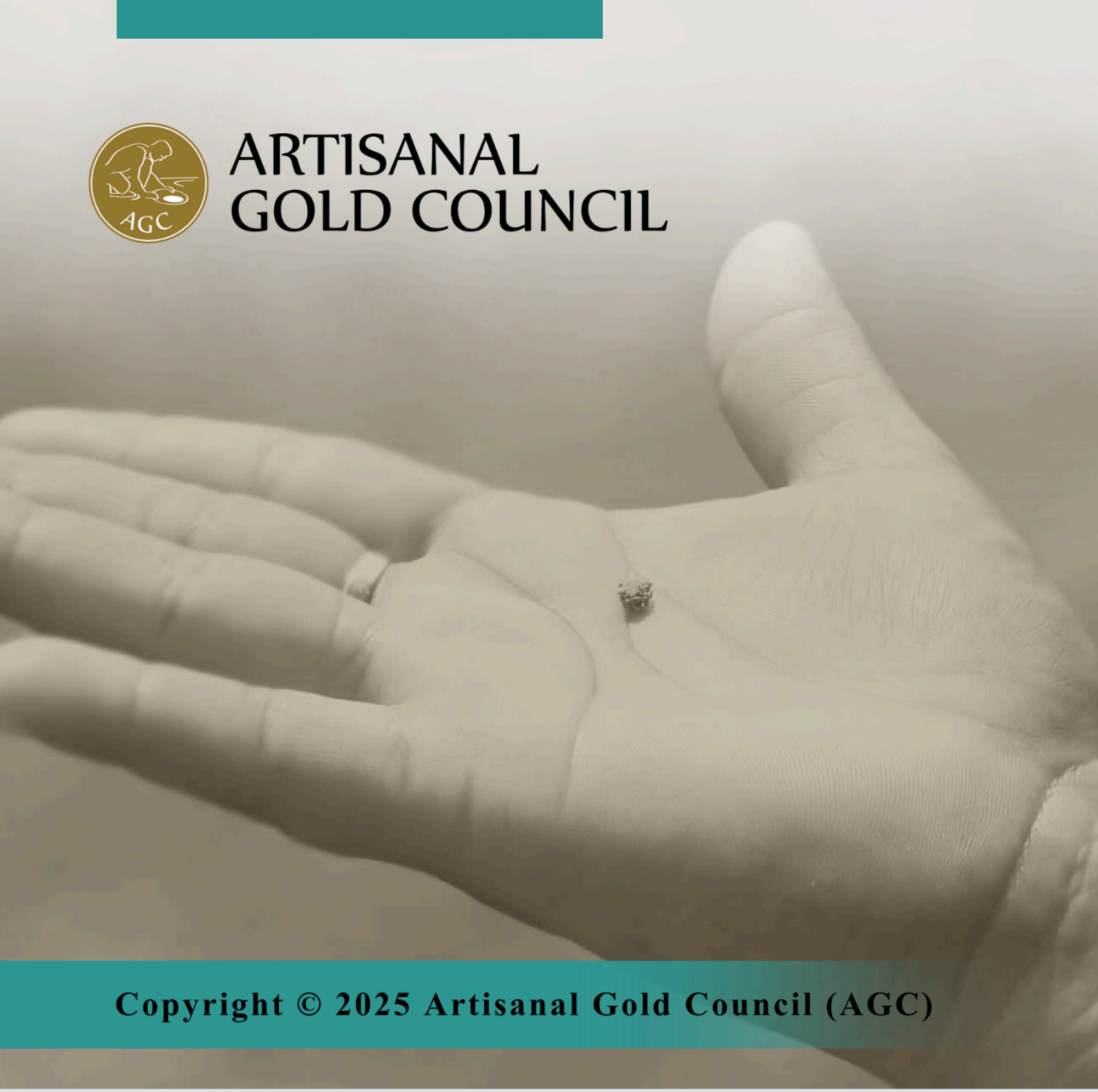

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