Over-spilling institutions: the political ecology of 'greening' the small-scale gold mining sector in Guyana

Article (Accepted Version)

Hook, Andrew (2019) Over-spilling institutions: the political ecology of 'greening' the small-scale gold mining sector in Guyana. *Land Use Policy*, 85. pp. 438-452. ISSN 0264-8377

This version is available from Sussex Research Online: <http://sro.sussex.ac.uk/id/eprint/84036/>

This document is made available in accordance with publisher policies and may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher's version. Please see the URL above for details on accessing the published version.

Copyright and reuse:

Sussex Research Online is a digital repository of the research output of the University.

Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable, the material made available in SRO has been checked for eligibility before being made available.

Copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

Over-spilling institutions: the political ecology of ‘greening’ the small-scale gold mining sector in Guyana

Andrew Hook

Science Policy Research Unit (SPRU), University of Sussex Business School, University of
Sussex

Jubilee Building, Room 366, Falmer, East Sussex, BN1 9SL

Phone: +44 7943 382093, Email: a.hook@sussex.ac.uk

Acknowledgements: Thanks to the Environmental Protection Agency (EPA) of Guyana for assistance with research permits. Also, thanks to the Guyana Geology and Mines Commission (GGMC) who assisted with logistics in the Potaro and Mazaruni Mining Districts and with access to the Guyana Mining School and Training Institute (GMSTI) and to geospatial data through the Geospatial Information Management (GIM) Unit. This research was conducted with the assistance of an Economic and Social Research Council (ESRC) Studentship.

Abstract:

This article applies a political ecology framework to examine the challenges of ‘greening’ Guyana’s relatively established small-scale gold mining sector. Based on a year of fieldwork conducted in Guyana’s gold mining landscape, the article highlights a range of ways in which the supposed stability and transparency of Guyana’s institutional mining framework is undermined by the dynamic and discretionary realities of actual small-scale gold mining activity. The tendency of mining activity to overspill institutional boundaries is contributing to worsening ecological conditions in the country’s interior. For miners, it is shown that, even having acquired or accessed formal property, they face various challenges (such as minimal state support, stressed conditions of production, and tenure insecurity) that compromise their ability to enact ‘green’ mining. The state meanwhile faces related challenges in ensuring that dynamic and fluid mining activity remains within its legal and literal boundaries. Overall, the article illustrates how the mainstream green mining ‘storyline’ – based on the notion of formal institutions as a disciplining or containing force – is disrupted by an intimate interaction among unruly socio-ecological realities.

Keywords: Small-scale gold mining; ‘green’ policies; institutions; political ecology; Guyana

1. Introduction

The artisanal and small-scale mining (ASM)¹ sector has emerged over the past ten years in Guyana – a sparsely-populated, heavily-forested country in the north-east corner of South America – as the main engine of economic growth amidst growing global demand for minerals and rising mineral prices (Hilson & Laing 2017a). Facilitated by the increased availability of cheaper mining machinery, many new entrants have been attracted into the sector, turning the majority of Guyana’s forested land area into a mosaic of formal mineral properties (Bulkan & Palmer 2016). Gold has come to dominate the economic and geographic landscape to such an extent that by 2017, it accounted for almost 60% of Guyana’s export earnings and a quarter of its Gross Domestic Product (GDP) (Guyana Bureau of Statistics 2017).

The sector has however begun attracting attention as the main driver of deforestation and a range of other environmental problems in Guyana in the context of a growing international focus on forests and fresh water and emerging frameworks (such as Reducing Emissions from Deforestation and Forest Degradation, or REDD+²) for addressing these issues (Hirons 2015; Dezecache et al. 2017). Focus on the environmental impacts of the mining sector in Guyana has been particularly stimulated by the increasing recognition of the importance of the Guiana Shield as one of the world’s last remaining major unfragmented tropical forests (Brodie et al. 2012); by Guyana’s explicit avowal of a ‘Low Carbon’ or ‘Green State’ development pathway and its concomitant participation in REDD+ and Forest Carbon Partnership Facility (FCPF)³ programmes (Lowe 2014); and by growing political and environmental agitation among Guyana’s largely forest-dwelling Amerindian population for improved environmental

¹ Although the majority of Guyana’s gold mining comprises *mechanized* dredging activity – and therefore differs from the type of ‘artisanal’ mining discussed in much of the literature – the terms ‘ASM’ and ‘small-scale mining’ will be used interchangeably in this article.

² REDD+ is a Payment for Ecosystem Services (PES) modality that emerged out of the United Nations Framework Convention on Climate Change (UNFCCC) framework.

³ The FCPF is the World Bank-funded REDD+ framework.

governance (Dooley & Griffiths 2014). This combined attention has led the Guyanese government to focus increasingly on reforming the gold mining sector to align the activities of small-scale miners with emerging global environmental norms and benchmarks (IADB 2015). The reform interventions have ranged from new technical requirements for tailings⁴ management, to projects aimed at phasing out mercury usage (IADB 2017). However, for a range of reasons, enacting this version of green mining has been a major challenge for both miners and state, even though Guyana's ASM sector appears in many ways to represent the institutional 'ideal' – in the sense that it appears to be characterized by a relatively high degree of formalization and by a relatively progressive ASM framework (Hilson & Maconachie 2017).

This article will operationalize a broad political ecology approach – combining an analysis of mainstream 'green' ASM policy discourses with ethnographic research of on-the-ground ASM practices – to illustrate and investigate the dissonances between 'green' mining policy and practice in Guyana. In particular, it will aim to understand why, despite mainstream assumptions that comprehensive (and progressive) formal mining frameworks provide a basis of 'good' ASM practices, practising and governing ASM in Guyana proves such a challenge. In so doing it will examine the range of intervening challenges (such as minimal state support, stressed conditions of production, and tenure insecurity) that miners face in enacting 'green' policy directives, even having secured a 'formal' title. It will also examine the perhaps more significant challenges that the state faces in keeping mining within its legal and literal boundaries within a dynamic socio-ecological context. The existence of these dynamics in such a relatively 'formalized' mining economy as Guyana offers new perspectives on the difficulties that institution-based reforms may face and suggests that property rights may be no panacea in containing the externalities of small-scale gold mining. As gold mining sectors in other countries move towards the more developed socio-technical context currently found in Guyana,

⁴ The slushy waste material of the dredging process.

this article may offer some valuable insights on the issues associated with transforming such a sector.

The article begins in Section 2 by situating the discussion within a broad political ecology perspective, underlining the benefits of such an approach. It then illustrates how this lens enables a characterization of ‘green’ ASM reform as a ‘storyline’ embodying a particular logic and set of accompanying practices that centre on formal institutions. It also shows how political ecology-inspired scholarship (on ASM and beyond) offers several critiques of this mainstream storyline, especially in its acknowledgement of the wider structural relationships that may shape both miners’ ability to adhere to ‘green’ mining standards and the state’s ability to enforce them. Section 3 then introduces the specific conditions and characteristics of the gold mining context in Guyana, highlighting its socio-technical and administrative dimensions. It also examines how ‘green’ or ‘sustainable’ ASM has articulated itself in the Guyanese context in response to environmental issues through both institutional and policy reforms. In applying the conceptual lens to the empirical context of Guyana, Section 4 then examines the political-ecological dimensions that are mediating the effectiveness of green policy initiatives within Guyana’s formalized mining system. Section 5 summarizes the findings and discusses the implications of these dissonances between the mainstream storyline and the realities on the ground for the prospects of ‘greener’ ASM activity.

2. A political ecology of ‘green’ ASM policy

2.1 Political ecology, ASM, and environmental policy

‘Political ecology’ is a nebulous term encompassing work that cross-cuts human geography, political science, rural sociology, environmental studies, and anthropology – and which integrates theoretical perspectives from political economy, post-structuralism, actor-centred approaches, and socio-technical studies (Bryant & Bailey 1997). Political ecology’s

epistemological roots lie in early writings that focused on how unequal power relations, conflict, and capitalist-driven processes of modernization are key forces in “reshaping and destabilizing human interactions with the physical environment” (Walker 2005, p. 74).

However, distinct from – and in response to – the traditional ‘structuralist’ view of the biophysical environment that tended to cast it as “simply a stage or arena in which struggles over resource access and control take place”, political ecology takes a deeper appreciation of socio-ecological relationships (Zimmerer & Bassett 2003, p. 3). It thus focuses not only on how the particularities of natural resources and the environment (such as the location or nature of an oil or gold deposit) can shape social, economic, political, and institutional dynamics in particular places, for particular people, at particular times; but also on how resources, ecosystems, and communities are themselves shaped and affected by social, political, economic, or institutional dimensions (Bridge 2004; Bakker & Bridge 2006; Heynen et al. 2007). In the ASM literature, several authors (e.g. Bridge 2004; Bakia 2014; Malpeli & Chirico 2013; Spiegel 2014; Salman 2016) have captured these intimate socio-ecological interactions.

More recent political ecology approaches, influenced by post-structuralist thought, prioritize the analysis of how policy approaches for managing the human-environment relationship are shaped by dominant forms of knowledge (Forsyth 2004). This work takes an avowedly normative view of knowledge construction, seeing it as dependent on the ontological, epistemological, and political perspectives of particular situated actors (Robbins 2011). Political ecologists recognize the tendency for dominant forms of knowledge to take on the aura of authoritative truth by theorizing knowledge as ‘discourse’ (Adger et al. 2001). An elegant way of thinking about environmental policy discourses is Hajer's (1995) concept of a ‘storyline’, which he defines as a simple narrative through which elements from many different discursive spheres are combined to provide actors with symbolic references that imply a common understanding. By framing policy approaches as ‘storylines’, it opens them up to

analysis in unique ways according to which their abstractions can be tested against reality, enabling the identification of new storylines (and thus new policy approaches) (Hajer 1995). Among ASM scholars, Hirons (2011) is one of the few to have engaged explicitly with poststructural political ecology to examine the epistemological roots of environmentally-oriented ASM policies.

A growing body of work in the political ecology tradition has applied a hybrid methodological approach to the analysis of environmental policy narratives and policy approaches, conducting in-depth field research to challenge dominant discourses. In this regard, Peluso's (1992) work on forest politics and policies in Indonesia and Fairhead and Leach's (1996) work on environmental change and policy interventions in West Africa are exemplary works. While there is far from a consensus that political ecology should attempt to apply itself to policy problems in order to be 'useful' in this way (Walker 2005; Rocheleau 2008; Blaikie 2012), others argue that disrupting the dominant representations of social and ecological reality that underwrite policy approaches – through a closer engagement with situated, on-the-ground realities – can help reveal pathways towards more inclusive *and* effective interventions (Zimmerer et al. 2003). In terms of scholarship that has explicitly applied this type of methodological approach to the study of 'green' ASM policies, Spiegel's (2017) examination of the justice implications of Environmental and Social Impact Assessments (ESIA) is of note.

2.2 The 'green' ASM storyline: formal institutions

So how can political ecology analysis help us to understand better the rationalizations behind (and practices constituting) 'green' ASM reform? While a small number of studies have explicitly sought to investigate the epistemological assumptions underlying environmentally-oriented ASM reform (e.g. Hirons 2011; Spiegel 2017), a broader range of other work has implicitly examined these reform agendas. As such – and following Hajer (1995) – it is possible

to use this work to characterize the dominant approach to ASM reform as a ‘storyline’ that assumes ‘responsible’ mining should be predicated on private mineral property rights and a supporting regulatory and technological framework. As many scholars have noted, such an approach appears underwritten by a so-called ‘legalist’ epistemology that argues that “most social and environmental problems associated with the sector stem from the fact that ASM is predominantly unregulated and operates outside the legal sphere” (Maconachie & Hilson 2011, p. 293). On a practical level, these agendas therefore aim to bring illegal small-scale mining activity into the formal sector, while redefining the terms and parameters of legal mining activity (Siegel & Veiga 2009; Hilson & McQuilken 2014; Hilson & Maconachie 2017).

The agendas are predicated largely on the institutional ideas of thinkers such as de Soto (2000) which assume that actors can be guided towards ‘sustainable’ modes of behaviour through carefully calibrated institutional design (Scoones 2016). These agendas are meanwhile consistent with the dominant Global Environmental Management ontology that believes developing natural resources in a ‘sustainable’ way through ‘formalization’ to be both desirable and possible (Adger et al. 2001; Hirons 2011; Putzel et al. 2015; Spiegel 2017). Although there are variations between jurisdictions, ASM formalization agendas today appear to be broadly based on two sets of institutional structures: private mineral property rights and supporting regulatory frameworks (Siwale & Siwale 2017).

2.2.1 Private mineral rights

Invoking de Soto’s (2000) theories on informality and development, formalization logic assumes that formal property rights are essential in making extraction a profitable activity through the guarantee of tenure security, while also enabling access to credit and other forms of assistance (Siegel & Veiga 2009). From an environmental perspective, property rights are also thought to encourage long-term investment and a more ‘sustainable’ use of the resource

(Hinton 2005). For the regulator, tenure clarification and security are considered to help the state to minimize conflict between land users, which is often caused by overlapping interests (Hilson 2002). They should also enable the state to maximize its revenues by eliminating the illegal and untaxed activity that is taking place outside the formal framework (Huggins et al. 2017). For the state, property rights are also thought to ensure that responsibility for any abuses of regulations is assigned to the perpetrator, rather than being socialized – thus protecting those who are outside the discreet, privatized mining spaces from the activity going on within (as argued on a general level by Vatn and Bromley (1997)). Formal property systems are thus considered to impose order on natural resource activity (Cleaver 2017; Sikor et al. 2017).

2.2.2 Beyond tenure – supporting regulatory and technological policies

Further to organizing mining activity into private titles, formalization advocates recognize the need for accompanying formal rules, regulations, and monitoring to guide and guarantee good practices (Siwale & Siwale 2017). Clausen et al. (2011, p. 19) argue that only where miners are held responsible for damage done do they “have incentives to develop their claims in an environmentally, socially, and economically sustainable manner”. A substantively efficient ASM law would therefore have to include “a clear set of duties that miners have to obey, such as controlling the use of toxic chemicals used to process the minerals and rules governing the use of explosives” (ibid. p. 19). Although improved environmental practice in small-scale mining has sometimes been seen as more of an ancillary benefit of greater formalization, it has risen to prominence as a primary motivation for reform in recent years (Masson et al. 2013). The text of the Minamata clause⁵, for example, implies that formalization will be synonymous with better environmental management of mercury (Spiegel et al. 2015). Rules and regulations may then involve bureaucratic requirements for obtaining mine licences and mining

⁵ See <http://mercuryconvention.org/Portals/11/documents/Booklets/COP1%20version/Minamata-Convention-booklet-eng-full.pdf>

permissions and specific technical requirements for mine management (such as correct mercury usage and the acquisition of ESIA's) (Spiegel 2017).

As non-compliance is considered the greatest challenge in governing ASM, theorists believe that the threat of onerous punishment can deter transgressions, and enforcement can be aided by comprehensive state monitoring (Spiegel 2012). Because meeting these new standards essentially requires "turning an ASM operation into a sustainable and profitable industrial extractive unit" (Seccatore et al. 2014, p. 804), some writers acknowledge the need to support miners in acquiring whatever technological capacity is required to meet new formalization requirements (Siwale & Siwale 2017). Siegel and Veiga (2009, p. 51), for example, argue that, as well as working within a formalized tenure framework, smaller miners should be 'capitalized' "in ways that permit them to move from transient artisanal mining so that they can move to more sustainable small- and medium-scale mining."

2.3 Critics of formalization from (a broad) political ecology

Although less work has examined challenges associated with implementing explicitly 'green' ASM formalization policies (and, as previously mentioned, hardly at all from an explicitly poststructuralist perspective), a range of work has nonetheless drawn attention to some of the potential challenges and limitations of formalization policies more generally. These relate both to the challenges that miners face in adhering to the standards demanded by formal mining rules and regulations and challenges that the state faces in enacting and enforcing these institutions. Much of this work responds to Hirons's (2011, p. 353) call to move beyond analysis "dominated by work on technical improvements" and towards a recognition that the task of formalizing ASM is mediated by broader political-economic and socio-ecological relationships. In that sense, this work could be said to share an *implicit* link to political ecology

perspectives. Overall, it problematizes the notion that formal institutions should be considered a panacea for managing the negative impacts of ASM activity.

2.3.1 Miners' ability (and willingness) to participate in and adhere to formal mining practices

Even before examining challenges miners may face in operating within a formal system, their ability to even participate in the system in the first place should not be taken for granted. Indeed, in ASM systems in many countries, high barriers to entry may exist for smaller miners, with property application fees and technical requirements only within the reach of larger 'medium-scale' miners (Siwale & Siwale 2017; Hilson et al. 2019). Alternatively, land access may be contingent on political patronage, discriminating against those who lack these connections (Verbrugge et al. 2015; Hilson et al. 2017). Where miners are ultimately unable to access the formal system, they may be driven to operate illegally, driving conflict with other land users (Nyame & Blocher 2010). Although it is not inevitable that mining taking place outside formal properties will necessarily contribute to environmental degradation, the extra pressure that these expressions of informality place on the state may contribute to the mis-allocation of time and resources that could have otherwise been used to prevent ecological degradation elsewhere (O'Faircheallaigh & Corbett 2016).

Where miners *can* acquire or access formal property, their ability to comply with regulations may be hampered by expensive technical expectations and requirements that are often modelled on larger-scale operations (Spiegel 2017). Mercury-free recovery technologies, for example, such as Knelson Concentrators, Shaking Tables, and Gold Katchas, are beyond the means of most small-scale miners (IADB 2015). These financial difficulties are often compounded by the fact that, in spite of the promise that property titles would bring access to finance, "the overwhelming reality on the ground is that formalized ASM operators continue to face momentous challenges in accessing credit" (Siwale & Siwale 2017, p.3). Where miners'

ability to comply with rules is not possible, it may once again drive practices that contribute to ecological degradation (Hilson et al. 2017).

As well as the fact that there has been little historic state, non-governmental organizations (NGO), or private sector support to help ASM operators meet these formal requirements, smaller miners are often operating within further constraining structural conditions defined by class relationships and conflict dynamics (Siwale & Siwale 2017). In Guyana, for example, it has been increasingly recognized that while many landless dredge owners have been able to access a legal property to work within, they have found themselves vulnerable to exploitation by a powerful class of land owners (Bulkan & Palmer 2016). These insights support Ribot and Peluso's (2003, p.162) argument: that a realm of factors – such as “technology, capital, markets, knowledge, authority, social identities and social relations” – can shape natural resource users' ability to thrive, *even where legal property rights have been secured*.

Compounding these material constraints to institutional adherence may be subtler discursive contestation around the policy narrative itself. This contestation may ultimately undermine miners' willingness to adhere to rules and regulations. Indeed, if miners are sceptical about the framing of the reform agenda, they may resist or evade it, underlining the contested nature of environmental knowledge (Keeley & Scoones 2003). Veiga et al. (2014), for example, show how specific ‘clean’ recovery technologies, such as mercury retorts, were rejected by miners in Zimbabwe as they were found to be inappropriate for miners' methods. Similarly, miners' perceptions of policy illegitimacy may lead to their refusal to engage with the formal mining agenda (Geenen 2012; Heemskerk et al. 2015). In French Guiana, for example, a strict mercury ban was enacted with no prior warning, leading to a dramatic increase in wholesale regulatory evasion by miners (Veiga et al. 2014). Thus, the perceived *legitimacy* of formal rules and regulations is also essential in encouraging policy ‘buy in’ (Clausen et al. 2011).

2.3.2 State capacity and integrity to enforce and monitor formal mining

At the same time as miners themselves may be unable (or unwilling) to access formal property or adhere to formal standards and requirements, states may also struggle to ensure the overall functioning of the formal framework (Spiegel 2012). A lack of resources – financial, technical, and human – may, for example, limit the state’s capacity to train miners in the necessary ‘clean’ mining techniques (Seccatore et al. 2014). Alternatively, an under-resourced state may lack the capacity to gather the prospecting information about deposits that is needed to minimize haphazard mining practices (Clifford 2011). A lack of capacity or political will to develop an effective calibration of policies and regulations may meanwhile result in a regulatory system that is ineffective in deterring negative practices among miners who are content to pay the minimal fines and continue polluting (Spiegel et al. 2018). States themselves, despite platitudes to international donors about enforcing standards, may equally be reluctant to constrain profitable sectors which provide significant employment for their population (as well as being sources of revenue and rent for certain state actors). Ongolo and Karsenty (2015) observed such processes in Cameroon where the state failed to implement agreed-upon international forest policies, despite pledging to the contrary.

From a practical point of view, state mining regulators may also face serious challenges in performing the necessary monitoring and enforcement across inhospitable ASM geographies (Hirons 2011). These challenges may be confounded by the temporal cycles of ASM activity, which, according to Lanzano (2018, p. 258), are driven ineluctably by “short-term strategies oriented toward profit maximization”. They may also be complicated by the proliferation of discretionary and informal mining arrangements, which can blur the lines of accountability between property owners and miners, making monitoring and enforcement particularly challenging (Van Bockstael 2014; Verbrugge 2015; Peluso 2018).

Scholars in other areas of natural resource studies have drawn attention to the more profound limitations of legal institutions such as property rights and human management techniques in controlling and containing certain complex and dynamic socio-ecological phenomena. Indeed, as Scoones (1999, p. 490) observes, there is a “growing appreciation of complexity and uncertainty in social-ecological systems and, with this, the recognition that prediction, management, and control are unlikely, if not impossible.” Given the non-linear nature of flows of tailings and other effluvia, a regulator is thus clearly faced with significant challenges in holding perpetrators to account (Hentschel et al. 2002; Hinton et al. 2003; Miserendino et al. 2013). From a broader perspective, states’ efforts to control degradation within their own borders may also be undermined by changing policy approaches in other countries: the introduction of a more restrictive law in a neighbouring country, for example, could cause illegal miners to cross the border into another (Dezecache et al. 2017).

While observers often assume that redressing such weaknesses is purely a question of funding greater surveillance through increased officer numbers or re-calibrating incentive frameworks (e.g. Miserendino et al. 2013; IADB 2017), there is widespread documentation of ‘petty corruption’ in the mining literature, with rules and regulations evaporating in the face of a bribe (Robbins 2000; Kolstad & Søreide 2009; Peluso 2018). In such a context, neither an increase in officer numbers nor the introduction of stricter punishments are likely to have a serious impact, especially where the rules effectively exist only on paper (Crawford & Botchwey 2017).

2.4 Putting the framework into action in Guyana

In order to examine ‘green’ mining policy and practice in Guyana according to a political ecology lens (and thus interpret the relevance of the preceding debates in the literature to Guyana’s case), a hybrid methodological approach was taken that aimed to compare stated

policy aims with the ground-level realities associated with implementation. Such a strategy reflects political ecology's commitment to exploring subjective impressions and experiences in order to problematize conventional environmental policy framings (Forsyth 2004). As the 'social' and the 'ecological' are understood to be interlinked, it also required engaging with data on both the socio-political dimensions of mining (such as the social relations of land access) and the technical dimensions of mining (such as the geophysical dimensions of gold mining) (Salman 2016).

To gather a comprehensive picture of the gold mining sector and historic reform agendas in Guyana, an extensive range of documentation (that included laws, regulations, and government and NGO reports on mining, land tenure, environmental projects, and Amerindian issues) was collected. Much of the quantitative mining data were found in the Guyana Geology and Mines Commission's (GGMC) C. N. Barron library, while other documents were obtained at the National and University libraries. The online archives of the *Stabroek News*, *Kaieteur News*, *Demerara Waves*, and *Guyana Chronicle* newspapers were also used to search for historical stories and information about mining-related issues, and to track the course of national and local narratives on mining and reform. The Geographic Information Systems (GIS) maps that feature in this article were downloaded from Guyana's public Geospatial Information Management (GIM) Unit website⁶ and edited by the author using QGIS software.

Based on the understanding that a policy "problem" must be seen from inside the "specific historical and geographical context" (Leach & Mearns 1996, p. 446), a range of qualitative data was also collected during a year of fieldwork in Guyana between May 2016 and June 2017. This process included: conducting 143 semi-structured interviews with different types of miners, Amerindian villagers, GGMC officials, and policy professionals; conducting field-

⁶ See <http://data.gim.gov.gy/>

based observation of mining practices in the Potaro and Mazaruni Mining Districts at more than 50 different types of gold mines; and engaging extensively with miners and officials through the Guyana Mining School and Training Institute (GMSTI) – as well as attending several classes on mining safety, prospecting, and environmental regulations. Across these sites, different actors’ interpretations and experiences of mining and mining reform were gathered to ultimately understand better the phenomena that were potentially being misread, oversimplified, or omitted by the mainstream policy ‘storyline’ on ‘green’ mining in Guyana.

3. Small-scale gold mining in Guyana: the national context and environmental policies

3.1 An overview of the sector

Unlike in many other contexts, where debates about formalization often centre around the persistent failure of states to accommodate or support ASM within the legal framework (e.g. Verbrugge & Besmanos 2016; Van Bockstael 2014, 2019; Hilson et al. 2019), ASM has been formalized in Guyana, i.e. recognized by the state and governed by legal institutions, since the late 19th century (Lowe 2003). This very early formalization was primarily aimed at seeking to control revenues while also preventing Guyanese from entering the mining sector – a move that would have threatened colonial sugar plantations’ labour pool (Clifford 2011). Since 1886, when the first law outlined a process for licensed mining, a slew of Mining Ordinances and Acts followed, including the Principle Mining Ordinances of 1903, 1922, and 1931, and the Mining Acts of 1972 and 1989 (Lowe 2003). According to the 1989 Mining Act, only Guyanese citizens can apply to mine – a deliberate move that has created a largely local and small-scale sector (Hilson & Laing 2017a). This legal structure stands in contrast to other Latin American countries where the prioritization of large-scale mining in the development of mining laws and regulations has contributed to a corresponding lack of local benefits (Hentschel et al. 2002).

Today, Guyana's landscape resembles a mosaic of formal (small and medium-scale) mineral properties, as illustrated in the map on the left in Figure 1, which shows the distribution of medium-scale mineral properties to the west of Bartica, one of Guyana's main mining towns (highlighted on the national map on the right by a yellow box). Although rising land demand has meant that available property has become scarce in recent years, rental fees have remained low, with the annual charge for a small-scale claim only at around US\$5 per year. This relatively accessible framework has stimulated high ASM participation, with more than 90% of all operators at the ASM scale (as opposed to the large-scale), and their contribution to total gold production at 75% of the total (Hilson & Maconachie 2017).

Figure 1: Medium-scale mineral property distribution west of Bartica (2015)

Source: GIS layers adapted by author from GGMC Geoserver. Accessed at <https://geoserver.ggmc.gov.gy/>

As well as the modern tenure framework (and its comprehensive mapping by the state using GIS), a detailed set of rules and regulations governs mining activity, specifying everything from the inspection requirements for tailings dams⁷, the types of safety equipment required when handling mercury⁸, and the minimum distance mining is allowed to take place from the

⁷ Mining (Amendment) Regulations No 3 of 2005 r245.

⁸ Mining (Amendment) Regulations No 3 of 2005 r127.

low water mark of a river bank⁹. These rules are embodied not only in specific mining laws and regulations, but are also contained in related laws, such as the Amerindian Act and the Protected Areas Act. Miners transgressing any of these rules risk being fined or having equipment confiscated.

Across this formalized landscape, 90% of gold mining in Guyana today is carried out by land dredges, which are essentially mechanized mining set-ups comprising plastic piping, diesel-powered engines, wooden sluice boxes, high-pressurized water hoses, and water-pumps (IADB 2015). In general, this socio-technical style of mining is less common in sub-Saharan Africa (the most commonly studied ASM context) than it is in Latin America and it generates unique environmental challenges (e.g. Seccatore & de Theije 2017; Cortés-McPherson 2019). The scale of this mechanized, largely regularized mining activity expanded gradually since the mid-1990s, and rapidly since the mid-2000s, as illustrated in Figure 2. Indeed, while in 1987 there were just 327 dredges licensed to operate in Guyana, by 2012 there were 4,868. These patterns were closely related to the world gold price.

Figure 2: Number of dredges licensed in Guyana vs world gold price over time

Source: Adapted by author from GGMC Annual reports and kitco.com

The number of small-scale claims also increased between 1987 and 2015, from 426 to 23,759 (a number that included 16,100 land and 7,470 river claims). The number of medium-scale

⁹ Mining (Amendment) Regulations No 3 of 2005 r251

mining permits meanwhile increased from 202 in 1992 to 3,773 in 2015, and the number of medium-scale prospecting permits increased from 1,600 in 1994 to 10,049 in 2015. The relationship between the world gold price and medium-scale mining permits over time is illustrated in Figure 3.

Figure 3: Medium-scale mining permits in Guyana vs world gold price over time

Source: Adapted by author from GGMC Annual reports and kitco.com

Spatially, the expansion in property demand has seen small and medium-scale mineral property coverage increase from 11,736 acres (or 0.02% of Guyana's total land area) in 1987 to around half of Guyana's total land area by 2015, as illustrated in Figure 4 (where the orange colours represent medium-scale mineral properties and the pink colours represent Amerindian villages). Although mining on Amerindian village land is illegal without GGMC permission, it is a common practice (IHRC 2007; Hennessy 2015; Hilson & Laing 2017b). Thus, many of the issues discussed in this article relate to mining taking place on *both* State Lands (which comprise 85% of Guyana's land area) *and* Amerindian lands (which represent 15% of Guyana's land area).

Figure 4: Mineral property distribution and Amerindian villages in Guyana as of 2015

Source: Adapted by author using QGIS from data downloaded from Guyana GIM Unit portal. Accessed at <http://data.gim.gov.gy/>

Although mineral property expansion appears comprehensive, dredging activity is not taking place in every single claim or block, with many devoid of licensed activity¹⁰. Indeed, although there were 23,570 claims and 3,773 MPs in 2015, this only corresponded to 3,349 licensed dredges. The number of ‘live’ operations will be winnowed down further when one considers that the total number of licensed dredges will not necessarily reflect the total number operating. Indeed, according to GGMC Officers, for a range of reasons, as many as half of licensed dredges may end up being dormant if a miner cannot raise the capital to finance an operation, or if bad weather forces them to cease mining, for example. The number of ‘live’ operations is a number best captured by Figure 5, showing monitored dredge activity for 2016 (where the blue dots signify ‘monitored’ dredges).

¹⁰ Of course, this doesn’t mean that illegal, unlicensed dredges couldn’t be operating out of sight and knowledge of GGMC officers.

Figure 5: Map showing monitored dredges in Guyana for 1st, 2nd, and 3rd quarters of 2016

Source: GGMC

3.2 Growing environmental impacts and policy responses

3.2.1 Environmental impacts

The expansion in gold mining activity since the early 2000s led to an increasing visibility of environmental impacts that invited corresponding policy and public responses (Roopnarine 2002, 2006; IHRC 2007; Hennessy 2015). A major area of contention is the impact of gold mining on forests. Although data is scarce before 1990, a range of quantitative and spatial data now directly links rises in deforestation to extractive activities, principally gold mining (Dezecache et al. 2017). While forest loss averaged 0.01% per year between 1990 and 2000 (an annual loss of 2,217 ha), by 2010, 91% of all recorded annual deforestation (or 10,287 ha) was attributed to horizontal expansions in land dredging activity, with annual forest loss jumping to 0.06%. Figure 6 illustrates the extent to which the world gold price and forest loss

have dovetailed over the past 20 years in Guyana. The failure of miners to ‘back-fill’ and re-contour mines having deforested an area can lead to the creation of permanent pools of stagnant water (IADB 2015). These can become magnets for mosquitoes – a major cause of malaria and other insect-borne diseases, such as Dengue fever and Zika – which can affect local populations, especially Amerindian villages (IHRC 2007).

Figure 6: World gold price vs deforestation in Guyana over time

Source: *kitco.com* and *Guyana Forestry Commission*

Perhaps the most serious impact from alluvial gold mining, however, is disruption to rivers (Hilson & Vieira 2007; GHRA 2017). The release of overburden material and wastewater by mining operations into streams and rivers pollutes the water, affecting livelihoods and domestic uses of those resources (Thomas 2009). Amerindians are most affected by this in Guyana through the impacts of turbidity on their fishing activities and pollution of their drinking water sources (Colchester et al. 2002; Hennessy 2015). Such occurrences are supposed to be prevented by miners preparing tailings ponds and dams, but there are frequent lapses in practice (IADB 2017). River dredging, especially using *dragas*¹¹, is also considered to be a major cause of river degradation, especially due to the highly damaging ‘cutter head’ technology (shown in

¹¹ A modern and powerful type of river dredge developed in Brazil.

Figure 7) that bores into the river banks and river beds (GHRA 2017). Public attention on river pollution escalated in 2017 following the Guyana Human Rights Association's (GHRA) (2017) exposure of widespread river pollution and degradation in the Upper Mazaruni region (where they dramatically claimed the Puruni River was “a ruinous mess of tailings and devastation”).

Figure 7: The 'cutter head' part of the draga

Source: Author

Strongly related to water pollution is mercury pollution, with the ASM sector thought to be responsible for as much as a third (or around 727 tonnes) of global total annual global anthropogenic mercury pollution (UNEP 2013). Although mercury is decreasingly used in the mining pit itself in Guyana, most miners still use it in the final process of separating the gold from the sandy contents of the sluice box (IADB 2015). Once this material is isolated, miners use a blowtorch to burn away the amalgam to leave the raw gold (Hilson & Vieira 2007). As well as exposing their skin to contact with mercury (as the majority do not wear gloves or other protection), miners also expose themselves to mercury vapours in the process of burning the mercury, as few use retorts or respirators. As mercury often runs off in tailings material, traces of it end up in rivers and creeks, where it enters the food chain (Childress 2010).

3.2.2 Policy responses

While there is not an explicit ‘green’ mining policy in Guyana, there have been increasing attempts over the past 20 years to introduce new regulations and enact policies that will minimize the ecological footprint from the growing expansion of gold mining activity¹² (IADB 2015). These agendas have been driven strongly by international actors and discourses but have also been shaped by growing local recognition of the environmental impacts of mining (IADB 2017). Although the wheels of reform were already in motion as a result of the rapid increase in land dredging from the early 1990s, the 1995 Omai cyanide spill (when a large-scale mine collapsed, releasing millions of gallons of polluted water into the Essequibo river) was the stimulus for a flurry of environmental legislation and activity in Guyana (Bulkan 1998).

The approach in Guyana to dealing with the environmental effects of mining has broadly betrayed the same formalization logic as the one outlined in Section 2.2, holding to the principle that making ASM activity more ‘sustainable’ is, in theory, both desirable and possible (Lowe 2006, 2014). However, Guyana’s already-formalized ASM sector means that, unlike other countries (which have focused on addressing widespread illegal mining by introducing *new* property rights regimes), Guyana’s efforts have represented more of a *consolidation* of formalization logic. In this regard, property rights interventions have focused on clarifying and defending the sovereignty of existing mineral property, indigenous land, and Protected Area boundaries; adjudicating on the new land claims of indigenous villages; and resolving conflicts between mineral property owners and other land users (IADB 2015, 2017).

As far as regulatory and technological policies go, new codes and regulations have been introduced for mining activity taking place within legal titles, particularly the 2005 Regulations¹³, which were funded by the Canadian government under a programme called the

¹² A full list of these interventions features in the Annex.

¹³ Mining (Amendment) Regulations No. 3 of 2005.

Guyana Environmental Capacity Development Mining Project (GENCAP). These regulations covered guidelines for mercury use, mine reclamation, mine effluents, contingency and response plans, mine waste management and disposal, and tailings management (Lowe 2006; IADB 2015). As with the policing of property rights, the monitoring and enforcement of the formal rules and regulations has taken on an increasingly militarized approach through the GGMC's newly-established 'Compliance Unit' (Kaieteur News 2016a; Stabroek News 2017).

Information about these new requirements – and guidance about how to adhere – has been offered to miners in sporadic educational programmes through the GMSTI since its establishment in 2013. Stimulated by the signing of several international agreements on environmental issues such as mercury and forests, a scattering of donor and state-funded programmes have also been enacted, involving testing 'clean' recovery technologies and offering finance for miners to acquire such equipment (IADB 2015). For reasons that will be explored in the next section, so far, such measures have been largely unsuccessful due to a lack of miner buy-in (Stabroek News 2015).

4. The political ecology of green mining in Guyana: challenges for the miner and the state

4.1 Challenges for the miner

4.1.1 Insecurity within formal tenure

In conventional formalization theory, the formal property right is assumed as a stable and secure basis of tenure that can support prudent mining practices (Siegel & Veiga 2009). However, the realities of mineral property politics in Guyana undermine this notion in several ways. Although a formal tenure system is in place, miners have in recent years been increasingly unable to access their own property through the state as lands have become 'locked up' by large land owners (Bulkan & Palmer 2016). As the GGMC (2015) itself acknowledged, around 50 individuals control approximately 13,000 of Guyana's 18,000 small-scale mining

claims, leaving landless miners with no choice but to become tenants on a land owner's property. Around three-quarters of miners in Guyana work as tenants in this way, entering into formal contracts with land owners that see them pay rental fees of around 10% of gold production – two to three times higher than on land accessed through the state (Lowe 2006; Thomas 2009). There is significant suggestion that these stressed conditions of production are affecting miners' practical ability to comply with the technical principles of good mine management. As one miner argued:

When you go to work his land... because he holding out for that 10%... It's like he is forcing you then... he putting you under pressure¹⁴

Another significant factor stemming from this landlord-tenant relationship is the influence of tenure insecurity on mining practices. Although many miners have attempted to ensure that they possess the legal document protecting them from eviction since the option became available in 2012¹⁵, others reported that land owners often refuse to sign this agreement, leaving the tenant-miners vulnerable to being thrown off from the property at any time. Many miners claimed that this fear dissuades them from putting the necessary environmental and safety precautions in place before mining. Moreover, many miners reported that the uncertainty of tenure drove them to mine in a more haphazard manner than they would like, cutting corners in order to extract whatever they can before their contract is terminated. As this miner explained:

You see... when you go for this kind of arrangement, and they say, 'oh you can work, its fine... you know...' Some miners know very well what this arrangement means... So what are you going to do is try and do as much work as is possible as you can ... So they don't

¹⁴ Interview, miner, 25th November 2016.

¹⁵ This pervasiveness of the 'word of mouth' arrangements between landowners and miners led it to become a source of abuse, exploitation, conflict, and violence in the interior. As a result, the GGMC sought to regularize the process in The Mining (Amendment) Regulation 2012.

really care that much about if the trees are all the way off... what we're going to try and do is make a hustle...Because we know we don't have any papers¹⁶

As with high rental costs, it is therefore likely that the ineluctably short-termist mind-set of gold mining (Lanzano 2018) – and the poor mine practices that this mind-set drives – is being *further* intensified by the absence of any tenure stability or certainty, in spite of the fact that these miners are technically working within the 'formal' system. In this context, it appears that access to a formal property alone is no guarantee of 'good' mining practices.

4.1.2 Techno-financial exclusion

Even where property can be obtained or accessed under less insecure conditions, for many miners, the cost of purchasing or hiring machinery necessary for complying with environmental requirements is beyond their financial capacity. Indeed, in an IADB (2017) report on 'green' gold mining in Guyana, the Annex cites a price for a spiral concentrator as US\$100,000 – far beyond the means of the typical small-scale miner who is producing a matter of ounces of gold per month¹⁷. Earth-moving machinery required for the construction of tailings dams or settling ponds and mine closure activities such as re-contouring (typical expectations of 'sustainable mining') is meanwhile only affordable for larger miners, leaving poorer miners with no choice but to either practise illegally, or to leave the sector altogether. As the IADB (2015) reported, an excavator costs around GY\$30m (US\$145,000) to buy or GY\$1,000,000 (US\$5,000) per month to access through a 'hire purchase' scheme. An excavator meanwhile costs around GY\$50,000 (US\$250) per hour plus fuel to rent privately, with even smaller mining operations requiring the use of one for several days at a time in order to open

¹⁶ Interview, miner, 9th November 2016.

¹⁷ Reflecting the tacit acknowledgement that these technologies are ultimately unrealistic for smaller miners, it is telling that a 2017 Conservation International and Global Environment Facility (GEF) project entitled 'Global Opportunities for Long-term Development of the ASGM Sector – GEF Gold Program' was being piloted, not with smaller-scale miners, but on an effectively 'large-scale' mine (owned by a former GGMC Commissioner) that was allegedly extracting hundreds of ounces of gold per month (Interview, civil society actor, June 7th 2016).

up the pit and clear overburden from the mining pit walls before mining can commence. The necessity to have access to an excavator is moreover becoming greater over time as shallower deposits (those lying at less than 30 feet) become scarcer. A miner expresses these challenges as follows:

Implementing the technology that they're bringing into mining now... It would be very much expensive for the small miners to buy... So, you can't buy these things because they're GY\$2m or GY\$3m or... So that's why you're seeing it... the small miners... like, you're trying to push we out... Because you're bringing in things that you know we can't afford... They're threatening we... if we can't produce a certain amount of ounces, we'll have to stop mining¹⁸

As well as a lack of state support, miners have traditionally struggled to access finance as they are considered risky lending prospects. As a case in point, the GGMC approached the commercial banks in 2015 to manage a US\$5m Mining Development Fund to support technological development in the sector. The banks refused, citing perennial risks associated with investing in the mining sector (Kaieteur News 2015). It was later reported that not one miner had applied for the funds, with the Gold and Diamond Miners Association (GGDMA) claiming that potential technologies were beyond the reach of most small miners (Stabroek News 2015). Overall, such a predicament appears to undermine de Soto's (2000) evocation of the property right as a route to accessing finance (Siwale & Siwale 2017), particularly considering that most miners in Guyana's landlord-dominated ASM sector are merely short-term tenants with no chance of using their landlord's property as collateral.

To its credit, the Guyanese government is currently investing in trying to equip miners with the knowledge and skills (in Global Positioning System (GPS) and map-reading, for example) through the GMSTI (as seen in Figures 8 and 9). However, these courses are only attended by

¹⁸ Interview, miner, 16th May 2017.

a fraction of miners due to their infrequency and the heavy time commitment they entail. Furthermore, even equipped with the theoretical skills, miners still require significant resources to set themselves up with the technology and capital to conduct proper prospection; and then, once on the land, there is still no guarantee minerals will be found.

Figure 8 A GMSTI lecturer gives a lesson on 'benching'

Source: Author

Figure 9: Miners see a functioning 'model mine'

4.1.3 The political ecology of prospecting

Echoing emerging insights elsewhere about the powerful role of uncertainty in shaping ASM activity (e.g. Geenen 2018; Verbrugge & Geenen 2018), another major impediment to minimizing environmental degradation within formal properties is therefore the absence of reliable information about the location of gold deposits. Many miners described decision-making processes about where to mine as characterized by a 'herd mentality', with dredge owners following 'word of mouth' information about the latest big 'shout'. As one miner explains:

There is no proven scientific way of quantifying alluvial minerals... So, when everybody was saying, because of environmental issues, you need to prospect before you mine, there

is no way of doing it! There is no way of doing it! It's more luck and chance... Work and prospect¹⁹

More guaranteed methods of mineral prospecting, such as satellite imagery and deep drilling, do exist, but are only realistically within the reach of larger mining companies. This haphazard method of prospecting is one of the major drivers of what the IADB (2015, p. 85) terms “unnecessary” degradation. Indeed, as the IADB (2015, p. 85) states, although “the issue of renting barren lands to miners has been on the Government’s agenda since the 1990s, it has not been addressed.” For some, improved prospecting information is nevertheless at the heart of improving economic conditions for smaller miners. As one GGMC official recognized:

Land access is always given by miners as a major problem... However, prospecting is just as important, because what are you going to do when you get the land? Some people think enhanced recovery is more important than prospecting, but this overlooks the importance of prospecting, which would inevitably contribute to better recovery²⁰

But while the GGMC has pledged to invest more in prospecting, miners in Potaro were universally sceptical about the likely neutrality of the dissemination of this prospecting information:

The thing with GGMC is... they should have a budget to find lands that is proven. But, you know, what would happen to that land? They would give it to some of their friends! Access... is only for certain miners... But if you go with some money... like a million dollar, and ask for some assistance²¹

¹⁹ Interview, miner, 19th May 2017.

²⁰ Interview, GGMC official, 10th October 2016.

²¹ Interview, miner, 15th May 2017.

4.2 Challenges for the state

4.2.1 State capacity amidst discretionary and dynamic activity

The task of monitoring 3,000 licensed dredging operations spread across 83,000 square miles of Guyana would clearly be a logistical challenge for any regulator – even assuming that each operation was mining within its own legal property. However, as was conveyed in the previous section, there is considerable dynamism and complexity in Guyana’s ASM sector that undermines the notion that the formal property system necessarily provides a stable and transparent governance framework. Considering that the GGMC comprised (at the time of writing) just 90 officers – none of whom were permanently based ‘in the field’ at mining stations but are sent out for monitoring trips several times a year – containing this activity is clearly a challenging prospect.

A first major regulatory challenge is the growing phenomenon of ‘raiding’. Indeed, the inability of many miners to acquire or access property due to land inequality leads them to ‘raid’ on others’ properties (Kaieteur News 2016b). While these activities do not necessarily cause environmental degradation, they do generate conflict and drain scarce GGMC resources. Monitoring capacity is further stretched by the reality of multiple tenants mining on the same single mineral property. Such instances undermine the direct link between ‘property owner’ and ‘miner’, blurring the lines of responsibility and accountability (e.g. Van Bockstael 2014). The miners who *can* access formal property may often meanwhile lack the resources to adhere to environmental requirements; but rather than leaving the sector, they remain in it, invariably infringing the regulations in some way, thus contributing further to ecological degradation. As the loss of an environmental bond (around US\$500) pales into insignificance against gold mining profits, it is moreover much more efficient for miners to pay the fine rather than implement costly mine management measures. Overall, then, it appears that mining activity

not only overflows the formal property system, but it also transgresses regulations even when taking place within formal properties.

The scale of such combined infringements is difficult to estimate, due to a lack of data – a common problem in the ASM world (Heemskerk 2005). However, as recently as 2005, the IHRC (2007) estimated that, although there were 1,500 registered dredges in Guyana, there may have been as many as 9,000 *unregistered* dredges operating. Such a figure casts doubt over current official accounts claiming that only around 12% of mining activity is ‘illegal’²². The apparent pervasiveness of unregistered operations and infringements of the regulations would come as no surprise to those who have emphasized the unique inter-temporal dynamics of small-scale mineral extraction (D’Angelo & Pijpers 2018; Geenen 2018; Lanzano 2018). Indeed, in the context of ever-fluctuating world mineral prices and growing competition over resources, miners are perpetually fighting against both “the scarcity of time and uncertainty about the spatial location of gold deposits” (Lanzano 2018, p. 254).

This short-termism makes ASM different from other types of natural resource activity, where it is more reasonable to consider the property right as a source of prudent resource management (Seccatore & de Theije 2017). Indeed, unlike ‘eco-regulatory’ activities such as agriculture, miners have no long-term incentive to ‘look after’ the mining claim to make it more economically ‘sustainable’ over several years (Boyd et al. 2001; Heemskerk 2002). On the contrary, according to one miner in Mahdia²³, the priority of mining is “extract and beat out as quickly as possible”, with little regard for an environment that the miner will never have to see again. These dynamics therefore challenge the notion that a formal framework may automatically enable state monitoring efforts by containing mining activity. A Mines Officer

²² These estimates are based on GGMC monitoring reports for 2016 that recorded the number of operations that were shut down (otherwise known as being given ‘Cease Work Orders’) out of the total that were monitored.

²³ Interview, miner, 12th May 2017.

appeared exasperated at the very notion that miners would prioritize environmental management:

Do you think he's going to mine a whole area, and then plant some trees...?! No, he's not going to because, first of all, he has spent GY\$79m in gas... So, you see, even though they know they've got to maintain it, they're not... I've never heard of a miner who volunteers to plant back trees... No! It's not going to happen!²⁴

Enforcement challenges are further compounded by the inherently dynamic socio-ecological nature of alluvial gold mining activity itself, which is forever threatening to overwhelm the boundaries designed to contain it (Cremer & Warner 1990; Wotruba et al. 1998; Hentschel et al. 2002). From a transboundary perspective, for example, environmental externalities, particularly tailings material and mercury-bearing effluvia, frequently spill over the boundaries of mining properties, polluting rivers, creeks, and settlements – especially when correct mine management methods are not followed (Clifford 2011). From a trans-temporal perspective, the short-term nature of mining further means that environmental abusers are rarely held to account, with Mines Officers unable to reach the field until months after the perpetrator has disappeared.

Since the 1990s, many of these illegal miners have been Brazilians, who have crossed the porous borders into Guyana following a state crackdown in Brazil stimulated by ecological degradation in the Amazon (Roopnarine 2006). These Brazilians run operations undetected for months or years at a time before crossing back into Brazil (Dezecache et al. 2017). Although the development of drone-facilitated monitoring has been proposed in Guyana (Demerara Waves 2017), so far, a lack of resources has hampered such developments. As a result, river

²⁴ Interview, GGMC official, 9th November 2016.

bank degradation caused by illegal mining – such as that illustrated near the Amerindian village of Maicobie in Figure 10 – is common.

Figure 10: Damage to the Potaro River's banks caused by illegal river mining

Source: Author

The ever-evolving character of recovery technologies creates a further pressure on regulatory efforts by generating continuous possibilities for new frontiers to be opened up (and for previously-worked areas to again become viable). This tendency to ‘re-visit’ old areas is made inevitable by the inefficiency of the sluice box technology: as recovery rates are so low (ranging from 20% to 40%), miners know that up to 80% of the gold may be left in the tailings material (Lowe 2000). Such a process can be seen in the White Hole area of Potaro, where significant ‘green’ mining resources were expended on restoring and re-vegetating ‘mined out’ areas under the GENCAP programme, only for ongoing technological developments to make the previously-worked-out area once again viable, with the subsequent mining activity degrading the costly restoration work (as illustrated in Figure 11). Such a dynamic erodes the potential viability of policy options aimed at identifying spatially-fixed zones for mining (as suggested, for example, by Corbett et al. (2017) and Smith et al. (2017)).

Figure 11: Tailings (circled in red) run through a reforestation project in White Hole, near Mahdia

Source: Author

4.2.2 State integrity

While miners are being driven to infringe rules by the high costs of adherence, insecure tenure arrangements, and the general pressures driving extraction, there is significant evidence that transgressions have been facilitated over a number of decades by corruption within the regulator. One prior study²⁵ for example found that there was “a standard bribe of one ounce of gold to get a Mines Officer to ignore a tailings dumping problem” – a significant amount considering that a Mines Officer is only earning around GY\$100,000 (US\$500) per month. According to the research conducted in Potaro for this article, the main form of corruption is indeed where administrative or environmental abuses are overlooked in exchange for a reward, typically an amount of gold. As is illustrated by this miners’ quote below, such practices clearly have governance – as well as environmental – implications:

Two officers came up... we were ‘shitting in the river’²⁶ there... because it was a first pit and we didn’t have anywhere to put the tailings... Otherwise we would have had to dig two pits from the start, at a cost... The two officers took an ounce or so each, then a couple

²⁵ See IHRC (2007, p. 13).

²⁶ Dumping tailings into the river, rather than into a tailings pond.

of days later their two buddies came ‘round and took another ounce... And that’s the problem we’re having²⁷

There are, however, different ways of conceptualizing corruption that go beyond the simple legalistic definitions. For example, officers’ monitoring activities are often highly dependent on the hospitality and cooperation of hinterland communities, and friendships will regularly overpower the strict need to enforce rules. Cumulatively, however, such laxity may have seriously contributed to environmental problems, as one GGMC official conceded:

I do admit that there is some amount of leniency in the mining industry, in terms of holding to the letter of the law... For example, in terms of mining and the issues of reclamation and... and all of those things... If those things were imposed, then mining would have never really have blossomed into what it was... You see, they were required to reclaim every single pit that they dug... and restore it! But then it would not have been an economical venture...!²⁸

4.2.3 *Discursive disagreement*

Beyond these more *material* factors, discursive dimensions may also be undermining ‘green’ mining policy efforts in subtler ways. Indeed, while it is assumed that exposure to information about correct practices will ‘nudge’ miners towards improved behaviour (Clausen et al. 2011), many miners in Guyana are reluctant to adhere to rules and regulations because they simply don’t *believe* that the rationale for reform is justified. Some miners are, for example, suspicious that the state is attempting to further an ulterior policy agenda. As one miner explained:

²⁷ Interview, miner, 29th April 2017.

²⁸ Interview, GGMC official, 12th December 2016.

I think the approach to small miners is to phase them out... As soon as the oil declare... we gonna see it more blatant... We're gonna see it more, because you'll have another source of economic development²⁹

Alternatively, non-compliance may be rooted in miners' scepticism about the policy storyline, especially where their direct experiences conflict with the mainstream narrative. In Potaro, for example, almost all miners interviewed cited routine re-growth of vegetation following the ceasing of mining activities as evidence that casts doubt over the mining-deforestation nexus. The GGDMA's critique has meanwhile contested the idea that mining is a cause of *permanent* forest loss at all – instead arguing that mining impacts are only 'temporary' disturbances³⁰.

Similar scepticism exists in discussions about the biggest contemporary environmental concern in the ASM world: mercury pollution (e.g. Clifford 2014; Spiegel et al. 2018). While miners appeared to recognize that mercury vapours may condense and enter the water supply and food chain, many were philosophical about the possible impacts. As one miner argues:

I must have got a lot of mercury cos I should have burning a lot of gold, since when I was a youth man... They're banning mercury basically because it's affecting humans... But what about alcohol? Alcohol doesn't affect humans? ... Me ain't know when I last hear of somebody die in mercury³¹

This ambivalence about the dangers of mercury – illustrated in Figure 12 which shows a miner massaging the mercury-and-sand-mix in his bare hands – is somewhat reflected in the inconclusive nature of the (minimal) scientific data gathered thus far in Guyana (e.g. Howard et al. 2010). But beyond this epistemological opacity, there is generally a strong socio-technical

²⁹ Interview, miner, 13th May 2017.

³⁰ The GGDMA, for example, referred me to this FAO (2010, p. 24) definition: "Deforestation implies the long-term or permanent loss of forest cover and implies transformation into another land use... Deforestation also includes areas where, for example, the impact of disturbance, over utilization or changing environmental conditions affects the forest to an extent that it cannot sustain a tree cover above the 10% threshold."

³¹ Interview, miner, 12th May 2017.

association between mercury usage and poorer miners that helps to explain their reluctance to give it up as a method. Indeed, as mercury is empirically observed to be the most effective way of recovering the fine gold particles using the more rudimentary methods that smaller miners can afford (Hilson & Vieira 2007). These miners emphasize both their reluctance to abandon mercury and its appropriateness to their methods:

We small miners come from pork knocker times... We all of us using silver, right? Cyanide dangerous... we using quicksilver³² all of we days of we life... That's the only technology small miners know about... You understand?³³

I don't use a retort, because I'm only currently getting pennyweights, which means that they would be lost using the retort.... And it is time consuming... And it burns a lot of gas... If I is getting larger amounts, it is more realistic to think to use a retort³⁴

Such a reality suggests that non-adoption of new 'clean' technologies is not necessarily unreasoned evasion but can also be based on a rational decision-making process (Jønsson et al. 2013; Veiga et al. 2014). However, in the context of the prohibitive costs of 'clean' technologies, miners' ongoing reluctance to try alternatives appears as an easy decision to make. It therefore seems unrealistic to imagine that improvements in the dissemination of information and education by the state alone will be able radically change miners' current practices without additional financial support (e.g. Spiegel et al. 2018).

³² Slang for mercury.

³³ Interview, miner, 16th May 2017.

³⁴ Interview, miner, 24th November 2016.

Figure 12: A miner handles a gold-mercury amalgam mixture with his bare hands

Source: Author

This reluctance to buy into the ‘green’ mining agenda may not be limited to miners but may also extend to high-level state actors themselves. Although the Guyanese government signed the Minamata Convention on Mercury in October 2013, agreeing to ban the production, export, and import of a range of mercury-containing products by 2020 (Kaieteur News 2013), many are sceptical about its commitment. One interviewee shared a view that was echoed by many others – that, in spite of the government’s rhetorical commitments to Minamata, it was merely paying lip service to reform to keep its international partners happy:

I was, like, on a one to one basis with politicians, nearby politicians, and I would say, you know the implications of this, and I was told things like, ‘We only have to ‘talk the talk’’ ... We don’t have to ‘walk the walk’... We’ll kick the ball down the road for the next 10 years³⁵

³⁵ Interview, miner, 9th June 2016.

5. Discussion and conclusion

Although conventional formalization logic would assume Guyana is well-placed to enact a ‘green’ ASM agenda as a result of its comprehensively (and progressively) regularized mining economy, this article has shown that a range of socio-ecological phenomena appear to be undermining the successful functioning of the legal-institutional framework. These phenomena – visible to a political ecology analysis – were seen to both obstruct miners’ willingness and ability to adhere to rules and regulations and the state’s willingness and ability to manage and monitor mining activity. The illumination of these phenomena disrupts key assumptions underlying the mainstream storyline on ‘green’ formalization – principally, the notion that formal institutions are an automatically *ordering* force vis-à-vis natural resource activity (Cleaver 2017; Spiegel 2017). Moreover, it suggests that the technically-framed task of ‘dealing with’ the environmental dimensions of ASM (e.g. Hinton et al. 2003; Seccatore et al. 2014; Veiga et al. 2014) should be recognized as entangled in a range of dynamic political-ecological considerations (Hirons 2011). It also underlines that the gold mining landscape is not merely an inert “backdrop” to the legal-institutional task of ‘greening’ mining, but an active force in shaping intimately both miners’ own practices and the state’s enforcement efforts (Salman 2016, p. 1127).

While the orthodox view within the ASM formalization ‘storyline’ is that securing access to formal property rights can be something of a panacea for would-be miner-entrepreneurs, the article highlighted a range of interacting factors that are shaping the ability of ASM operators to practise the state’s version of ‘green’ mining. As well as allegations that exorbitant rental contracts with landlords are hindering miners’ adherence to costly regulations, miners’ anxieties over tenure insecurity are also driving them to mine haphazardly and to ignore environmental concerns. Such conditions are not helped by the burgeoning number of regulatory requirements and the minimal access to finance or prospecting information about

deposits. Such realities therefore cast doubt over small-scale operators' ability to turn "an ASM operation into a sustainable and profitable industrial extractive unit" (Seccatore et al. 2014, p. 804), especially in states that lack the fiscal ability (or will) to fund ASM operators (Hilson & McQuilken 2014; Siwale & Siwale 2017). The proliferation of complex tenure arrangements meanwhile also undermines the vision of a property title as a basis of transparency and stability – for either the miner or the state.

These findings support Ribot and Peluso's (2003) argument that a realm of factors beyond the purely 'technical' can shape natural resource users' ability to thrive. They also indicate that interventions aiming to support (or punish) small-scale miners should be cognizant of the constellation of structural factors (e.g. Geenen 2012; Spiegel 2014; Verbrugge 2015; Bulkan & Palmer 2016) that may be preventing miners from being able to re-orient their practices. Thus far, even though political factors such as land inequality and landlordism are recognized by policy makers as powerful determinants of miners' ultimate ability to adhere to environmental initiatives (e.g. GGMC 2015; IADB 2015), the government and other 'green' mining project partners in Guyana have been reluctant to confront such contentious issues due to political expedience.

The factors driving mining activities to overspill property boundaries and regulatory requirements are however not only related to miners' ability to adhere to rules and regulations and adopt new technologies, but also to their *willingness*. In this regard, there is evidently under-appreciated discursive contestation in Guyana around the perceptions of mining impacts on the environment, particularly with respect to deforestation and mercury. There is also scepticism about switching away from cheap and efficient technologies, such as mercury (as seen earlier by Hilson and Vieira (2007)). This highlights the importance of clashes over knowledge in influencing environmental policy 'buy in' (Forsyth 2004).

Miners' perceptions about the unfair distribution of land and the unreasonable nature of new policies meanwhile appear to be further undermining their willingness to adhere to regulations, particularly when they see larger miners being able to evade the rules through bribery or political connections (Bulkan & Palmer 2016). This provides an empirical illustration of Clausen et al.'s (2011) contention that participants' willingness to respect formal institutions is strongly related to the institutions' perceived legitimacy. Stimulating miner 'buy in' to the environmental reform agenda must then also be seen as an attempt to win over 'hearts and minds' – as well as a task of making alternative technologies available (Childs 2008).

While a popular view in the ASM literature is that illegality is driven by economic necessity (e.g. Hilson et al. (2017)), in Guyana's case, such a conclusion clearly only explains part of the story. Indeed, miners' infringements of environmental regulations appear largely *opportunistic*: miners know they generally cannot afford to comply with rules, but they also know they can get away with not doing so. This is because the GGMC struggles to properly monitor dynamic ASM activity across a vast landscape of thick forests and minimal infrastructure (Clifford 2011; Hilson & Laing 2017b). It is also because the fines punishing environmental and other abuses are insignificant compared with gold mining profits, thus making it cost-effective for miners to pay the fine and continue operating (e.g. Spiegel et al. 2018). Alternatively, miners know that they can simply pay a bribe to a Mines Officer and escape without a mark on their record. These dynamics underline forcefully that without a correctly calibrated system of regulatory incentives and punishments (Clausen et al. 2011) or adequate enforcement, formal institutions themselves are relatively meaningless (Robbins 2000; Kolstad & Søreide 2009; Crawford & Botchwey 2017). Overall, the apparent pervasiveness of regulatory infringements invites the conclusion that, while much mining activity is taking place within the formal property boundaries illustrated by Figure 1, actual

mining practices are invariably transgressing the formal rules in some way, significantly enabled by corrupt officials (as Van Bockstael (2014) observed in Liberia).

Although bolstering institutional capacity by training more officers, paying them more (in order to minimize susceptibility to bribery), and introducing more sophisticated monitoring technology (such as drones) could be effective (e.g. Ledwaba et al. 2019), there appear yet more profound enforcement challenges. One relates to the highly dynamic and non-linear socio-ecological character of ASM that has been increasingly acknowledged in the ASM literature (e.g. Bakia 2014; Malpeli & Chirico 2013; Spiegel 2014; Salman 2016; Lanzano 2018). Shaped by fluctuations in global mineral prices and guesswork about the location of deposits, miners' approach in Guyana appears driven by a short-termist mentality and a haphazard methodology that propels their activities outside legal boundaries. Such a raw reality casts doubts over de Soto's (2000) assertions that private property rights may stimulate more sustainable mining through the encouragement of long-term investment (Siegel & Veiga 2009). It also casts doubt over proposals for ASM to be containable in a 'zone' or 'reserve' (e.g. Corbett et al. (2017) and Smith et al. (2017)). The reality of cross-border movements of illegal miners within the Guiana Shield (between Suriname, Brazil, French Guiana, Guyana, and – increasingly – Venezuela) moreover underlines the transnational dynamics that may challenge individual states' abilities to govern ASM (Lowe 2006; de Theije 2016; Dezecache 2017).

The dynamic extractivism of alluvial gold mining is also reflected in the non-linearity and unpredictability of its externalities, which the formal framework appears powerless to control (Miserendino et al. 2013; Salman 2016). Mines Officers working for the poorly-resourced GGMC are often unable to attribute responsibility for alluvial waste flows or ecological degradation across the landscape. This supports insights from inter-disciplinary scholarship on complex socio-ecological systems and the limitations of human management approaches (Scoones 1999; Jacka 2018). In such instances, it will be the Amerindian communities of

Guyana who continue to be most affected, as their titled villages bind them to demarcated parcels of land, and their livelihoods are more dependent on the surrounding ecosystems (Colchester et al. 2002; Hennessy 2015; Bulkan 2016).

So, what are the implications of the seemingly inherent tendency of ASM activity to overspill institutions for the formalization ‘storyline’ itself? Considering the range of environmental challenges identified in this article, it seems difficult to consider ASM in Guyana as being consistent with the ‘sustainable development’ principles that underlie the reform ‘storyline’. This may not necessarily be because the formalization storyline itself is *wrong*; it could also be because it is not being implemented properly. Indeed, it is clear that the many political-ecological dimensions currently driving ASM activities in Guyana outside their current legal and literal boundaries need to be substantively addressed. Whether – and how – this will happen is another matter.

If, for example, the GGMC did begin to hold miners to the letter of the law in Guyana today, it is likely that many ASM operators would be unable to remain in the sector, potentially harming livelihoods and risking social instability (e.g. Siwale & Siwale 2017). In order to avoid doing this, the state would have to support ASM operators *on a national scale* to enable them to access the types of ‘clean’ technological solutions that have been proposed elsewhere (e.g. Veiga et al. 2009; Davies 2014; Marin et al. 2016; IADB 2017; Teschner et al. 2017; Spiegel et al. 2018). However, there are not only doubts about whether resource-poor states such as Guyana would actually be able (or willing) to make these investments; there are further unanswered questions about whether Guyana would be prepared to *also* confront serious political issues that appear to be driving poor mining practices, such as landlordism and institutional corruption. A broader moral (and epistemological) question is whether even a ‘greener’ version of ASM (that is contained within current legal boundaries) could be

considered ‘successful’ while it still disrupts ecosystems and the livelihoods of Amerindian communities (Boyd et al. 2001; Colchester et al. 2002).

Amidst these profound challenges and uncertainties, change could nevertheless be imminent in Guyana: although the fall in deforestation after 2015 was linked to a decline in world gold prices, others have suggested that smaller operators may soon be frozen out of the sector, potentially making the state’s monitoring job considerably easier. This high-level state actor reflects hopefully on this possibility:

The die is cast where small mining is concerned... Because most of the saprolites, and alluvial systems, have been mined! And, even if there is still gold there as I believe there is... it is that hi-tech, centrifugal, non-mercury system that is going to work... So these thousands of miners like ants all over the countryside is a phase! It’s going to end!³⁶

Thus, with available gold deposits becoming deeper (up to 80 feet and beyond), it will only be the larger operators (who – in theory – use ‘cleaner’ technologies and spend longer in each location) that will be able to prosper in the sector. These developments could yet usher in a version of ‘green’ gold mining by default in Guyana – though not one that sheds much light on whether ‘sustainable’ ASM is indeed a utopian idea or not (Hinton et al. 2003).

³⁶ Interview, government official, 5th July 2016.

References

- Adger, W.N., Benjaminsen, T.A., Brown, K. & Svarstad, H., 2001. Advancing a political ecology of global environmental discourses. *Development and change*, 32(4), pp.681-715.
- Bakia, M., 2014. East Cameroon's artisanal and small-scale mining bonanza: How long will it last? *Futures*, 62, pp.40-50.
- Bakker, K. & Bridge, G., 2006. Material worlds? Resource geographies and the “matter of nature.” *Progress in Human Geography*, 30(1), pp.5-27.
- Blaikie, P., 2012. Should some political ecology be useful? The inaugural lecture for the Cultural and Political Ecology Specialty Group, Annual Meeting of the Association of American Geographers, April 2010. *Geoforum*, 43(2), pp.231-239.
- Boyd, W., Prudham, W.S. & Schurman, R.A., 2001. Industrial dynamics and the problem of nature. *Society and Natural Resources*, 14(7), pp.555-570.
- Bridge, G., 2004. Contested terrain: mining and the environment. *Annual Review of Environment and Resources*, 29(1), pp.205-259.
- Brodie, J., Post, E. and Laurance, W.F., 2012. Climate change and tropical biodiversity: a new focus. *Trends in ecology & evolution*, 27(3), pp.145-150.
- Bryant, R.L. & Bailey, S., 1997. *Third World Political Ecology*. London: Routledge.
- Bulkan, J., 1998. Impact of the gold industry on the indigenous peoples of Guyana. In D. Canterbury, ed. *Transitions (Special Issue 27-28)*. Georgetown: Institute of Development Studies, Faculty of Social Sciences, Guyana, pp.71-96.
- Bulkan, J., 2016. 'Original Lords of the Soil'? The Erosion of Amerindian Territorial Rights in Guyana. *Environment and History*, 22(3), pp.351-391.
- Bulkan, J. & Palmer, J., 2016. Rentier nation: Landlordism, patronage and power in Guyana's gold mining sector. *Extractive Industries and Society*, 3(3), pp.676-689.
- Childress, M.D., 2010. Land tenure and land management issues for REDD preparation in

- Guyana: framing the agenda for policy discussion. In: *Annual World Bank Conference on Land Policy and Administration*. Washington: World Bank, pp.1-12. Available at: <https://siteresources.worldbank.org/EXTARD/Resources/336681-1236436879081/5893311-1271205116054/ChildressNewPaper.pdf> [Accessed September 6, 2017].
- Childs, J., 2008. Reforming small-scale mining in sub-Saharan Africa: Political and ideological challenges to a Fair Trade gold initiative. *Resources Policy*, 33(4), pp.203–209.
- CI-Guyana., 2013. *Guyana's Extractive Industry Sector (EIS)*. Georgetown: Conservation International Guyana. Available at: http://awsassets.panda.org/downloads/extractive_industries_sector_final_report_1.pdf [Accessed July 4, 2017].
- Clausen, F., Barreto, M. & Attaran, A., 2011. Property Rights Theory and the Reform of Artisanal and Small-Scale Mining in Developing Countries. *Journal of Politics and Law*, 4(1), pp.15–26.
- Cleaver, F., 2017. *Development through bricolage: rethinking institutions for natural resource management*. London: Routledge.
- Clifford, M.J., 2011. Pork knocking in the land of many waters: Artisanal and small-scale mining (ASM) in Guyana. *Resources Policy*, 36(4), pp.354–362.
- Clifford, M.J., 2014. Future strategies for tackling mercury pollution in the artisanal gold mining sector: Making the Minamata Convention work. *Futures*, 62, pp.106-112.
- Colchester, M., La Rose, J. & James, K., 2002. *Mining and Amerindians in Guyana*. Georgetown: Amerindian Peoples Association.
- Corbett, T., O'Faircheallaigh, C. and Regan, A., 2017. 'Designated areas' and the regulation of artisanal and small-scale mining. *Land Use Policy*, 68, pp.393-401.
- Cortés-McPherson, D., 2019. Expansion of small-scale gold mining in Madre de Dios: 'capital

- interests' and the emergence of a new elite of entrepreneurs in the Peruvian Amazon. *The Extractive Industries and Society*.
- Crawford, G. & Botchwey, G., 2017. Conflict, collusion and corruption in small-scale gold mining: Chinese miners and the state in Ghana. *Commonwealth & Comparative Politics*, 55(4), pp.444-470.
- Cremer & Warner, 1990. *Gold Mining in Guyana: A Review of Environmental Aspects of Dredge and Small Pit Mining Operations*. London: Commonwealth Secretariat.
- D'Angelo, L. and Pijpers, R.J., 2018. Mining temporalities: an overview. *The Extractive Industries and Society*, 5(2), pp.215-222.
- Davies, G.R., 2014. A toxic free future: Is there a role for alternatives to mercury in small-scale gold mining?. *Futures*, 62, pp.113-119.
- Demerara Waves, 2017. Mining of river banks continues; wardens, drones to join fight. *Demerara Waves*. Available at: <http://demerarawaves.com/2017/10/16/mining-of-river-banks-continues-wardens-drones-to-join-fight/> [Accessed 21 October 2018]
- Dezecache, C., Faure, E., Gond, V., Salles, J.M., Vieilledent, G. and Hérault, B., 2017. Gold-rush in a forested El Dorado: deforestation leakages and the need for regional cooperation. *Environmental Research Letters*, 12(3), p.034013.
- Dooley, K. & Griffiths, T., 2014. *Indigenous Peoples' rights, forests and climate policies in Guyana: A special report*. Moreton-in-Marsh, UK: Forest Peoples Programme. Available at: <http://www.forestpeoples.org/sites/default/files/private/publication/2014/06/guyana-special-report-fpp-2014.pdf> [Accessed January 7, 2017].
- Fairhead, J. & Leach, M., 1996. *Misreading the African landscape: society and ecology in a forest-savanna mosaic*. Cambridge: Cambridge University Press.
- FAO, 2010. Global Forest Resources Assessment 2010. Assessment, pp.1–27. Available at: <http://www.fao.org/docrep/013/i1757e/i1757e.pdf>.

- Forsyth, T., 2004. *Critical political ecology: the politics of environmental science*. London: Routledge.
- Geenen, S., 2012. A dangerous bet: The challenges of formalizing artisanal mining in the Democratic Republic of Congo. *Resources Policy*, 37(3), pp.322–330.
- Geenen, S., 2018. Underground dreams. Uncertainty, risk and anticipation in the gold production network. *Geoforum*, 91, pp.30–38.
- GGMC, 2015. Inception Report: Management and Systems Review. Georgetown: Guyana Geology and Mines Commission.
- GHRA, 2017. *Guyana's rivers remain a battleground between present and future*. Press release. Georgetown: Guyana Human Rights Association.
- Guyana Bureau of Statistics, 2017. Guyana National Accounts Data 2017. Georgetown: Guyana Bureau of Statistics.
- Hajer, M. A., 1995. *The politics of environmental discourse: Ecological modernization and the policy process*. Oxford: Clarendon Press.
- Heemskerk, M., 2002. Livelihood decision making and environmental degradation: Small-scale gold mining in the Suriname Amazon. *Society and Natural Resources*, 15(4), pp.327–344.
- Heemskerk, M., 2005. Collecting data in artisanal and small-scale mining communities: Measuring progress towards more sustainable livelihoods. *Natural Resources Forum*, 29(1), pp.82–87.
- Heemskerk, M., Duijves, C. & Pinas, M., 2015. Interpersonal and institutional distrust as disabling factors in natural resources management: small-scale gold miners and the government in Suriname. *Society and Natural Resources*, 28(2), pp.133–148.
- Hennessy, L.A., 2015. Where there is no company: indigenous peoples, sustainability, and the challenges of mid-stream mining reforms in Guyana's small-scale gold sector. *New*

- Political Economy*, 20(1), pp.126–153.
- Hentschel, T., Hruschka, F. & Priester, M., 2002. *Global Report on Artisanal & Small-Scale Mining*. London: IIED. Available at: <http://pubs.iied.org/pdfs/G00723.pdf> [Accessed November 21, 2016].
- Heynen, N., McCarthy, J., Prudham, S. & Robbins, P. eds., 2007. *Neoliberal environments: false promises and unnatural consequences*. London: Routledge.
- Hilson, G., 2002. An overview of land use conflicts in mining communities. *Land Use Policy*, 19(1), pp.65–73.
- Hilson, G. & Laing, T., 2017a. Guyana Gold: A Unique Resource Curse? *Journal of Development Studies*, 53(2), pp.229–248.
- Hilson, G. & Laing, T., 2017b. Gold mining, indigenous land claims and conflict in Guyana's hinterland. *Journal of Rural Studies*, 50, pp.172–187.
- Hilson, G. & Maconachie, R., 2017. Formalising artisanal and small-scale mining: insights, contestations and clarifications. *Area*, 49(4), pp.443–451.
- Hilson, G. & McQuilken, J., 2014. Four decades of support for artisanal and small-scale mining in sub-Saharan Africa: A critical review. *Extractive Industries and Society*, 1(1), pp.104–118.
- Hilson, G. & Vieira, R., 2007. Challenges with minimising mercury pollution in the small-scale gold mining sector: Experiences from the Guianas. *International Journal of Environmental Health Research*, 17(6), pp.429–441.
- Hilson, G., Goumandakoye, H. and Diallo, P., 2019. Formalizing artisanal mining 'spaces' in rural sub-Saharan Africa: The case of Niger. *Land Use Policy*, 80, pp.259–268.
- Hilson, G., Hilson, A., Maconachie, R., McQuilken, J. & Goumandakoye, H., 2017. Artisanal and small-scale mining (ASM) in sub-Saharan Africa: Re-conceptualizing formalization and 'illegal' activity. *Geoforum*, 83, pp.80–90.

- Hinton, J.J., 2005. *Artisanal and small-scale mining in Uganda: key issues, constraints and opportunities*. Summary report prepared for Ministry of Energy and Mineral Development, Department of Geological Survey and Mines, Uganda.
- Hinton, J.J., Veiga, M.M. & Veiga, A.T.C., 2003. Clean artisanal gold mining: A utopian approach? *Journal of Cleaner Production*, 11(2), pp.99–115.
- Hirons, M., 2011. Managing artisanal and small-scale mining in forest areas: Perspectives from a poststructural political ecology. *Geographical Journal*, 177(4), pp.347–356.
- Hirons, M., 2015. Trees for development? Articulating the ambiguities of power, authority and legitimacy in governing Ghana’s mineral rich forests. *Extractive Industries and Society*, 2(3), pp.491–499.
- Howard, J., Trotz, M.A., Thomas, K., Omisca, E., Chiu, H.T., Halfhide, T., Akiwumi, F., Michael, R. & Stuart, A.L., 2011. Total mercury loadings in sediment from gold mining and conservation areas in Guyana. *Environmental monitoring and assessment*, 179(1-4), pp.555-573.
- Huggins, C., Buss, D. & Rutherford, B., 2017. A “cartography of concern”: Place-making practices and gender in the artisanal mining sector in Africa. *Geoforum*, 83, pp.142–152.
- IADB, 2015. *Analysis of the Small and Medium-scale Mining Industry in Guyana: Challenges and Needs*. Washington: Inter-American Development Bank.
- IADB, 2017. *Toward the Greening of the Gold Mining Sector in Guyana: Transition Issues and Challenges*. Washington: Inter-American Development Bank. Available at: <https://publications.iadb.org/bitstream/handle/11319/8432/Toward-the-Greening-of-the-Gold-Mining-Sector-of-Guyana-Transition-Issues-and-Challenges.PDF?sequence=1&isAllowed=y> [Accessed February 4, 2018].
- IHRC, 2007. *All that glitters: Gold mining in Guyana. The failure of government oversight and the human rights of Amerindian communities*. Cambridge: Harvard Law School.

- Available at: http://hrp.law.harvard.edu/wp-content/uploads/2013/02/959_file_AllThatGlitters_FINAL_.pdf [Accessed May 7, 2017].
- Jacka, J.K., 2018. The Anthropology of Mining: The Social and Environmental Impacts of Resource Extraction in the Mineral Age. *Annual Review of Anthropology*, 47, pp.61-77.
- Jønsson, J.B., Charles, E. and Kalvig, P., 2013. Toxic mercury versus appropriate technology: Artisanal gold miners' retort aversion. *Resources Policy*, 38(1), pp.60-67.
- Kaieteur News, 2013c. Guyana unveils 5-year plan to reduce mercury use. *Kaieteur News Online*. Available at: <https://www.kaieteurnews.com/2013/10/12/guyana-unveils-5-year-plan-to-reduce-mercury-use/> [Accessed January 17, 2018].
- Kaieteur News, 2015. Banks decline to manage \$B mercury-free fund. *Kaieteur News Online*. Available at: <https://www.kaieteurnews.com/2015/01/14/banks-decline-to-manage-b-mercury-free-fund/> [Accessed January 17, 2018].
- Kaieteur News, 2016a. Special unit of wardens to police mining, logging areas. *Kaieteur News Online*. Available at: <https://www.kaieteurnews.com/2016/11/11/special-unit-of-wardens-to-police-mining-logging-areas/> [Accessed January 17, 2018].
- Kaieteur News, 2016b. Raiding, finding mercury alternatives stymieing mining operations – GGDMA. *Kaieteur News Online*. Available at: <https://www.kaieteurnews.com/2016/09/25/raiding-finding-mercury-alternatives-stymieing-mining-operations-ggdma/> [Accessed January 17, 2018].
- Keeley, J. & Scoones, I., 2003. *Understanding Environmental Policy Processes: Cases from Africa*. London: Earthscan.
- Kolstad, I. and Søreide, T., 2009. Corruption in natural resource management: Implications for policy makers. *Resources Policy*, 34(4), pp.214-226.
- Lanzano, C., 2018. Gold digging and the politics of time: Changing timescapes of artisanal

- mining in West Africa. *The Extractive Industries and Society*, 5(2), pp.253-259.
- Leach, M. & Mearns, R., 1996. *The lie of the land: Challenging received wisdom on the African environment*. Oxford: James Currey Press.
- Ledwaba, P.F. and Mutemeri, N., 2018. Institutional gaps and challenges in artisanal and small-scale mining in South Africa. *Resources Policy*, 56, pp.141-148.
- Lowe, S., 2000. *A Model to Quantify Gold Output from Local Miners in Guyana*. Georgetown: Geology and Mines Commission.
- Lowe, S., 2003. *Historical Analysis of Mining Policy, Law, and Administration in Guyana: 1831-2002*. Georgetown: Pavnik Press.
- Lowe, S., 2006. *Situation Analysis of the Small-Scale Gold Mining Sector*. Georgetown: WWF-Guianas.
- Lowe, S., 2014. Can mining be part of a low-carbon, low-deforestation development strategy? The Case of Guyana. *Environment: Science and Policy for Sustainable Development*, 56(3), pp.4–11.
- Maconachie, R. & Hilson, G., 2011. Safeguarding livelihoods or exacerbating poverty? Artisanal mining and formalization in West Africa. *Natural Resources Forum*, 35(4), pp.293–303.
- Malpeli, K.C. & Chirico, P.G., 2013. The influence of geomorphology on the role of women at artisanal and small-scale mine sites. In *Natural Resources Forum* (Vol. 37, No. 1, pp.43-54).
- Marin, T., Seccatore, J., De Tomi, G. and Veiga, M., 2016. Economic feasibility of responsible small-scale gold mining. *Journal of Cleaner Production*, 129, pp.531-536.
- Masson, M., Walter, M. & Priester, M., 2013. *Incentivizing Clean Technology in the Mining Sector in Latin America and the Caribbean: The Role of Public Mining Institutions*. New York: Inter-American Development Bank.

- Miserendino, R.A., Bergquist, B.A., Adler, S.E., Guimarães, J.R.D., Lees, P.S., Niquen, W., Velasquez-López, P.C. & Veiga, M.M., 2013. Challenges to measuring, monitoring, and addressing the cumulative impacts of artisanal and small-scale gold mining in Ecuador. *Resources Policy*, 38(4), pp.713–722.
- Nyame, F.K. & Blocher, J., 2010. Influence of land tenure practices on artisanal mining activity in Ghana. *Resources Policy*, 35(1), pp.47–53.
- O’Faircheallaigh, C. and Corbett, T., 2016. Understanding and improving policy and regulatory responses to artisanal and small scale mining. *The Extractive Industries and Society*, 3(4), pp.961-971.
- Ongolo, S. & Karsenty, A., 2015. The politics of forestland use in a cunning government: lessons for contemporary forest governance reforms. *International Forestry Review*, 17(2), pp.195–209.
- Peluso, N.L., 1992. *Rich forests, poor people: Resource control and resistance in Java*. Oakland: University of California Press.
- Peluso, N.L., 2018. Entangled Territories in Small-Scale Gold Mining Frontiers: Labor Practices, Property, and Secrets in Indonesian Gold Country. *World Development*, 101, pp.400–416.
- Putzel, L., Kelly, A.B., Cerutti, P.O. & Artati, Y., 2015. Formalization as development in land and natural resource policy. *Society and Natural Resources*, 28(5), pp.453–472.
- Ribot, J.C. and Peluso, N.L., 2003. A theory of access. *Rural sociology*, 68(2), pp.153-181.
- Robbins, P., 2000. The rotten institution: corruption in natural resource management. *Political Geography*, 19(4), pp.423-443.
- Robbins, P., 2011. *Political ecology: A critical introduction*. London: Blackwell.
- Rocheleau, D.E., 2008. Political ecology in the key of policy: From chains of explanation to webs of relation. *Geoforum*, 39(2), pp.716-727.

- Roopnarine, L., 2002. Wounding Guyana: gold mining and environmental degradation. *European Review of Latin American and Caribbean Studies*, 73(73), pp.83–91.
- Roopnarine, L., 2006. Small-scale gold mining and environmental policy challenges in Guyana: Protection or pollution. *Canadian Journal of Latin American and Caribbean Studies*, 31(61), pp.115–143.
- Salman, T., 2016. The Intricacies of “Being Able to Work Undisturbed”: The Organization of Alluvial Gold Mining in Bolivia. *Society & natural resources*, 29(9), pp.1124-1138.
- Scoones, I., 1999. New Ecology and the Social Sciences: What Prospects for a Fruitful Engagement? *Annual Review of Anthropology*, 28(1), pp.479–507.
- Scoones, I., 2016. The politics of sustainability and development. *Annual Review of Environment and Resources*, 41, pp.293-319.
- Seccatore, J. & de Theije, M., 2017. Socio-technical study of small-scale gold mining in Suriname. *Journal of Cleaner Production*, 144, pp.107–119.
- Seccatore, J., Marin, T., De Tomi, G. & Veiga, M., 2014. A practical approach for the management of resources and reserves in Small-Scale Mining. *Journal of Cleaner Production*, 84, pp.803-808.
- Siegel, S. & Veiga, M.M., 2009. Artisanal and small-scale mining as an extralegal economy: De Soto and the redefinition of “formalization.” *Resources Policy*, 34(1–2), pp.51–56.
- Sikor, T., He, J. and Lestrelin, G., 2017. Property rights regimes and natural resources: a conceptual analysis revisited. *World Development*, 93, pp.337-349.
- Siwale, A. & Siwale, T., 2017. Has the promise of formalizing artisanal and small-scale mining (ASM) failed? The case of Zambia. *Extractive Industries and Society*, 4(1), pp.191–201.
- Smith, N.M., Smith, J.M., John, Z.Q. and Teschner, B.A., 2017. Promises and perceptions in the Guianas: The making of an artisanal and small-scale mining reserve. *Resources Policy*, 51, pp.49-56.

- Soto, de. H. 2000. *The mystery of capital: Why capitalism triumphs in the West and fails everywhere else*. New York: Basic.
- Spiegel, S.J., 2012. *Formalisation policies, informal resource sectors and the de-/re-centralisation of power Geographies of inequality in Africa and Asia*. CIFOR.
- Spiegel, S.J., 2014. Rural place-making, globalization and the extractive sector: Insights from gold mining areas in Kratie and Ratanakiri, Cambodia. *Journal of Rural Studies*, 36, pp.300-310.
- Spiegel, S.J., 2017. EIAs, power and political ecology: Situating resource struggles and the techno-politics of small-scale mining. *Geoforum*, 87(November), pp.95–107.
- Spiegel, S.J., Keane, S., Metcalf, S. & Veiga, M.M., 2015. Implications of the Minamata Convention on Mercury for informal gold mining in Sub-Saharan Africa: from global policy debates to grassroots implementation? *Environment, development and sustainability*, 17(4), pp.765-785.
- Spiegel, S.J., Agrawal, S., Mikha, D., Vitamerry, K., Le Billon, P., Veiga, M., Konolius, K. and Paul, B., 2018. Phasing Out Mercury? Ecological Economics and Indonesia's Small-Scale Gold Mining Sector. *Ecological Economics*, 144, pp.1-11.
- Stabroek News, 2015. Gold miners still to tap billion-dollar fund to go mercury-free. Available at: <https://www.stabroeknews.com/2015/news/stories/01/11/gold-miners-still-tap-billion-dollar-fund-go-mercury-free/> [Accessed January 17, 2018].
- Stabroek News, 2017. Raid against Kaieteur mining nabs 21. *Stabroek News*. Available at: <https://www.stabroeknews.com/2017/news/stories/05/29/raid-kaieteur-mining-nabs-21/> [Accessed January 9, 2018].
- Teschner, B., Smith, N.M., Borrillo-Hutter, T., John, Z.Q. and Wong, T.E., 2017. How efficient are they really? A simple testing method of small-scale gold miners' gravity separation systems. *Minerals Engineering*, 105, pp.44-51.

- de Theije, M., 2016. Small-scale gold mining in the Guianas: mobility and policy across national borders. In *Post-Colonial Trajectories in the Caribbean* (pp. 112-126). Routledge.
- Thomas, C.Y., 2009. *Too Big to Fail: A Scoping Study of the Small and Medium-scale Gold and Diamond Mining Industry in Guyana*. Institute of Development Studies, Guyana.
- UNEP, 2013. Global Mercury Assessment 2013. United Nations Environment Programme. Available at: <http://wedocs.unep.org/bitstream/handle/20.500.11822/7984/-Global%20Mercury%20Assessment-201367.pdf?sequence=3&isAllowed=y> [Accessed 19 November 2018]
- Van Bockstael, S., 2014. The persistence of informality: Perspectives on the future of artisanal mining in Liberia. *Futures*, 62, pp.10–20.
- Van Bockstael, S., 2019. Land grabbing “from below”? Illicit artisanal gold mining and access to land in post-conflict Côte d’Ivoire. *Land Use Policy*, 81, pp.904-914.
- Vatn, A. & Bromley, D.W., 1997. Externalities - A market model failure. *Environmental and Resource Economics*, 9(2), pp.135–151.
- Veiga, M.M., Angeloci-Santos, G. & Meech, J.A., 2014. Review of barriers to reduce mercury use in artisanal gold mining. *The Extractive Industries and Society*, 1(2), pp.351–361.
- Veiga, M.M., Nunes, D., Klein, B., Shandro, J.A., Velasquez, P.C. and Sousa, R.N., 2009. Mill leaching: a viable substitute for mercury amalgamation in the artisanal gold mining sector?. *Journal of Cleaner production*, 17(15), pp.1373-1381.
- Verbrugge, B., 2015. The Economic Logic of Persistent Informality: Artisanal and Small-Scale Mining in the Southern Philippines. *Development and Change*, 46(5), pp.1023–1046.
- Verbrugge, B. and Besmanos, B., 2016. Formalizing artisanal and small-scale mining: Whither the workforce?. *Resources Policy*, 47, pp.134-141.

- Verbrugge, B. and Geenen, S., 2018. The gold commodity frontier: A fresh perspective on change and diversity in the global gold mining economy. *The Extractive Industries and Society*.
- Verbrugge, B., Cuvelier, J. & Van Bockstael, S., 2015. Min(d)ing the land: The relationship between artisanal and small-scale mining and surface land arrangements in the southern Philippines, eastern DRC and Liberia. *Journal of Rural Studies*, 37, pp.50–60.
- Walker, P.A., 2005. Political ecology: Where is the ecology? *Progress in Human Geography*, 29(1), pp.73–82.
- Wotruba, H., Hentschel, T., Livan, K., Hruschka, F. & Priester, M., 1998. *Environmental Management in Small-Scale Mining*. LA Paz: MEDMIN.
- Zimmerer, K.S. & Bassett, T.J., 2003. *Approaching Political Ecology*. New York: Guilford Press.

Annex

Year	Intervention name	Funding agency	Value	Executing agency	Activity
1996	Guyanaese inter-agency cooperation	Government of Guyana	Not available	GGMC, Environmental Protection Agency (EPA)	Memorandum of Understanding signed between the GGMC and the EPA
1996 - 2004	Guyana Environmental Capacity Development Mining Project (GENCAP)	Canadian Government	US\$3m	GGMC	Training for miners; scientific studies
2005	Amendments to Mining Act and introduction of Codes of Practice	Canadian Government	N/A	GGMC	Regulations and Codes of Practice drafted
2005	Reducing the Pressure of Goldmining on the Guianas Ecosystem	World Wildlife Foundation (WWF)-Guianas	Not available	WWF-Guianas, GGMC	Training programmes; studies
2013 -	Land restoration projects	GGMC	Not available	GGMC	Re-vegetation and land restoration
2013	Guyana Mining School and Training Institute (GMSTI) set-up	WWF, United Nations Development Programme (UNDP)	c. US\$100,000	GGMC	Equipment and training materials developed
2014-	Biodiversity mainstreaming in the mining sector	UNDP, Global Environmental Facility (GEF)	US\$900,000	UNDP, GGMC, GFC	Capacity-building for state monitoring agencies
2016-	Global opportunities for long-term development of the ASGM sector	CI-Guyana, GEF	US\$167m (split between 8 countries)	CI-Guyana, GGDMA, GGMC	Testing of mercury-free technologies
2017-	Strengthening the enabling framework for biodiversity mainstreaming and mercury reduction in small-scale gold mining operations	GEF	US\$34m	UNDP, GGMC, EPA, Ministry of Natural Resources and the Environment (MNRE)	Capacity-building for state monitoring agencies; resources for miner training and education