


ARTICLE

A double-edged sword: Realities of artisanal and small-scale mining for rural people in the Alaotra region of Madagascar

Natasha Stoudmann¹  | Lena M. Reibelt^{1,2} |
 Aimée G. Rakotomalala² | Olivier Randriamanjakahasina² |
 Claude A. Garcia^{1,3} | Patrick O. Waeber¹

¹Forest Management and Development, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

²Madagascar Wildlife Conservation, Ambatondrazaka, Madagascar

³Forêts et Sociétés, CIRAD, Montpellier, France

Correspondence

Natasha Stoudmann, Forest Management and Development, Swiss Federal Institute of Technology (ETH), Universitätstrasse 16, 8092 Zurich, Switzerland.
 Email: n.stoudmann@net-c.com

Abstract

A growing number of people are entering the artisanal and small-scale mining (ASM) sector worldwide. In Madagascar, millions of individuals depend on this informal activity. Through a case study in the Alaotra-Mangoro region of Madagascar, our research aimed to understand the “bottom-up” dynamics and ripple effects of the sector, by looking at the realities for rural communities where inhabitants are both directly and indirectly affected by ASM. We were interested in community members' and miners' perceptions of the socio-economic and environmental impacts of ASM, and in identifying the factors attracting people living in one of the country's agricultural hubs to this activity. Our results show a wide diversity of push and pull factors leading people to enter the sector. Although many positive impacts of ASM exist for miners and communities within the vicinity of mines, most miner participants considered themselves worse off since starting to mine, highlighting the high risk and low probability of return of ASM. ASM's potential for local and national development will remain squandered if its negative impacts continue to go unmanaged. Accounting for local contexts and the ripple effects of ASM will be crucial in achieving safety

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2021 The Authors. Natural Resources Forum published by John Wiley & Sons Ltd on behalf of United Nations.

and security for miners, and to tap into the benefits it may offer communities while minimising environmental damage.

KEYWORDS

Agriculture, artisanal and small-scale mining, diversification, farming, livelihood, Madagascar, mineral resources

1 | INTRODUCTION

Artisanal and small-scale mining (ASM) represents a source of income for millions of people around the globe, with numbers continuously increasing. The sector's growth is tied to rising mineral prices, increasing difficulties to make a living from agriculture, as well as population growth (Intergovernmental Forum on Mining Minerals Metals and Sustainable Development (IGF), 2017). The last few years have seen a surge in ASM activities, with the estimated number of people directly working in the sector growing from 13 million in 1999, to 30 million in 2014, and 40.5 million in 2016 (IGF, 2017). The numerous social, environmental, and economic impacts of ASM are well documented, with many of its benefits, including local and regional development and employment opportunities being accompanied by a host of negative impacts such as environmental degradation, water pollution, and social insecurity (Cook & Healy, 2012; Funoh, 2014; Ingram et al., 2011). Various factors push and pull people to start working in this sector, with both poverty and the prospect of wealth coming into play (Verbrugge, 2016). In the context of this paper, we understand “push” factors as those driving people away from farming, and “pull” factors those driving them towards mining.

Madagascar's ASM sector is one of the world's largest, with an estimated 500,000 people directly working as miners, and an additional 2,500,000 indirectly depending on the sector for their livelihood (Hilson, 2016), representing over 10% of Madagascar's 25.6 million inhabitants (World Bank, 2020). The main exploited minerals are gemstones and gold, and activities either occur seasonally or as rushes, with large influxes of people to sites where minerals are newly discovered (Cartier, 2009). Drought and poverty have played an important role in pushing people to find new sources of income, and contributed to the growth of the ASM sector in Madagascar (Canavesio, 2014). Conservationists have a strong stake in the sector's future but little power, as much of the mineral deposits overlap with present and planned protected areas, thereby threatening the few remaining natural ecosystems of the island (Andriamihaja, Metz, Zaehringer, Fischer, & Messerli, 2019; Cook & Healy, 2012). An assessment of the overlap of potential mining areas with important conservation areas showed that a third of the area planned for protection in 2005 overlapped with mining concessions (Cardiff & Andriamanalina, 2009), highlighting conflicting objectives and the shortfall of regulation of the mining industry. ASM is *per se* legal and regulated in Madagascar, as applying for a permit for ASM is possible (LAW N°2005–021 of July 27, 2005, and DECREE N°2006–910 of December 19, 2006, concerning the enforcement of the Mining Code; The Ministry of Mines). However, the Malagasy government has so far been unsuccessful in incentivising miners to do so, with accessibility and costs remaining an issue for most (Clausen, 2013; Geenen, 2012). In addition to the lack of governmental resources and competencies required to enforce mining laws, the administrative steps required to apply for a permit are deterrent to the majority of those taking part in ASM (Crawford & Nikiéma, 2015; Randria Arson, 2017). On top of that, mining also takes place illegally in protected areas. Recently, there has been a report on the growing threat of gold mining to Madagascar's conservation objectives, through the case of the Ranomafana National Park where illegal gold mining takes place with devastating biodiversity impacts (Cabeza, Terraube, Burgas, Temba, & Rakoarijaona, 2019). Wetlands are already often overlooked in terms of conservation priority (Stoudmann, 2019), and are particularly threatened. Despite the presence of authorities to contain the problem, ASM continues unabated.

A number of studies have looked at local perceptions of ASM, and the often site-specific complex interactions that shape the daily reality for miners and communities (Hilson & Garforth, 2013; Zakrisson et al., 2015). These local perspectives can enable decision-makers to better understand realities on the ground and develop effective tools

and policies. The present study aims to contribute to a better understanding of the “bottom-up” dynamics of the mining sector in the Alaotra-Mangoro region of Madagascar, and the realities not only for miners, but for the rural communities in the region who are directly and indirectly affected by mining. As Walsh (2006, p. 4) stated regarding ASM taking place in the mining town of Ambodromifehy in northern Madagascar, “The people whose lives had been most changed by sapphires were actually those least involved in the exploitation and trade of these stones.” Most of the research and publications done regarding (perceptions of) ASM in Madagascar focus on mining sites or the villages directly adjacent to these. However, considering the number of people being involved in mining at some point in their lives and considering the catchment area of mining sites, and the impacts the miners bring to the villages en route, it is important to apply a broader system view, and to assess perceptions in more distant sites. So far, little has been published on how mining activity and its impact is perceived in such areas. Our focus is, therefore, not solely the experience of miners, but rather we are interested in the broader context in which mining takes place. The Alaotra-Mangoro region is of particular interest, as it is one of the main agricultural areas of the country, and has experienced a number of mining rushes over the last decades, including within environmentally protected areas (Cartier, 2009; Hilson, 2010). The authors were interested in identifying the factors that incentivise people in rural settings to start mining and how communities perceive the socio-economic and environmental impacts of ASM. The study thereby is interested in the ripple effects of mining; those felt further afield than the mining sites, by giving an insight into the experiences of people living in a rural setting, where the pushes and pulls from nearby mines are strong. Results may help to frame more responsive and informed policies in this area where conservation and development stakes are high.

2 | LITERATURE REVIEW

Preceding our study, we present a brief background on ASM and give a broad literature analysis on the subject. For a long time, ASM was perceived by international bodies (e.g., World Bank, United Nations) as a “get rich quick” activity. However, since the 1990s, there has been a shift in attitudes and discourses of international bodies who began portraying ASM as an activity driven by poverty. Donor agencies began to realise the important economic potential of the sector, and acknowledged the precarious situation in which many of its workers were in (Barry, 1996; Clausen, 2013; The World Bank, 2005). Since then, little action has followed, with ASM remaining on the backburner of donor and government priorities (Canavesio, 2014; Hilson & McQuilken, 2014). Formalisation of the sector is expected to bring miners access to technical support, credit, and clear property and user rights, and help governments minimise the negative social and environmental impacts while deriving revenue from their mineral resources (Salo et al., 2016; Siwale & Siwale, 2017). Despite these potential benefits, governments have so far largely been unsuccessful in managing ASM activities, leaving miners vulnerable and the environment devastated in their wake (Hilson & Maconachie, 2017; Marshall & Veiga, 2017; Siwale & Siwale, 2017). This failure has been attributed to a number of factors. These include governmental actions that do not consider the financially insecure situations of those making up the sector (Hilson, 2010), an oversight of the importance of context-specific formalisation processes (Geenen, 2012), as well as a contentment of certain governments with the current informality that allows the sector to act as a “socio-economic shock absorber” (Labonne, 2014). Another issue is the very definition of “formalisation.” Hilson and Maconachie (2017) state that there is currently a clear research-policy divide, with the latter equating formalisation with legalisation, while academics see it as a process, rather than a product. This process is not only meant to give people legal rights, but also the ability and incentive to take part in it, an opportunity currently only accessible to those with financial means (Geenen, 2012; Salo et al., 2016; Siwale & Siwale, 2017). From the literature, it is evident that making ASM a reliable and legitimate source of livelihood for the millions depending on it will be a slow process. Local voices and experiences will be crucial in helping achieve this goal.

Why people decide to take part in ASM has been the subject of much research and debate. From the “get rich quick” view of international bodies discussed above came research depicting a different reality. Hilson (2010) showed that a combination of context-specific factors came into play in the case of ASM taking place in Akwatia,

Ghana. These included: economic shocks to the country's diamond industry tied to events taking place at the international level, which translated at the local level to decreased financial security and the need for many to search for alternative sources of income, found in the form of artisanal gold mining. The interconnectedness of mining and agriculture also helps explain the motivations of those engaging in ASM. High levels of resource dependence and related vulnerability to climatic events push people to have to find alternatives to agriculture, and ASM is a low barrier to entry option. Hilson (2016) puts forward that these strong linkages are an opportunity for ASM to contribute towards poverty alleviation and regional development, if the correct policies are put in place. As concluded by Verbrugge (2016), the expansion of ASM in the global South also causes political and social shifts, not yet fully understood.

Perceptions of (the effects of) mining and ASM are also well described in the international literature. Positive impacts and perceptions correspond with job opportunities, increases of income, goods and services, and infrastructure improvements (e.g., Petkova-Timmer, Ivanova, & Rolfe, 2009; Wang, Awuah-Offei, Que, & Yang, 2016). On the other hand, health and safety risks, social conflict, and environmental pollution (water, air, land/soil, noise) are impacts shedding a negative light on the sector (e.g., Adeyemi Babatunde et al., 2013; Adeyemi & Olagunju, 2017; Aigbedion & Iyayi, 2007; Sana, De Brouwer, & Hien, 2017). Further negative ASM perceptions relate to land conflict, human rights violations, alcohol abuse and sex trading, so-called conflict minerals and related reputational issues, increasing living costs, labour shortages for mining-external businesses and increases in traffic and crime (IGF, 2017; Wang et al., 2016). Depending on mine buffer (distance), size and life duration, population changes in communities can vary, and can be perceived as both positive and negative; migrants can for example affect the local markets, lifestyles, and traditions in both ways.

While perceptions of ASM can vary from country to country (IGF, 2017), Wang et al. (2016) summarise that actual mining impacts, governance and community demographics in general affect community acceptance of mining. Still, ASM is a very diverse sector and its main challenges do not only vary from region to region, but often even from site to site (IGF, 2017).

A number of scholars have extensively researched ASM in Madagascar and related socio-economic aspects of the activity. Some state that the negative impacts of ASM far outweigh the benefits. Focusing on sapphire mining in Ilakaka, Duffy (2007) argued that the state received extremely little revenue from ASM despite the vast number of people taking part in the activity and the volumes of minerals being exported. Duffy highlighted the difficulties in regulating ASM activities despite attempts by the government and international bodies to do so, as well as the precarious situation in which many miners are in due to the gem dealers being in positions of power relative to miners. The dynamics within ASM have also been a focus of Cartier (2009), who looked at the relations and power balances between sapphire and ruby miners and international traders, and related vulnerabilities. People entering the ASM sector are not only driven by getting rich quick; often it is due to people being in highly vulnerable situations requiring them to opt for mining to improve their livelihood. However, others have shown that ASM can have positive impacts that cannot be neglected. Canavesio (2014) found that artisanal mining activities in the Ilakaka region, home to the largest ASM site in Madagascar, had led to regional development and improved infrastructure, and has given an opportunity for the local population to invest in agriculture thanks to these new revenue streams. These benefits may, however, not always be equally felt, and important differences exist depending on socio-demographic factors, including gender. Lawson (2018) found that despite women making up an estimated half of the ASM workforce, scholars do not often focus on their roles. Women miners are generally in highly precarious situations, with higher barriers to entry and their roles undervalued. For these women, entering ASM is often an attempt to try to escape financial hardship and food insecurity caused by agricultural difficulties, rather than a desire to get rich quick. In contrast, Walsh (2003) shed light on how young male miners in the sapphire mining town of Ambondromifehy spent "hot money", that is, money spent on short-term desires rather than on long-term goals or investments to improve their livelihoods. The author found that this type of spending allows these miners to create social networks upon which they rely when mining. Also in Ambondromifehy, Walsh (2012) was interested in what happens to mining towns after the boom has subsided. He depicts the lasting effects of the boomtown and the uncertainties experienced by residents in these places of waiting.

The body of literature on ASM in Madagascar remains small considering the scale of the sector and its environmental and socioeconomic implications. In recent years, relatively few studies on ASM have been published. Our study aimed to contribute to the body of knowledge by taking a broader approach, by considering ASM as part of the socio-ecological system (SES) of the Alaotra region.

3 | METHODOLOGY

This study was part of a larger research project interested in the SES of the Alaotra-Mangoro region, and how the current development and conservation divide might be bridged given the high pace of change taking place (Stoudmann, Waeber, Randriamalala, & Garcia, 2017; Waeber, de Grave, Wilme, & Garcia, 2019). While a number of gold mining communities are present in the Midwest of Madagascar, the Northeast (including the Alaotra-Mangoro region) is known for sapphire and ruby mining as well as for its quartz mining, for which people will work seasonally and more consistently, than for gold or gemstone mining (Cartier, 2009).

Fieldwork was conducted from October to December 2016. The two study sites were the communes of Antanandava in the north-east of the region, and Andreba Gare on the south-eastern shore of Lake Alaotra (Figure 1). Antanandava (2,732 inhabitants in 2009) is an important market-base for the area, as well as being one of the gateways to the Zahamena National Park (IUCN category II) around and in which mining is known to take place (Bodonirina et al., 2018; King et al., 2013). Although Antanadava is well known for being close to mines, it remains an agricultural village. Andreba Gare, home to 5,280 inhabitants in 2017, is not in close proximity to mines. However, it is on the route to Antanandava as well as Andilamena, a prominent mining community in the north of the region, so experiences strong mining through-traffic and many of its inhabitants are drawn to these mines. These locations were intentionally selected because they are two agricultural-centred sites, as opposed to villages where mining is the main activity as ASM does not only have localised impacts at the mining sites, but also affects communities further afield. For example by having their inhabitants travel to take part in ASM, or experiencing the through-traffic of miners.

Data collection involved face-to-face interviews with inhabitants of the two study sites (Antanandava: $n = 59$; Andreba Gare: $n = 53$), including both miners (either currently working in ASM or having done so in the past) ($n = 67$) and non-miners ($n = 45$), as well as interviews with three local authorities (the village chiefs of the two sites, and the deputy mayor of Antanandava). Average age of miners was 36 (min = 20, max = 67), and non-miners 38 (min = 17, max = 74). Ninety-four per cent of miner interviewees were male. Regarding non-miner participants, 40% were male. The development of the interview questions was assisted by an initial exploratory study from October to December 2015 involving 30 interviews in three communities of the Alaotra-Mangoro and Analanjirofo regions on the perception of ASM activity in the region, allowing to contextualise and target the questions (Stoudmann et al. 2016).

The interview questions were developed in French, and discussed and agreed upon by the research team before translation into Malagasy by two native Malagasy members of the research team. An English version of the questionnaire is provided in the Appendix S1. As many people were in the area for mining but were not permanent residents of the villages, sampling from households would not have been appropriate. Instead, we approached people at the market places of the communes as grounds to gather participants, as these locations are central hubs where people with different activities and from various socio-economic groups spend time. People we approached who were engaged in mining or had been in the past, and were asked a subset of questions different from those asked to non-miners. In this study, we define “miner” as an individual working or having worked as a digger in a mine, on a regular or occasional basis. Interviews with three representatives of local authorities were further undertaken to triangulate our data. We conducted structured face-to-face interviews in Malagasy to allow any person to participate, irrespective of their level of literacy. The responses were translated into French immediately after completion. The research followed the ethical code of conduct put forward by Wilmé et al. (2016): all participants were informed about their anonymity and prior informed consent was granted before any interview. We used the software QSR



FIGURE 1 Alaotra region with the two case study sites, Antanandava and Andreba Gare. Andilamena in the north is a prominent mining site, while mining is known to take place in the Zahamena National Park in the east of the socio-ecological system (cf. Reibelt et al., 2019) [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

NVivo (version 11) to code the interviews (with an intercoder reliability of 81%). Further details regarding the coding can be found in the Appendix S1. IBM SPSS (version 23) was used to test for differences between the sites using Welch's *t*-test and cross tabulations.

4 | RESULTS

4.1 | Pushed and pulled towards mining

Mining is rarely performed as a main livelihood activity. Over 90% of participants undertake mining sporadically or seasonally, primarily counting on an activity bringing in regular income—most commonly agriculture—as opposed to the uncertain returns of mining. Andreba Gare has a larger diversity of activities compared to Antanandava, thanks to fishing in Lake Alaotra upon which many families depend, as well as many relying on work as day labourers. As Participant 17 explains, mining is for many an income buffer when not enough money is coming in from farming:

Mining helps us to lighten the difficulties of life. My cousin told me about the benefits and showed me how mining is done. There were people who started mining and their way of living changed. I also dreamed of becoming rich, but actually, the money from mining is complementary. If it is a bad time for farming, I can do mining. It helps for unpredictable events. That way I don't have to sell my yields. (Participant 17, Antanandava).

The factors that led participants to start mining do not differ between sites, and can be divided into push and pull factors (Figure 2). The push factor most often mentioned is the need for additional income and the opportunity that mining represents in filling this need. This income is mostly for daily necessities, paying children's schooling fees or improving the performance of their main activity. Many participants have cyclical periods of free time on their hands, often during the rainy season and hunger gap (December–April) when most crops are growing and not much work is required in the fields. Another issue affecting farmers is decreasing agricultural yields, requiring them to find additional sources of income to compensate this income deficiency. Lastly, certain participants were pushed to mining due to an unplanned event leading them to need “quick” cash (e.g., family member falling sick, birth of a child, price fluctuations in agricultural produce). Most often, a mix of these factors cause them to make the leap. For example for Participant 5, climatic events and the opening of a mine close-by influenced his decision:

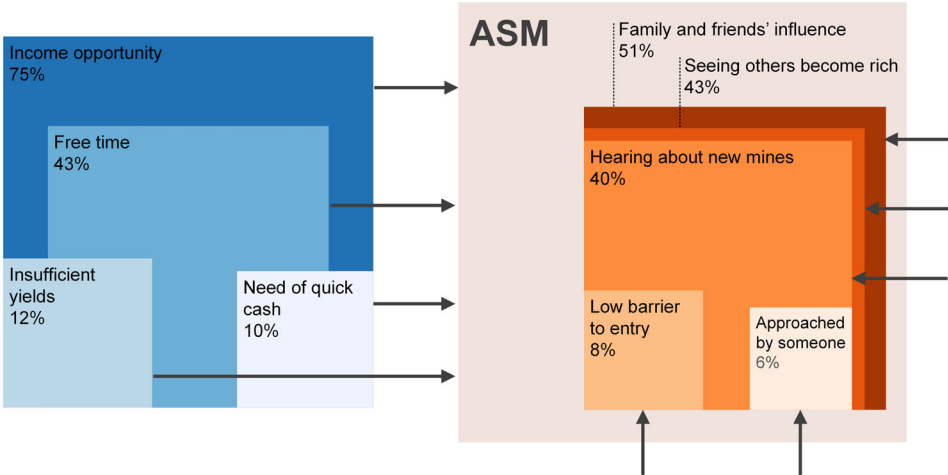


FIGURE 2 Push (blue) and pull (orange) factors having led participants to start mining. The size of the squares are proportional to the percentage of participants having mentioned each factor (n = 67) [Color figure can be viewed at wileyonlinelibrary.com]

Land was very dry because there was not enough rain for a period of time, and a mine opened then, which is when I started mining. Since then it has become a habit, to earn a living. It is not a stable activity—sometimes one wins, sometimes one has nothing. But if you are lucky the money earned in five days can be enough to last a year. Insecurity [in the community] decreases because people have work to do with mining, and poverty decreases. (...) There can be problems with transportation costs when the mines are far away, and problems with the boss, if it is supposed to be 50-50 but he does not give us our share. (Participant 5, Antanandava)

The most frequently mentioned pull factor is the influence of friends or family members returning from mining and looking for trustworthy relations to accompany them on their next trip. The peer pressure once in such a group can be strong, and it is not always easy to leave once integrated, as Participant 69 explains regarding his experience with mining in protected areas. Mining within these areas threatens the few remaining forested areas of the island and the species within. Entering these zones can also be dangerous, but the temptation is high considering the potential payoff.

I am worried, because even if I don't want to go, my friends pay for my transportation and food, and once there they make me work even if I am sometimes afraid, as the mines have entered into the protected area. I started mining after I stopped studying. I had nothing to do after that. Friends paid me to transport their equipment, and since then I have been part of their team. Although I earn a lot with mining because I am part of a team, there is no safety, because they exploit in secret as they are scared of being stopped by the police for being in the forest. I am scared, because I heard rumours of people being arrested, and others killed by bandits. (Participant 69, Andreba Gare).

Seeing or hearing about others getting rich also plays a big role, as well as hearing about a new mine within the region and therefore with relatively easy access. Certain participants mentioned that the attraction of mining came from its low barriers to entry, particularly if the mines were close by. Lastly, some participants stated that they were approached by gem dealers who offered to pay for their transportation and equipment, thereby lowering the cost of entry. Most expressed that it was a combination of these push and pull factors that led them to first work in the sector.

4.2 | Perceived impacts of mining

Participants identified impacts affecting social (e.g., prostitution, population increase), economic (e.g., wasted savings, less agricultural produce available as many farmers leave for the mines), health and safety (e.g., diseases, accident risk while mining) and environmental (e.g., deforestation, pollution) realms (Figure 3). Fifty per cent of the identified negative impacts were felt significantly more by miners than non-miners. Regarding gender differences, no significant differences were identified regarding perceived impacts within non-mining participants (60% women). Only three of the 18 identified negative impacts of mining are significantly associated with sites. These are (a) “increased living costs”, mentioned by 64% of Antanandava participants and 30% in Andreba Gare, (b) “soil degradation” with 10% in Antanandava and 53% in Andreba Gare, and (c) “population increase” mentioned by 22% of participants in Antanandava and 6% in Andreba Gare. The impact of children's disappearances, tied to rumours of sacrifices required before starting to mine, was only mentioned in Andreba Gare (19%). The impact “less rain” refers to the perception of certain participants that the deforestation taking place due to mining is causing less rainfall in the region.

Although the opinion of most non-miner participants were most often strongly for or against ASM, certain participants had a more nuanced viewpoint, seeing benefits as well as issues needing to be addressed. This was for example the case for Participant 23:

There are positive and negative impacts of mining. Business improved and there are new forms of transportation that are created, but on the other hand, there are diseases, and young girls are destroyed by prostitution. Living close to mines is good, as I am busy with my business as a driver, my wife sells drinks at the mines, and we can rent our house out to foreigners here for mining. (Participant 23, Antanandava).

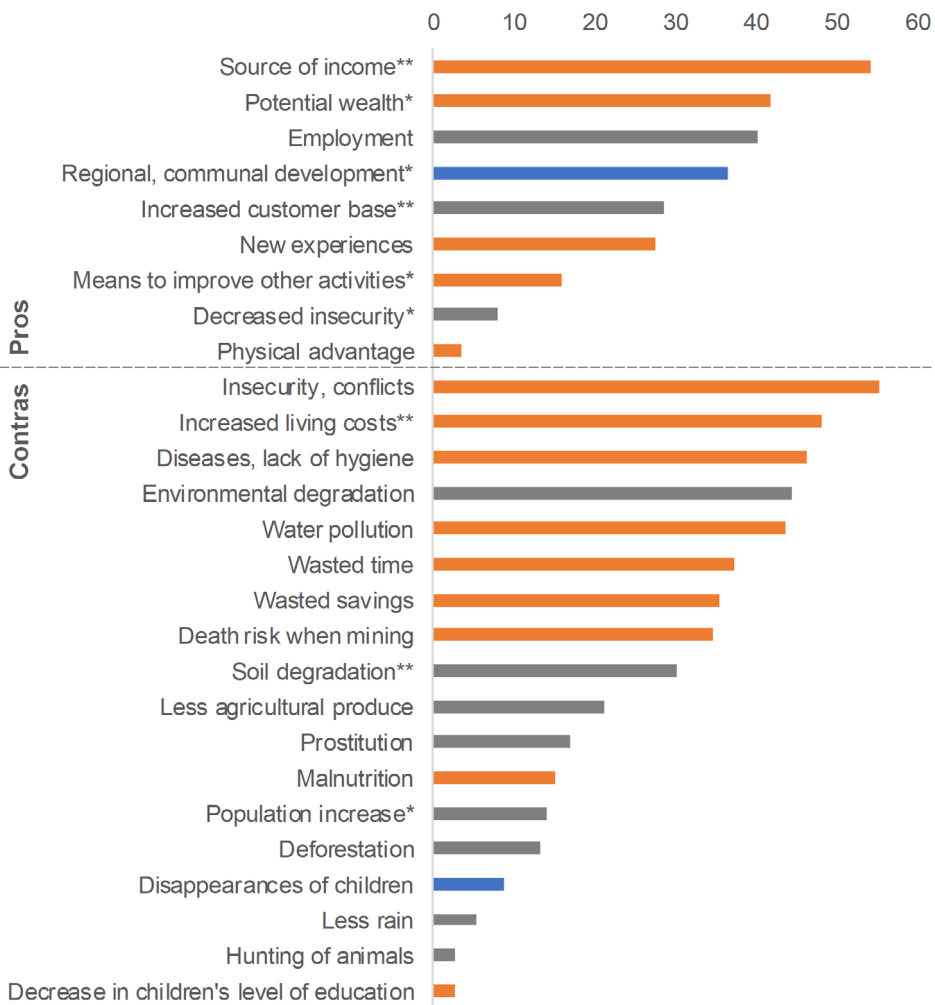


FIGURE 3 Identified impacts of ASM. Top section are positive impacts, bottom section negative impacts (percentages; miners: $n = 67$; non-miners: $n = 45$). Difference between sites (Antanandava and Andreba Gare): **, significant at $p < 0.01$; *, significant at $p < .005$. Difference between miners and non-miners: orange indicates significantly more miners associated with the impact; blue significantly more non-miners associated with the impact; grey no association between activity and impact [Color figure can be viewed at wileyonlinelibrary.com]

Many benefits were identified as stemming from mining activities (Figure 3), although there is a stronger association with sites than regarding negative impacts. The results indicate that financial benefits from mining are felt more strongly in Antanandava (68%) than Andreba Gare (40%). Close to a quarter of Antanandava participants saw the income from mining as being a way to improve their primary activity, compared to only 8% in Andreba Gare. The proximity and ease of access to mines for inhabitants of Antanandava attract local inhabitants, as they do not have many of the constraints of villagers further away. Over half of participants in Antanandava spoke of mining as a way of getting rich fast, as opposed to 30% in Andreba Gare. A small number of mining participants also stated that the activity benefits them physically, as the hard work in the mines strengthened them and made them more efficient in their agricultural work once they returned home.

Benefits such as increased customer base was only mentioned in Antanadava, thanks to the influx of miners coming from other parts of the region or country, increasing the revenue of non-miners, although also often tied to soaring prices, as explained by Participant 33:

Rain has become insufficient, which is why I decided to start mining. I want to live a good life like others, to be rich and have valuable things. And with mining one can earn a lot of money in a short space of time. Yields are decreasing, and there is money to be made in the mines. Life has improved for me because the market where I sell produce works well and I can afford some nice things. Many people from the region come here, trying to sell things. There are a growing number of houses, but living costs also increase. (Participant 33, Antanandava).

Participants stated that being able to mine means avoiding having nothing to do during the hunger gap (cf. Stoudmann et al., 2019) and closed fishing season, as well as creating jobs for the unemployed. Some participants explained that mining keeps those who would otherwise turn to thieving busy, thereby increasing their feeling of safety. This was most often mentioned in Antanandava (14 vs. 2% in Andreba Gare). This is in opposition to the increase in insecurity and conflicts mentioned by others, as outsiders come through the commune and jealousy between miners leads to tension and sometimes violence. This mining through-traffic does however have its benefits, such as the regional development it brings about, mentioned by close to half of the participants in Andreba Gare and about a third in Antanandava. As explained by a representative of local authority in Andreba Gare:

On the one hand, mining can allow people to improve their lives if they find something. But it can also deteriorate it, because when they win they often waste their money. If the risks are well managed, we as a community hope more and more mines open. People don't stay here, they only pass through the village, but residents are happy because the market works well, and gives work to the unemployed. (Local authority representative, Andreba Gare).

The three female miners who were interviewed had had very different experiences of mining. While two of them were pushed to mining because of financial difficulties and wanting to “leave poverty behind” (Participant 106, Andreba Gare), the third (Participant 48, Antanandava) was attracted by the low barrier to entry and the development of a mine close to the village. Since starting to mine 6 years previously, she had been able to save money and buy livestock as a result of her mining work. While one of the female participants driven by poverty had earned substantial money from mining, she explained that the money runs out fast, as it is not a permanent source of income. The second female participant echoed this, and had a more negative view of the activity:

Mining is hard work and risky. I am tired of coming back hurt and without having earned enough. (Participant 47, Antanandava).

The majority of miner participants stated their quality of life (sensu World Health Organization, 2020) had deteriorated since starting to mine: just over a third of participants believed they were better off (Figure 4). These results varied significantly between sites, with 49% of miner participants in Antanandava believing that mining has improved their standard of living, but only 18% in Andreba Gare. Wasted time and money, leading to the degradation of their

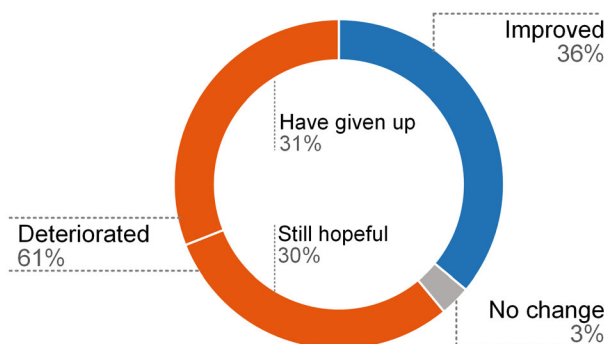


FIGURE 4 Perceived effects of mining on quality of life of miner interviewees ($n = 67$) [Color figure can be viewed at wileyonlinelibrary.com]

own crops and other activities were cited as main causes for negative effects on their lives, as experienced by Participant 38:

"I started mining because I wanted to become rich. Back in 2015 when I first started, the mines were easy to exploit and there were many minerals. But income from mining depends on one's luck, whereas the farming work I did before always insured a certain revenue. With mining, there is no rest until finding stones that may never be found. There are often deaths, and one has to be far away from one's family. Life became harder after mining. I was very tired, and couldn't finish my agricultural work, so didn't get high yields. I no longer mine. I got tired of the work and not earning anything, so I now stay with my crops." (Participant 38, Antanandava).

However, this group who perceives mining as having had a negative effect on their quality of life diverges regarding their attitude towards this deterioration. Some have given up on the prospect of earning money from mining, stating that they do not plan to take part in this activity again, while others still believe it to only be a matter of time before they strike big, so continue to mine despite the strain put on their lives.

We started mining the year that there were mines very close to the village that opened, and it was the hunger gap. Living costs were very high, so we decided to try our luck. We wanted to improve our standard of living, and add to what we had. But mining hasn't given us much, and we wasted our time over there instead of farming so there are now no yields or harvesting to do. I will still continue working in the mines as long as I can. We do not lose hope, we enjoy it as we get to visit different places even though we haven't found anything yet." (Participant 53, Andreba Gare).

For those whose lives have improved from mining, the benefits are often profound. The extra income allowed them to invest in improving their main activity, or purchasing items for their households that lift their quality of life, as is the case for Participant 24:

Mining has improved our lives. Before, we used candles, but now we have solar panels. In 2014, there was a new mine that opened so I got inspired to go. We needed money at the time for our crops and to buy seeds. (Participant 24, Antanandava).

5 | DISCUSSION

5.1 | Perceptions, push and pull factors

This study gives an insight into the role of ASM within agricultural communities experiencing both direct and indirect impacts of the sector. A wide variety of factors come into play in driving people from farming to mining in one of the main agricultural regions of Madagascar. Participants described a combination of push and pull influences that contributed to their initial decision to start mining, adding complexity to the poverty driven and "getting rich quick" perspectives. As shown by other research, the ASM and agriculture are strongly linked and often occur complementarily (Hilson, 2016; Verbrugge, 2016). Our results show that the need to increase household income by complementing farming activities is a strong push for many. Hilson and Garforth (2013), who studied the dynamics between small-scale gold mining and smallholder farming in Southern Ghana, found similar results. These two activities are highly interconnected, and a disconnect between policies and local realities hinder people's ability to improve their livelihood. Rather than treating ASM as a problem, it should be regarded as an important economic activity with the potential to sustain individuals and households in combination with agricultural activities. It is part of rural people's livelihood strategies. The social pull towards mining is also apparent. Seeing or hearing of others finding gemstones and having friends or family that mine was the reason for many participants to start to mine. It is also apparent that for many the full risks and implications of this activity may not have been fully understood before experiencing it first-hand. It should be noted that had the interviews been conducted solely at ASM sites, the overall findings might have been significantly different. Yet, our aim was precisely to give a larger scope of perspectives than often taken in studies on ASM by acknowledging that the impacts of this activity are felt beyond the mining sites.

Negative social and environmental impacts of ASM are inevitable. However, ASM's current informality means that these social and environmental dimensions are left unmanaged, making the negative impacts felt far more strongly than perhaps necessary for the activity to take place. Miner participants perceived many more negative impacts to mining than non-miners, as the former have experienced the hardships and insecurity tied to this activity. Even the seasonal mining performed as an alternative livelihood activity by most of the miner participants is accompanied by many risks and uncertain returns on investment, putting their entire families in highly vulnerable positions. However, these negative impacts were often outweighed by the potential benefits of mining, even if not yet personally experienced. Miners who took part in the study struggled to make a living from mining, most being worse off than before starting. The majority of miners perceived a deterioration in their quality of life since they started taking part in the activity. Mining, or income diversification through mining, does not necessarily translate into financial security, as many participants talked about their increased vulnerability, particularly those living far from mines. Non-miner participants, on the other hand, were less affected by mining detriments, and felt the indirect benefit of regional development that the activity could have on improving their livelihood. This was the case both in Antanadava and Andreba Gare, despite the latter being further away from any mines. This also shows that because people are willing to travel substantial distances to mines, the benefits of this activity have the opportunity to spread far and wide as they may bring income earned from mining back to their villages where it will be spent.

The Alaotra region has been undergoing many changes over the last decades, and its inhabitants are experiencing increasing uncertainty about their livelihoods, tied to changes such as decreasing agricultural output, over-exploited ecosystems, irregular rainfall and increasing food prices (Reibelt, Richter, Waeber, Rakotoarimanana, & Mantilla-Contreras, 2015; Stoudmann et al., 2017). The appeal of ASM in such times is even greater, particularly in a region relatively close to mines, and where the effects of seasonality are strongly felt (Stoudmann et al., 2019). Participants from the Alaotra SES were almost all farmers first and only mined because of various hardships pushing them towards it, or because of various pull factors leading them to have made the decision to start mining. An example is the impact that the hunger gap has on pushing people to mine. This period is accompanied by many difficulties, and mining is often one of the few options available to farmers to try and complement their regular livelihood. The high interconnectedness between ASM and agriculture means that improving the stability and conditions of one may impact people's decision to undertake the other. If the push factors, that is, hardships tied to agriculture, were less severe or strong, certain people may decide not to take the risky path of ASM. The 30% of participants that have seen their quality of life deteriorate after starting to mine and yet still mine often do so because no other viable options are available to them. Turning to ASM when already in difficult situations may be the entry point into a poverty trap for many, especially for those who remain hopeful despite disappointments, with push and pull factors driving them back to mining again and again.

5.2 | The hurdles of formalisation

Establishing ASM as a legitimate alternative livelihood through formalisation has been put forward as a way to decrease the risks and uncertain returns currently experienced by miners. However, the bulk of people engaged in ASM in Madagascar today are unable to enter the formalisation process through the procurement of a mining permit due to cost, bureaucracy, and corruption (Randria Arson, 2017). Despite this, ASM is increasing across Madagascar, putting growing pressure on protected areas and endemic species, which in turn has incited calls for action considering the expected growth of ASM and the changing threats tied to the activity (Cabeza et al., 2019; Randrianavelona, Rakotonioely, Ratsimbazafy, & Jenkins, 2010). In the Analanjirofo region, the competition between mining and agriculture has also been shown to be strong and negatively impact protected areas (Andriamihaja et al., 2019). However, the potential high return of cash crops, such as vanilla grown in that region, makes agriculture more attractive than it might be in the Alaotra region, where most farming is subsistence-based. Cabeza et al. (2019) call for action

from the government and further research considering the changing threats to protected areas, for example the growing illegal gold mining activity in Ranomafana National Park.

Top-down formalisation may end up increasing the vulnerability of miners and inhibiting ASM's potential to provide employment and support agriculture. Dependency on government administration and corruption—Madagascar is globally amongst the 14% worst countries (Transparency International, 2018)—could end up preventing any benefits at the local level, and the incentive or capacity for the government to engage in bottom-up formalisation is currently lacking. However, this bottom-up formalisation is also not straightforward. One solution that has been proposed is the creation of “designated areas” in which ASM is allowed to take place (Corbett, O'Faircheallaigh, & Regan, 2017). However, in the case of Madagascar where many of the mineral deposits overlap with protected areas, this would likely not be a viable solution in stopping illegal mining taking place in these vulnerable locations and bears the risk to further corruption. The financial and human resources required to set up, manage and monitor such a system also makes this solution seem highly unlikely. The conclusion made by Corbett, O'Faircheallaigh and Regan, (2017) is that the institutional empowerment of local authorities is crucial for such a bottom-up approach to ever be viable, as well as the resources to support such an undertaking.

5.3 | Local contexts matter when considering policies

Local perspectives as those presented in this study are key to developing tailored policies to improve the track record of ASM in giving communities reliable and safe means of making a living. A number of successful projects have been run in various African countries, including Tanzania, Ghana, and Burkina Faso. These were largely focused on bottom-up, long-term tools such as transfer of knowledge, training, and administrative help with the formalisation process (IGF, 2017). In the case of the Alaotra region, it is crucial to take into account the local realities such as the largely seasonal nature of ASM, as well as the vicious circle that many miners are in—losing money and wasting time but nevertheless returning to the mines—when trying to develop or implement solutions towards ASM. Furthermore, the trade-offs between the positive and negative impacts are complex, and affect entire communities, not only those directly taking part in mining activities. Our results show that the distance of communities to mines may warrant further research: Although both sites in this study had similar stances regarding the many negative impacts of ASM, participants in Antanandava, closer to the mines, perceive more benefits than those in Andreba Gare. As with the positive impacts of mining felt more strongly in Antanandava, this may be due to its inhabitants being able to see the wealth that mining could potentially bring them as they have more contact with miners who do strike big, thereby reinforcing their hope. Considering this variation depending on the community under consideration, making ASM a legitimate and safe activity would require regional management plans that account for variations in local realities.

6 | CONCLUSION

Our results give an insight into the perceived impacts of ASM from those directly taking part in or indirectly being affected by it. ASM shows huge promise with regard to the benefits it can bring to communities, with not only miners, but a wide diversity of community members able to indirectly earn income from this sector and a huge potential to generate regional development. However, currently most negative impacts are left unmanaged, thereby counteracting many potential benefits by undermining social and environmental assets. Regional and more flexible ways to access ASM permits would give safety and security to workers and their families, helping towards the successful formalisation of the sector. The widespread seasonal nature of the activity and its strong link with farming make flexibility crucial in the context of the SES of the Alaotra region. Local authorities should account for this seasonality for example by simplifying the bureaucratic efforts to apply for a permit, and by making them financially accessible to the bulk of those working within the sector.

Many of Madagascar's species are put under high pressure in the face of mining rushes, but conservationists' efforts and critiques are often disregarded (Baker-Medard, 2012; The World Bank, 2012). The push and pull factors influencing locals, governments, and donor agencies have created an environment of great uncertainty and complexity, and leave many of those engaged in ASM highly vulnerable. Monitoring and controls on the ground need to go hand in hand with improvements in the formalisation process to avoid increased environmental risks. ASM cannot continue to be overlooked in Madagascar if rural communities' livelihoods, biodiversity and natural resources are to be protected in the long-run.

ACKNOWLEDGEMENTS

We would like to thank all participants for their time and collaboration, as well as the communities of Antanadava and Andreba Gare for their hospitality. A special thanks to Madagascar Wildlife Conservation and Durrell in Ambatondrazaka for their support. We also thank Julia J.P. Jones for her helpful comments on an earlier draft. Many thanks to the three anonymous reviewers who helped us improve the piece. This research was funded by the Swiss Programme for Research on Global Issues for Development, grant number IZ01ZO_146852.

ORCID

Natasha Stoudmann  <https://orcid.org/0000-0003-3954-2272>

REFERENCES

- Adeyemi Babatunde, O., Ayodele, L. M., Elegbede, O. E., Babatunde, O. O., Ojo, O., Alawode, D. A., & Atoyebi, O. (2013). Practice of occupational safety among artisanal miners in a rural community in southwest Nigeria. *International Journal of Science Technology*, 2(4), 2278–3687.
- Adeyemi, S., & Olagunju, A. (2017). Putting small-scale mining in perspective: An analysis of risk perception of a southwestern Nigerian community. *Review of Social Sciences*, 2(7), 7–18. <https://doi.org/10.18533/rss.v2i7.106>
- Aigbedion, I., & Iyayi, S. (2007). Environmental effect of mineral exploitation in Nigeria. *International Journal of Physical Sciences*, 2(2), 33–38.
- Andriamihaja, O. R., Metz, F., Zaehrer, J. G., Fischer, M., & Messerli, P. (2019). Land competition under telecoupling: Distant actors' environmental versus economic claims on land in north-eastern Madagascar. *Sustainability*, 11(3), 851–874. <https://doi.org/10.3390/su11030851>
- Baker-Medard, M. (2012). Conflicting treasures: Contrasting resource use governance in two artisanal gemstone mining sites in Madagascar. *Journal of Political Ecology*, 19, 221–237. <https://doi.org/10.2458/v19i1.21728>
- Barry, M. (1996). *Regularizing informal mining: A summary of the proceedings of the international roundtable on artisanal mining* (Industry and Energy Department Occasional Paper No. 6). Washington DC: The World Bank.
- Bodonirina, N., Reibelt, L., Stoudmann, N., Chamagne, J., Jones, T., Ravaka, A., ... Waeber, P. (2018). Approaching local perceptions of forest governance and livelihood challenges with companion modeling from a case study around Zahamena National Park, Madagascar. *Forests*, 9(10), 624–656. <https://doi.org/10.3390/f9100624>
- Cabeza, M., Terraube, J., Burgas, D., Temba, E. M., & Rakoarijaona, M. (2019). Gold is not green: Artisanal gold mining threatens Ranomafana National Park's biodiversity. *Animal Conservation*, 22(5), 417–419. <https://doi.org/10.1111/acv.12475>
- Canavesio, R. (2014). Formal mining investments and artisanal mining in southern Madagascar: Effects of spontaneous reactions and adjustment policies on poverty alleviation. *Land Use Policy*, 36, 145–154. <https://doi.org/10.1016/j.landusepol.2013.08.001>
- Cardiff, S., & Andriamanalina, A. (2009). Contested spatial coincidence of conservation and mining efforts in Madagascar. *Madagascar Conservation and Development*, 2(1), 28–34. <https://doi.org/10.4314/mcd.v2i1.44127>
- Cartier, L. E. (2009). Livelihoods and production cycles in the Malagasy artisanal ruby-sapphire trade: A critical examination. *Resources Policy*, 34(1–2), 80–86. <https://doi.org/10.1016/j.resourpol.2008.02.003>
- Clausen, A. (2013). *Madagascar country environmental analysis (CEA)*. Washington DC: The World Bank. Retrieved from <http://documents.worldbank.org/curated/en/599641468054534317/pdf/779930WP0MDGOC00Box377320B00PUBLIC0.pdf>
- Cook, R. and Healy, T. (2012) *Artisanal and small-scale mining in and around Liberia case study report*. World Wide Fund for Nature.
- Corbett, T., O'Faircheallaigh, C., & Regan, A. (2017). "Designated areas" and the regulation of artisanal and small-scale mining. *Land Use Policy*, 68, 393–401. <https://doi.org/10.1016/j.landusepol.2017.08.004>

- Crawford, A., & Nikièma, S. (2015). *Rapport d'évaluation de Madagascar*. Winnipeg. International Institute for Sustainable Development.
- Duffy, R. (2007). Gemstone mining in Madagascar: Transnational networks, criminalisation and global integration. *Journal of Modern African Studies*, 45(2), 185–206. <https://doi.org/10.1017/S0022278X07002509>
- Funoh, K. N. (2014). *The impacts of artisanal gold mining on local livelihoods and the environment in the forested areas of Cameroon* (CIFOR Working Paper No. 150). Bogor Barat, Indonesia: Center for International Forestry Research.
- Geenen, S. (2012). A dangerous bet: The challenges of formalizing artisanal mining in the Democratic Republic of Congo. *Resources Policy*, 37(3), 322–330. <https://doi.org/10.1016/j.resourpol.2012.02.004>
- Hilson, G. (2010). "Once a miner, always a miner": Poverty and livelihood diversification in Akwatia, Ghana. *Journal of Rural Studies*, 26(3), 296–307. <https://doi.org/10.1016/j.jrurstud.2010.01.002>
- Hilson, G. (2016). Farming, small-scale mining and rural livelihoods in sub-Saharan Africa: A critical overview. *Extractive Industries and Society*, 3(2), 547–563. <https://doi.org/10.1016/j.exis.2016.02.003>
- Hilson, G., & Garforth, C. (2013). "Everyone now is concentrating on the mining": Drivers and implications of rural economic transition in the eastern region of Ghana. *Journal of Development Studies*, 49(3), 348–364. <https://doi.org/10.1080/00220388.2012.713469>
- Hilson, G., & Maconachie, R. (2017). Formalising artisanal and small-scale mining: Insights, contestations and clarifications. *Area*, 49(4), 443–451. <https://doi.org/10.1111/area.12328>
- 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), 104–118. <https://doi.org/10.1016/j.exis.2014.01.002>
- Ingram, V., Tieguhong, J. C., Schure, J., Nkamgnia, E., & Tadjuidje, M. H. (2011). Where artisanal mines and forest meet: Socio-economic and environmental impacts in The Congo Basin. *Natural Resources Forum*, 35(4), 304–320. <https://doi.org/10.1111/j.1477-8947.2011.01408.x>
- Intergovernmental Forum on Mining Minerals Metals and Sustainable Development (IGF) (2017) *Global trends in artisanal and small-scale mining (ASM): A review of key numbers and issues*. Winnipeg. Retrieved from <https://www.who.int/healthinfo/survey/whoqol-qualityoflife/en/>
- King, T., Ravaloharimanitra, M., Randrianarimanana, L. H. L., Tovoninahary Rasolofoharivelo, M., & Chamberlan, C. (2013). Community-based conservation of critically endangered lemurs at the Sakalava and Ranomainty sites within the Ankeniheny-Zahamena rainforest corridor, eastern Madagascar. *Lemur News*, 17, 63–70.
- Labonne, B. (2014). Who is afraid of artisanal and small-scale mining (ASM)? *Extractive Industries and Society*, 1(2), 121–123. <https://doi.org/10.1016/j.exis.2014.03.002>
- Lawson, L. (2018). Rice, sapphires and cattle: Work lives of women artisanal and small-scale miners in Madagascar. K. Lahiri-Dutt In *Between the plough and the pick: Informal, artisanal and small-scale mining in the contemporary world* (pp. 171–192). Canberra, Australia: ANU Press. <https://doi.org/10.22459/bpp.03.2018.08>
- Marshall, B. G., & Veiga, M. M. (2017). Formalization of artisanal miners: Stop the train, we need to get off! *Extractive Industries and Society*, 4(2), 300–303. <https://doi.org/10.1016/j.exis.2017.02.004>
- Petkova-Timmer, V., Ivanova, G., & Rolfe, J. (2009). Mining developments and social impacts on communities: Bowen basin case studies. *Rural Society*, 19(3), 211–228. <https://doi.org/10.5172/rsj.19.3.211>
- Randria Arson, H. P. (2017). *Analyse de la Corruption dans le Secteur Minier Artisanal à Madagascar - Filière or et saphir*. Antananarivo, Madagascar. Transparency International.
- Randrianavelona, R., Rakotoeloely, H., Ratsimbazafy, J., & Jenkins, R. K. B. (2010). Conservation assessment of the critically endangered frog *Mantella aurantiaca* in Madagascar. *African Journal of Herpetology*, 59(1), 65–78. <https://doi.org/10.1080/04416651.2010.481761>
- Reibelt, L., Richter, T., Waeber, P. O., Rakotoarimanana, S., & Mantilla-Contreras, J. (2015). Environmental education in its infancy at Lake Alaotra, Madagascar. *Madagascar Conservation and Development*, 9(2), 71–82. <https://doi.org/10.4314/mcd.v9i2.3>
- Reibelt, L. M., Moser, G., Dray, A., Randriamalala, I. H., Chamagne, J., Ramamonjisoa, B., ... Waeber, P. O. (2019). Tool development to understand rural resource users' land use and impacts on land type changes in Madagascar. *Madagascar Conservation and Development*. <https://doi.org/10.4314/mcd.wetlands.3>
- Salo, M., Hiedanpää, J., Karlsson, T., Cárcamo Ávila, L., Kotilainen, J., Jounela, P., & Rumrill García, R. (2016). Local perspectives on the formalization of artisanal and small-scale mining in the Madre de Dios gold fields, Peru. *Extractive Industries and Society*, 3(4), 1058–1066. <https://doi.org/10.1016/j.exis.2016.10.001>
- Sana, A., De Brouwer, C., & Hien, H. (2017). Knowledge and perceptions of health and environmental risks related to artisanal gold mining by the artisanal miners in Burkina Faso: A cross-sectional survey. *Pan African Medical Journal*, 27, 1–14. <https://doi.org/10.11604/pamj.2017.27.280.12080>
- 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), 191–201. <https://doi.org/10.1016/j.exis.2016.12.008>
- Stoudmann, N., Waeber, P. O., Randriamalala, I. H., & Garcia, C. (2017). Perception of change: Narratives and strategies of farmers in Madagascar. *Journal of Rural Studies*, 56, 76–86. <https://doi.org/10.1016/j.jrurstud.2017.09.001>

- Stoudmann, N., Reibelt, L. M., Kull, C. A., Garcia, C. A., Randriamalala, M., & Waeber, P. O. (2019). Biting the bullet: Dealing with the annual hunger gap in the Alaotra, Madagascar. *Sustainability*, 11(7), 2147–2165. <https://doi.org/10.3390/su11072147>
- Stoudmann, N. (2019). Plight of the unsung ecosystems. *Madagascar Conservation and Development*. <https://dx.doi.org/10.4314/mcd.wetlands.6>.
- The World Bank. (2005). *The millennium development goals and small-scale mining: A conference for forging partnerships for action*. Washington, DC: The World Bank.
- The World Bank. (2012). *Artisanal mining in critical ecosystems: A look at Gabon, Liberia, and Madagascar*. Washington, DC: The World Bank.
- Transparency International (2018) *Corruption perceptions Index 2018*. Berlin. Retrieved from <http://cpi.transparency.org/cpi2013/results/>
- Verbrugge, B. (2016). Voices from below: Artisanal- and small-scale mining as a product and catalyst of rural transformation. *Journal of Rural Studies*, 47, 108–116. <https://doi.org/10.1016/j.jrurstud.2016.07.025>
- Waeber, P. O., de Grave, A., Wilme, L., & Garcia, C. (2019). Play, learn, explore: Grasping complexity through gaming and photography. *Madagascar Conservation and Development*. <https://doi.org/10.4314/mcd.wetlands.1>
- Walsh, A. (2003). “Hot money” and daring consumption in a northern Malagasy sapphire-mining town. *American Ethnologist*, 30(2), 290–305. <https://doi.org/10.1525/ae.2003.30.2.290>
- Walsh, A. (2006). “Nobody has a money taboo”: Situating ethics in a northern Malagasy sapphire mining town. *Anthropology Today*, 22(4), 4–8.
- Walsh, A. (2012). After the rush: Living with uncertainty in a Malagasy mining town. *Africa*, 82(2), 235–251. <https://doi.org/10.1017/S0001972012000034>
- Wang, L., Awuah-Offei, K., Que, S., & Yang, W. (2016). Eliciting drivers of community perceptions of mining projects through effective community engagement. *Sustainability*, 8(7), 658–675. <https://doi.org/10.3390/su8070658>
- Wilmé, L., Waeber, P. O., Moutou, F., Gardner, C. J., Razafindratsima, O., Sparks, J., ... Lowry, P. P. (2016). A proposal for ethical research conduct in Madagascar. *Madagascar Conservation and Development*, 11(1), 36–39. <https://doi.org/10.4314/mcd.v11i1.8>
- World Bank (2020) *Overview Madagascar*. Retrieved from <http://www.worldbank.org/en/country/madagascar/overview>.
- World Health Organization (2020) *WHOQOL: Measuring quality of life*. Retrieved from <https://www.who.int/healthinfo/survey/whoqol-qualityoflife/en/>.
- Zakrison, T. L., Cabezas, P., Valle, E., Kornfeld, J., Muntaner, C., & Soklaridis, S. (2015). The perceived consequences of gold mining in postwar El Salvador: A qualitative study. *American Journal of Public Health*, 105(11), 2382–2387. <https://doi.org/10.2105/AJPH.2015.302832>

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Stoudmann N, Reibelt LM, Rakotomalala AG, Randriamanjakahasina O, Garcia CA, Waeber PO. A double-edged sword: Realities of artisanal and small-scale mining for rural people in the Alaotra region of Madagascar. *Nat Resour Forum*. 2021;45:87–102. <https://doi.org/10.1111/1477-8947.12215>