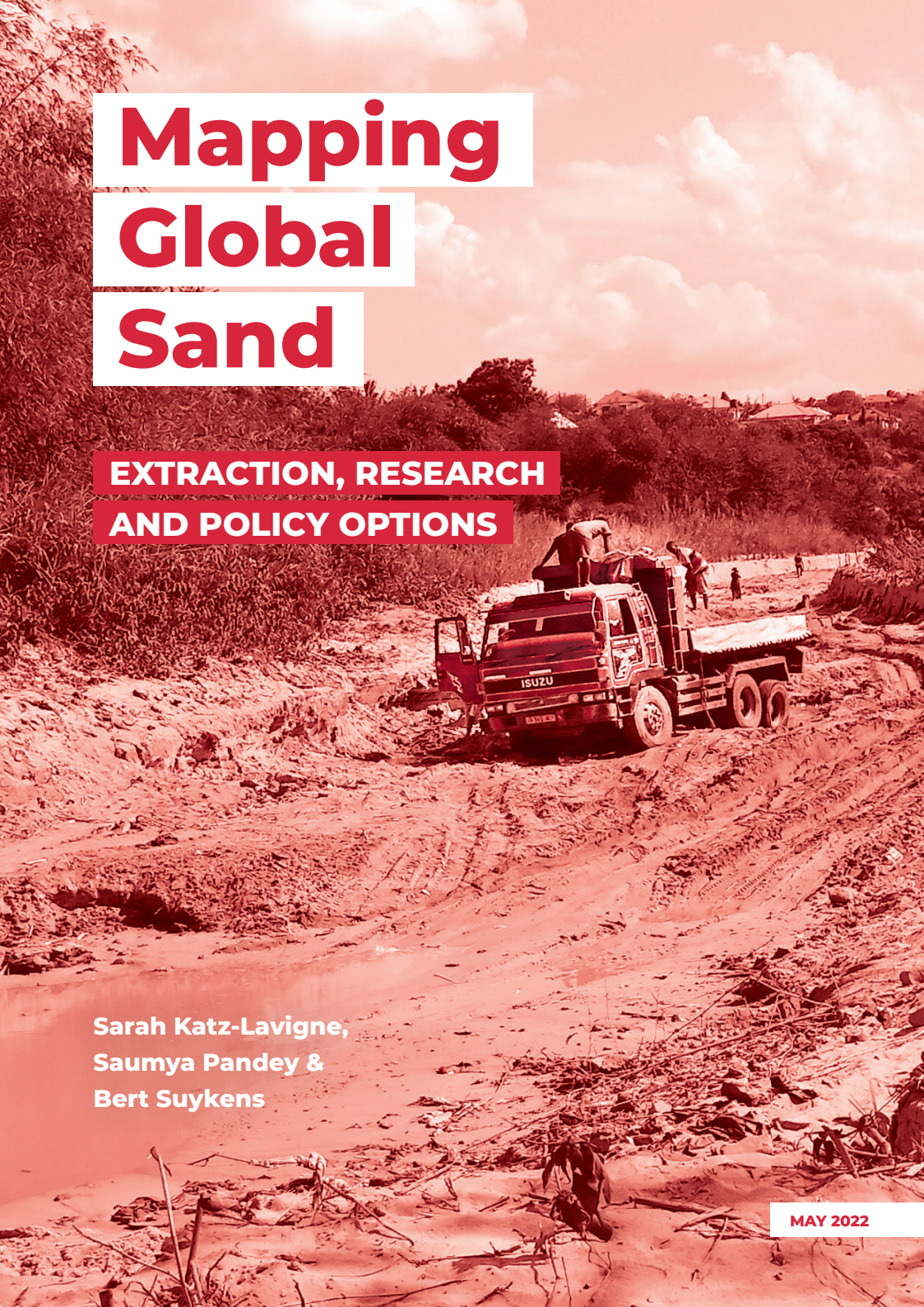
Mapping Global Sand

EXTRACTION, RESEARCH AND POLICY OPTIONS



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Introduction

In recent years, discussions of sand and gravel mining have been mostly based on the argument that there is an alarming increase in the demand for the resource, sand, which has subsequently led to its shortage. It is estimated by the United Nations Environment Programme (UNEP) that some 50 billion tons of aggregates (mostly sand, gravel and stones) are extracted every year (Koehnken, 2018; United Nations Environment Programme, 2019). Further, according to Global Aggregates Information Network (GAIN) (Lamb, Marschke, & Rigg 2019), if leading businesses in the construction sector and governments continue to extract sand at this rate, the global demand for aggregates is likely to rise to 60 billion tons per annum by 2030 (O'Brien, 2019). In addition to these reports, in March 2014, the Global Environment Alert Service (GEAS) warned the world that sand, which was once thought to be in abundance, was rarer than one thinks (Peduzzi, 2014). Some accounts show that the demand for sand has reached an insatiable level because cities and urban spaces are growing at a faster pace (Edwards, 2015). Growing demand for sand has been attributed to rise in population across the world, especially in the Global South that has led to newer infrastructure-based development projects for housing (Jaeger, 2006). However, examples of land and property speculation by investors, as well as increasing instances of homelessness across the globe cast doubt on such neo-Malthusian explanations that obscure the role of private investors in creating speculative demand. Whatever be the case, reports have consistently argued that rivers, a major source for extracting sand and gravel, will soon run out of this resource because of the excessive mining activities in these rivers, notably in places such as China and India (Bendixen, Best, et al., 2019). The anticipated shortfall in the supply of sand resources with a simultaneous increase in demand has been described by leading journalists, scientists and policy-makers as the sand 'crisis' (Beiser, n.d.; Pereira, 2020; Torres et al., 2017).

It is important to note that not all sand is suitable for construction or more specifically: to make concrete. Rivers are the preferred source of construction sand in many contexts. Desert sand (which might seem like an obvious solution to sand shortage) is materially not suited for making concrete (Sverdrup et al. 2017. Also sand from quarries or coastal sands are used for construction purposes. Marine sand can also be used, but its salinity offers many challenges. M-sand or manufactured sand is another, more recent source of sand, made by crushing hard stones or rock, that is also fit for construction.

The quantity of aggregates extracted exceeds that of any other group of materials: it is, after water, 'the second most used natural resource by modern human society' (Bisht, 2021a, p. 2). The extraction of sand is the biggest form of extraction of minerals. In the past few decades the Global South has been the primary site of consumption of aggregates, with the biggest rise in use of aggregates expected in the future. During the past century consumption of sand (closely linked to economic growth) has shifted spatially, with most now in the Global South, especially China and India. From 1970-2010, the consumption of non-metallic minerals in Europe and North America became stable, while extraction grew massively in the Asia-Pacific; Africa and Latin America exhibited growing extraction but stayed below the global average for consumption per capita. The 21st-century boom in infrastructure occurred especially in Brazil, Russia, India and China. Expanding commodity frontiers of sand thus shifted from Global North to South (Bisht, 2021a). Technological change has meant that while some places have a long tradition of extracting river sand for construction, there has been a significant shift in how it is done. Rather than buckets, people use machines like loaders, and boats and trucks for transport (Lamb, Marschke, & Rigg, 2019)

This report aims to contribute to this global debate on sand and sand governance. It focuses on construction sand and maps three interrelated elements: (1) the global, regional and country specific extraction of and trade in sand; (2) the current state of the social-scientific literature on sand extraction, as well as key policy reports on the topic; (3) other governance efforts in the extractive industries to provide jumping-off points for policy intervention on sand in light of sand-specific dynamics.

Mapping global sand production and trade

Mapping global sand production is challenging. There are no global databases on sand mining or sand consumption, making it hard to ascertain both the levels of sand production, and global trends in sand production. There is a lack of 'reliable quantitative data around extraction, import, export, extractors, location of extraction and dispatch' of sand, which complicates efforts to assess ecological, social, and economic harms (Bisht, 2021, p. 8) and reflects deficiencies in global monitoring. Data on the global sand trade obscure domestic data, and it can be challenging to distinguish connections across borders (Lamb, Marschke, & Rigg, 2019). In Cambodia and Myanmar, for instance, insufficient baseline data regarding 'industry activity and the river flows and ecologies' makes it difficult to interpret impacts, while there is little research on sand mining's impact on livelihoods (Lamb, Marschke, & Rigg, 2019, p. 1519). Since much of the trade is illicit, it is challenging to identify firms and networks. There is also a dearth of reliable data on transport. While it is typically believed—and the trade data presented here also demonstrates—that large volumes of sand are not exported internationally, evidence from Southeast Asia points to unrecorded export and import on a large scale (Bisht, 2021). Data collection is made more challenging by the remoteness of many rivers, and political and industrial sensitivity (Bendixen, 2019). These gaps point to a need for 'monitoring systems which are transparent and recorded and make real-time data publicly available', including on ecological distribution conflicts and movements against sand extraction (Bisht, 2021, p. 8).

Like other examples (see e.g. United Nations Environment Programme, 2019) this report uses cement production statistics compiled by the United States Geological Survey (USGS, 2021) and statistics on international trade of both cement and construction sand (CEPII, 2021) to provide a rough estimate of global construction sand production, its main players, and the role of the international sand trade. As mentioned above we focus exclusively on construction sand here, and do not include e.g. mineral sands, although at some points we indicate potential overlap in the available data. This is because there are various factors that have led to the problem in measuring sand. Most important being that due to the unavailability of data on the global demand for sand aggregates, there is often a discrepancy between the actual amount of sand that is extracted and its estimated figures that are recorded (Rege, 2015).

Our estimate shows that sand extraction has tripled in the last twenty years from around four billion tons to an estimate of twelve billion tons. This is a lot lower than the 50 billion tons estimated by UNEP, whose estimates focus on both gravel and sand and are based on their highest estimated cement-aggregate ratio (1:10) to calculate aggregate extraction from cement data (United Nations Environment Programme, 2019). We use a much lower 1:3 ratio only focusing on sand[1]. Given the methodological challenges to calculate sand volumes from cement, the trends presented here are more important than the absolute volumes. The international trade in sand has remained very limited according to available data (and even when keeping in mind the possibilities of illicit trade sketched above), averaging 75 million tons annually in the last twenty years and showing no clear upward trend, notwithstanding a peak in sand trade in 2017.

[1] This 1:3 ratio is a bit higher than the standard (volume) ratio to make concrete (1:2) and does not take into account the weight difference between sand and cement, but our estimate takes to a certain extent into account other cement-sand mixtures used in construction, as well as potential land infilling with sand before the actual use of a cement-sand mixture. In some cases however, like Dhaka, a huge amount of (construction) sand is used in this fashion (see also the section on land reclamation below), so we might underestimate sand consumption. Moreover, we assume that all cement produced in a country is also either traded or consumed in a given year, which does not account for stockpiling of cement. Obviously, our data also suffers from the many cases of incomplete data in the original cement statistics documented in the original datasets (USGS, 2021), as well as potential misreporting (e.g. silica sand for construction sand) in the trade data.

Regional distribution

If we look at individual countries, China dwarfs all other players, accounting currently for almost two thirds of all sand extraction. It is no coincidence then that China's three-decade investment in construction corresponded with its leading positions in the mining of sand and gravel from rivers (Ansar et al., 2016). In 2005 and 2006, the Poyang Lake in China was believed to have had the highest rate of sand and gravel extraction in the world (Bravard et al., 2013). Almost 9 percent — 236 million cubic meters per year — of China's demand for sand was met by Poyang Lake, which replaced Yangtze river after legislation was implemented in 2000 to protect the river from further degradation and ecological loss.

After a very steep rise from under 2 billion tons in 1998, China's estimated sand extraction has remained relatively stable at about 7 billion tons from 2012 (see figure 2). Given the global dominance in sand production, world production is highly determined by what happens in China. Any policy initiative, as well as much more empirical work, needs to be done to better understand this massive mining operation in China (see also below).

Figure 1: Global sand production and trade (1998-2018)

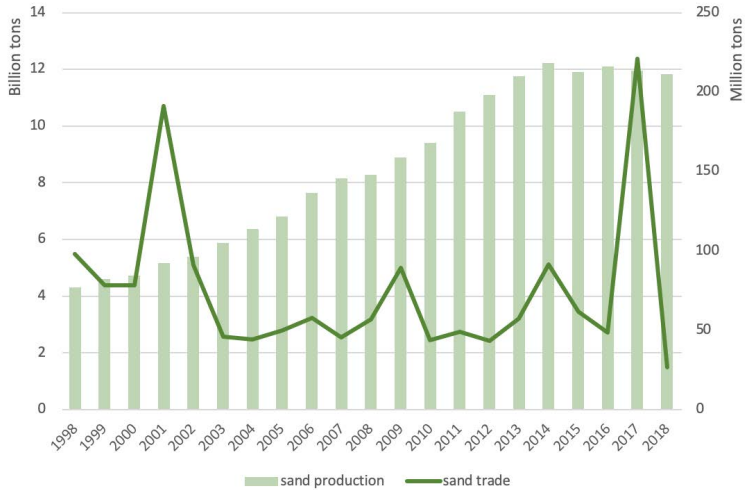


Figure 2: Sand production in China (1998-2018)

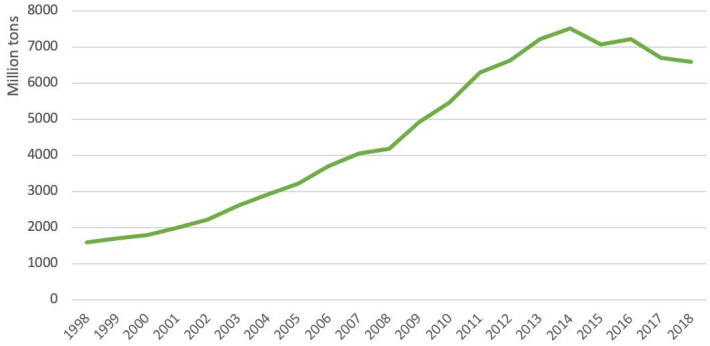
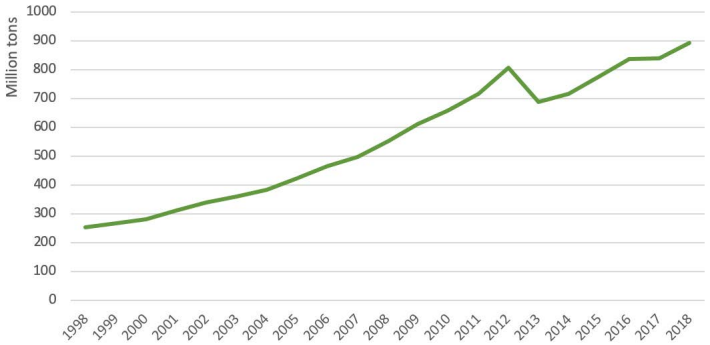


Figure 3: Sand production in India (1998-2018)



The second dominant producer is India (Figure 3). Fuelling its infrastructural boom, particularly after India's opening of economic doors for foreign direct investment (FDI) and greater domestic investment in 1991, India has seen sand mining increase almost four-fold between 1998 and 2018. Still, India is below extraction levels that China already reached in 1998. In contrast to China, sand production continues to increase in India after a short period of decline after 2012 as India witnessed an infrastructure crisis (Aiyer, 2012). While India is one of the cases which has received quite some attention in the literature (see below), we still need more data to understand the multiple forms of extraction and their impact found on the subcontinent.

Behind China and India, there is a big gap, with the United States being the third biggest producer, albeit at much lower levels. As figure 4 shows, sand mining in the US decreased quite massively after the start of the 2007 financial crisis, which was caused was caused by excessive deregulation and collapse of the financial sector related to a macroprudential crisis in the real estate sector. We see an increase since 2009, but at a slow rate, and not yet reaching the levels of the end of the 1990s. Brazil is the second largest sand producer in the Americas and sixth worldwide. Still, its production has slowed down in recent years after a boom in the beginning of the 2010s, now reaching about the level of Mexico which has seen fairly stable production around the 100 million tons per year. Both other top producers in the Americas—Canada and Colombia—operate at much lower levels.

Asia, where most developing countries are focused on infrastructure-based development, dominates global sand production, with the world's leading producers—China and India—located in the continent. However, quite a number of the ten top sand producing countries—including Japan (4th), South Korea (7th) and Indonesia (10th) (figure 4) are also in Asia. Further, there are two different, ongoing trends with older industrial powers Japan and South Korea seeing a stabilization (South Korea) or outright decline (Japan) of sand production, while Southeast Asia is home to actors experiencing significant growth in the sand business, like Indonesia and Vietnam but also Cambodia. Production in Vietnam has increased almost ten-fold, with Indonesia seeing a steady increase after a drop in the early 2000s. Saudi Arabia, however, is the odd one out, seeing a steady increase before seeing a drop after 2015.

Figure 4: Biggest sand producers in the Americas (1998-2018)

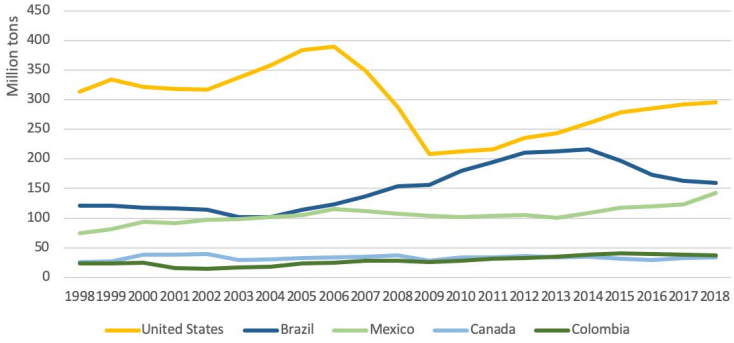


Figure 5: Biggest sand producers in the Asia (1998-2018)

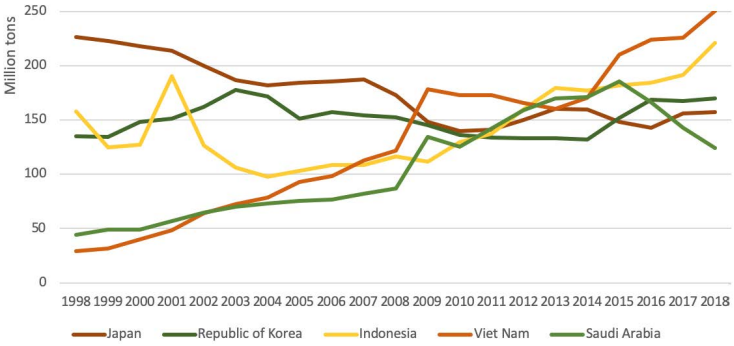
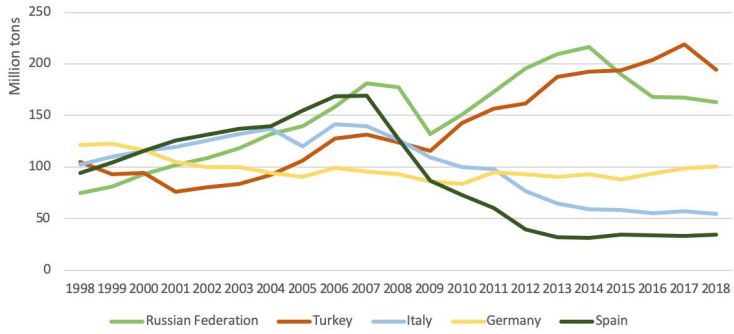


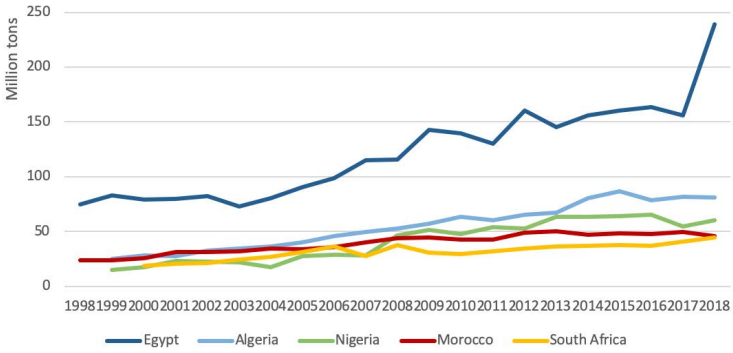
Figure 6: Biggest sand producers in Europe (1998-2018)



Europe is experiencing a similar trend as Asia (figure 6), in that the older industries in Western and Southern Europe are seeing a decline, which is most pronounced in Italy and Spain and seems directly related to the 2007-8 financial crisis in Europe (see above, for a similar trend for the US). Germany has exhibited a slow decline, but remains fairly stable around 100 million tons annually, making it the fifteenth largest sand producer over the entire 1998-2018 period.

Finally, apart from Egypt which has seen a steady increase with a boom in 2018, African countries are producing much smaller volumes, with North Africa dominating and seeing significantly increased production in Algeria and Morocco as well. At the same time Nigeria has shown a fourfold increase in sand production, starting at quite low levels, with a production of around 60 million tons now.

Figure 7: Biggest sand producers in Africa (1998-2018)



Sand trade

As mentioned above, the trade in sand is very small when compared to the production volumes[2]. This can also be related to underreporting of the trade in sand when it crosses informal land boundaries. However, given the discrepancy between estimated production figures (even when using a much more conservative measure than UNEP) and trade figures, we can assume that the trade in sand is generally at low levels. The most likely reason is prohibitive costs of transport given the low value, high bulk nature of sand and the still available 'reserves' in many countries, which, although potentially extracted informally or unsustainably, do not provide the necessary incentive for international trade.

Moreover, in most cases, sand exports comprise only a small fraction of the total in-country production of sand, which means that even in those countries with fairly high volumes of sand exports, the vast bulk of sand is still used internally. When looking at the major exporters, only seven of those reach a quite low threshold of the export of 50 million tons of sand over a twenty-year period (1998-2018). Indonesia, the top sand exporter according to our data, still only exports about 8 per cent of its production[3]. Germany, Europe's largest exporter (with a lot of its sand going to neighbouring countries including Belgium), also only exports 7.4 per cent of its production, which is similar to The Netherlands. Cambodia is the only exception in our data, having exported just over twenty per cent of its sand production over the full period. While operating at much lower volumes, Nepal is the only other country exporting a substantial amount of its sand production, especially to India. All other countries either are net importers or export a very small fraction of their sand production[4].

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[2] Sand trade was measured using the CEPII (2021) Baci dataset, which allows for a disaggregated focus on construction sand (excluding e.g. silica sands). Still, as we will note below, there might be some issues with proper reporting in the correct product categories as well as general under-reporting and cross-border unregistered smuggling.

[3] Given the data limitations, it is not even clear whether all these exports are in fact from in-country produced sand. While a net exporter, Indonesia (and other countries on our list) might also re-export some of sand it imported earlier, which would make the share exported even lower.

[4] Mozambique is a somewhat surprising case and the available material on the country does not really show large-scale extraction or trade in construction sand. Mozambique has become rather (in)famous for large-scale Chinese extraction (and export) of heavy sands and its impact on coastal wetlands (Amnesty International, 2018). This might have been reflected (erroneously) in the Baci construction sand data.

As very few countries export large quantities of sand, sand imports obviously are also small (figure 9). Many of the main sand importers are (very) small countries or in the case of Macao and Hong Kong, special administrative regions. Singapore is by far the largest sand importer, mostly from Southeast Asia. Its imports are a third above what it manages to produce internally. Belgium, while importing much smaller quantities than Singapore, imports about 3.5 times what it mines locally. With its economy closely integrated with major sand exporting countries like neighbouring The Netherlands and Germany, and a small resource base for extracting its own construction sand, this is not very surprising. Of all other major importing countries, only Hong Kong (1.2 times) and Macao (3.1 times) import more than they produce locally. For most other countries, including Japan and the United States, sand imports only contribute marginally to their internal sand market.

Figure 8: Twenty top exporters and share of export of in country production (1998-2018)

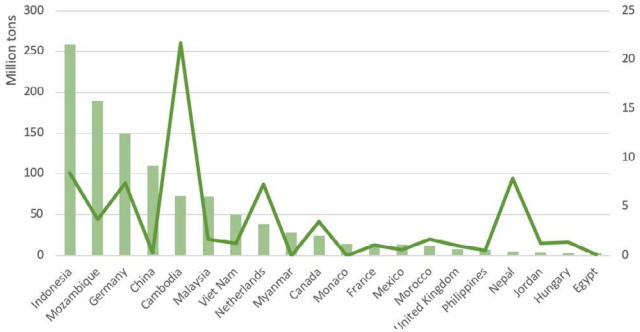
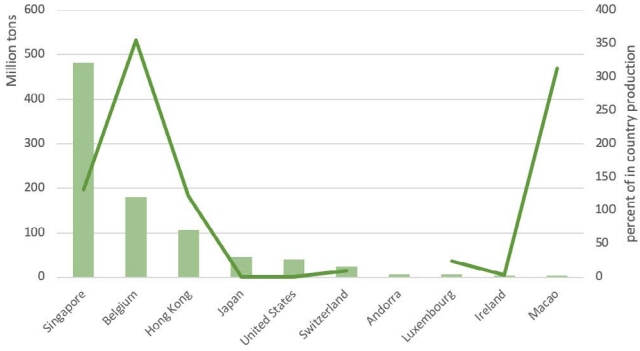


Figure 9: Ten top imports and import as share of country production (1998-2018)



Mapping the literature: A social review

Global sand data and measurement hardly tell the whole story. There is insufficient livelihood analysis of how global sand flows impact people with livelihoods at extraction sites, especially given sand's vital role in maintaining livelihoods. National statistics do not capture fisheries of a subsistence and semi-subsistence nature, or riverside farming. Sand mining in Cambodia, Myanmar and elsewhere undermines and sometimes eliminates traditional livelihoods (Lamb, Marschke, & Rigg, 2019). Sand's value 'for local resource users is effectively discounted or rendered invisible, with the ways in which sand feeds into subsistence and semi-subsistence activities generally overlooked' (Lamb, Marschke, & Rigg, 2019, p. 1524).

Four key areas of focus emerge from the social scientific literature and policy documents on sand mining: land reclamation, livelihoods and mining activities, environmental concerns and political conflict and sand-related corruption. It should be noted from the outset that these themes obviously leave much room for further thematic research. At the same time, global and regional coverage of the available research is far from uniform, with South and Southeast Asia having received quite some interest, with research on Africa and Latin America being more scarce. Within regions there is significant unevenness in coverage, leaving a lot of room for further research in almost all aspects of sand commodity chains.

Land reclamation

Land reclamation is the process of making land out of water bodies. According to Qing, '[r]eclaimed land is created by dumping sand into bodies of water or low-lying swamps and then levelling it off and building a wall around the new shoreline to prevent erosion. The sand — preferred over clay or rocks because it settles better — is harvested from hills or dredged from the sea' (Qing, 2005). In

other words, 'reclamation [is] a unique process in which land [is] explicitly produced as a commodity for market purposes' (Alshehabi & Suroor, 2016, p. 835) This process of reclamation exposes the different types of 'colonisation' of land through the extraction of sand where one region is stripped of its land mass to create land in another region (Jamieson, 2021) and at the same time demonstrates the role of sand in urbanization and city-making, which can be seen as geological processes (Dawson, 2021). Dhaka, the capital of Bangladesh and one of the fastest growing megacities, is largely built on swamps and consumes large quantities of sand, often harvested both up or downstream, to facilitate rapid urban expansion. Moreover, literature on Singapore and Dubai (Global Witness, 2010; IRP, 2020; Jamieson, 2021) shows how the two countries have imported sand for large-scale land reclamation projects and invested in artificial islands (see also the impact of Singapore's land reclamation on e.g. Cambodia above). In contrast, close to 12 dozen islands have disappeared in Indonesia—one of Asia's largest sand producers (see above)—due to excessive sand mining or dredging.

Due to rapid exhaustion of sand, several countries have started importing sand from other countries despite the constraints of cost-effectiveness and transport convenience which has continued to keep trade in sand low (see above). Uganda's sand is for instance exported to neighbouring countries of DRC, South Sudan and Rwanda (Daghar, 2020). Singapore again is the most important example as it imports a huge amount of sand from its South East Asian neighbours. It is the largest consumer and largest importer of sand primarily because it exhausted its own foreshore sand (coastal beach sand) in the late 1980s (Jamieson, 2021). Singapore then started importing sand from Malaysia, but Malaysia soon banned sand exports to Singapore. In 2007, Indonesia followed suit. Cambodia continues to provide sand to Singapore, of which only a small amount is recorded as exports. This highlights the limitations of official trade statistics to gauge real world trade in sand (see also above). Sand is illegally extracted and smuggled without the Cambodian government making much official revenue from this trade. In May 2009, and again in 2016 and 2017, Cambodia in turn decided to halt its supply of sand to Singapore, which then turned to China for importing sand (Global Witness, 2009). Since the 1960s Singapore's surface area has expanded by 22 per cent and by 2030 could have grown by 30 per cent (Global Witness, 2010). More often than not sand is extracted from poor nations, and the ones importing sand are wealthy.

THE ROLE OF (SUSTAINABLE) DREDGING

The dredging industry should be activated to play a role in sustainable sand mining. Large scale dredging is key in many instances of land reclamation, e.g. in Singapore or Dubai. Marine dredging obviously also plays a role in the creation and maintenance of harbours. Marine dredging has been argued to affect heavily on biodiversity and eco-systems which are also crucial in maintaining key livelihoods (see e.g. Boyd et al. 2005; Doloksaribu et al 2020; Erftemeijer et al 2012). Currently, national environmental regulations in the place where dredging is done, guide the kind of measures internationally operating dredging companies have to follow. Other policy imperatives might override issues of sustainability in these contexts. Many dredging companies also depend on export credit insurances from countries in which they are registered. While the latter could be used to pressurize dredgers registered in specific countries like Belgium of The Netherlands in following stringent environmental protection measures, they are unlikely to be successful in changing the sector. This would just shift dredging towards less demanding countries of registration.

A more successful strategy would be a global initiative, similar to others taken in the extractive industries to align to common guidelines (see policy initiatives below). While some industry initiatives have been undertaken, for instance under the sustainability committee of the International Association of Dredging Companies (IADC), a global initiative could not only provide a more level playing field, but also force the global dredging community to rethink their relation with nature. This would involve thinking at the project level whether e.g. land reclamation is indeed the best option, an independent assessment of the long-term impacts of dredging on ecosystems and livelihoods, giving more importance to mitigation strategies and close project monitoring at all stages. While many of these processes are supposed to be in place already, the discussions and protests surrounding the proposed Manilla airport land reclamation project (both in the Philippines and in the dredger's country or origin) for instance show that stronger international monitoring could both help to minimize environmental impacts, while providing more checks and balances as well as incentivize dredging companies to integrate sustainability in their business model.

Labour, livelihoods and mining activities

Sand, a development mineral, is mostly locally mined by labourers and consumed by nations, rather than exported, but these labourers are not given enough attention by policymakers (IRP, 2020). Few studies have focused on the workers behind sand mining activities, the 'production networks of sand, [or] livelihood vulnerabilities' (Lamb, Marschke, & Rigg, 2019, p. 1512), even though in 2016, the number of miners in artisanal and small-scale mining-related activities around the world was estimated to be 100-150 million and is still growing. This absence of data makes studying the extraction and transportation of sand a complex and challenging process. Sand mining is a regional activity so the emphasis in studying it has been from the local perspective. However, in framing sand as local, several hidden direct and indirect links in the sand business 'connecting livelihoods across space and national and livelihoods contexts are left out' (Lamb, Marschke, & Rigg, 2019, p. 1514). For example, one form of livelihood such as fishing and/or small-scale agriculture is undermined in favour of another, precarious livelihood such as mining.

Bisht (2021a, p. 6) distinguishes between

> small-scale traditional sustenance operations as opposed to illegal sand extractors, e.g., the sand mafia [...] sand frontiers are not spaces where traditional, manual, communal, small-scale and subsistence-based sand extraction occurs, but rather where large-scale extraction, controlled and consolidated by powerful actors, for accumulation occurs.

She notes that these actors are not usually a multinational firm or the state, but still possess significant political power and wealth at national, regional, or local levels, and their activities 'undermine the democratic rights, interests and values of local communities', including their access to sand commons (Bisht 2021a, p. 7). The concentration of value with locally influential actors rather than companies, global markets or the state strengthens local asymmetries of power. Even if local populations gain income or opportunities for employment, these prospects go hand in hand with high exploitation.

In the case of South Asia, it is argued miners — who are most likely contractual labourers — cannot be easily located and classified (Hinton et al., 2003). Some news reports speculate that the situation may not have really improved for sand miners in the 21st century: miners, sometimes children, die by drowning due to a fall in the bed level of rivers (Himalayan News Service, 2020). For example, divers have plunged into depths of 120 feet to extract sand, which has often led to deaths due to drowning in recent years (Jeyaranjan, 2019). In general, in South Asia and South Africa sand is part of artisanal and small-scale mining (Lahiri-Dutt, 2006), while in "developed" countries such as the United States of America and European countries mechanised technologies for river dredging are used. In the Indian state of Tamil Nadu, before the 1980s, sand was locally collected in small vehicles such as bullock carts in exchange for paltry fees to the local panchayat. Therefore, 'sand was like a free good which could be appropriated at an insignificant price by cart owners… most of the cost incurred by sand extraction was that of labour and transport' (Jeyaranjan, 2019, p. 96). Even though ploughs, shovels and sickles were and still are used for sand mining, mechanical excavators these days extract truckloads of sand. Overall, in recent years things have changed, and large-scale mining and dredging equipment is also used in developing countries. According to an International Resource Panel (IRP) report, *Mineral Resource Governance in the 21st Century*, export minerals and large-scale mining receive more attention in economics because of macroeconomic benefits and control over security of supply (IRP, 2020). Not much has been documented with respect to artisanal and small-scale sand mining because it is difficult to research and assess, even though it forms a key source of income for disadvantaged groups in different societies. Manual sand workers have been described as 'destitute people working in unstable, insecure, exploitative, unregulated, often illegal jobs which involve high risk and no occupational protection, often in locations that are not easily accessible and are lacking in basic services' (Bisht, 2021a, p. 6). The exploitative labour conditions under which labourers mine sand is yet to be empirically established (See e.g. Hoffmann's (2021) work in the section on sand mafia below). In Nepal, for example, sand mining provides an important livelihood in their home localities for those that previously migrated to regions such as India and Saudi Arabia for work. There is a growing perception among local government

officials and policy makers that sand mining as a livelihood practice helps provide employment and reduce poverty (Shrestha, 2013).[5]

Environmental concerns

The extraction of aggregates from rivers and the building of dams on them have led to severe damage to river basins, in particular lowering of the riverbed and water table. This has increased the incidence and severity of droughts, as tributaries of major rivers dry up when sand extraction reaches a certain threshold. In general, riverine sand mining is considered hazardous to ecosystems (Padmalal & Maya, 2014). Riverine sand mining operations may 'appear small and localized, but they remove important stabilizing riparian vegetation and constantly move location, leaving behind unproductive and unrestored land' (Daghar, 2020). Similarly, in the case of India, and other parts of South Asia, riverine sand mining along major rivers and their tributaries has provoked discussions among academics, environmental activists, lawyers and farmers about the importance of protecting rivers and assigning legal rights to them. Major rivers and their tributaries in India (Ganga and Yamuna), China (Mekong, Yangzi and Pearl), Uganda (Lake Victoria), Nepal (Bagmati and Sunkoshi) and several other regions are home to rich deposits of sand, silt and clay.

Further, the damming of rivers blocks the flow of sediments (sand and gravel) that stabilize riverbeds. Dams hold the sediments in the upstream reservoir whereas the downstream water is free from sediment particles, leading to 'hungry waters' and channel shrinking. Further, dredging also removes a large amount of sediment from rivers, similar to dams (Kondolf, 1997); the beach sands help in controlling the speed of storms and cyclones and prevents them from causing excessive damage (Pereira, 2020). Several news articles have moreover commented on the impact that sand mining has on aquatic life, and other species as well as on the livelihoods of fishing communities. The gharials and dolphins in the Chambal and Gandak rivers in India and Nepal are critically endangered and this situation is associated with rampant sand mining in the region and reduction of sandbars and islands, which in

[5] This information is part of ongoing research in Nepal by Saumya Pandey.

turn may lead to decreased fish species diversity (Wyzga et al. 2009; Eitzmann & Paukert 2010b). These mining activities destroy their preferred site of basking and building nests, forcing them to change their homes (Sunder, 2020). In contrast, a study found that while 'in-stream sand dredging in a Great Plains sand bed river did alter the main-stem river habitat, the modern fish community, which is tolerant to extreme conditions, did not differ between dredged and control reaches' (Taylor et al., 2014). The documentary *Sand Wars* shows that construction on coastal shores leads to massive erosion that makes the ground around water bodies quite unstable for living.

On the other hand, there are also speculation about how to best utilize the sand inundating rivers due to glacial meltdown and that has also been a cause of rising sea level. Here, the emphasis is on the fact that sand is a common-pool resource (managed by local communities) and is easily accessible to all. Since it is scattered all over the earth and forms an essential component of the earth's crust, it is argued that it will be very difficult and costly to regulate its extraction (Torres et al., 2017). Suggestions in this regard have been made to improve licensing policies and exploit sand in Arctic regions.

Sand mining represents 85 percent of mineral excavation (Pearce, 2019). Environment journalist Pearce, following a scientific investigation on the effects and causes related to sand mining, has pointed out that extraction from rivers should not exceed the resupply from upstream. Those who have argued against sand mining highlight that contrary to popular belief, sand is a non-renewable resource because it takes hundreds of years of erosion of rocks and melting of glaciers for the formation of sediments (Pereira, 2020). Bruce Edward (2015) has raised concerns about the 'insatiable' demand for sand, and argued that the overdependence of the global economy on the natural resource works against a sustainable development strategy. Further, the lack of mechanisms in place to assess the environmental impact of sand extraction does not help. In some cases, when Environmental Impact Assessment (EIA) is conducted, it is often too late and the rivers have been greatly harmed already. Other times, governments are negligent in conducting EIA.

Political conflict and sand corruption

Sand mining has led to frequent conflict or violations of sovereignty in international waters. For example, in 2017 the United Nations Security Council made trading in sand from North Korea a violation of international law (Security Council, 2017). Before that, sand had been the first commercial trade (in 2014) between North Korea and South Korea since 1950 (Welland, 2010, p. 106). In another case, Singapore was taken to the Hamburg-based International Tribunal for the Law of the Sea in September 2003 by its northern neighbour, Malaysia, accusing the island of dredging in the Johor Strait between the two countries without consulting Malaysia. Malaysia said Singapore's northern reclamation projects have hurt marine life and affected shipping in the Johor Strait. The 18-month dispute cooled in January when the two acknowledged the strait as 'a shared water body' (Qing, 2005).

The 2010 report *Shifting Sand: How Singapore's Demand for Cambodian Sand Threatens Ecosystems and Undermines Good Governance* by Global Witness described the key players involved in Cambodia's illicit sand sector. By tracing the business of sand, the report showed that most companies that engaged in dredging in Cambodia had connections to Singapore. Some were listed with the Singapore government agency while others had a license that bore a signature and stamp from representatives of the Singaporean embassy in Cambodia. This report draws from the 2009 report by Global Witness, *Country for sale — how Cambodia's elite has captured the country's extractive industries*, which identified the Thai businessman turned CPP Senator Ly Yong Phat as the major player in the dredging business in Koh Kong Province[6] (Global Witness, 2009). In 2009 his company LYP Groups received the license to mine three rivers, Sre Ambil, Ta Tai and Koh Por, which was in direct violation of Article 1.2 of the *Decision Concerning the Limiting of Sand Trafficking*. (Global Witness, 2010, p. 8)

According to a news report, in Morocco, half of the sand used every year in the construction industry is illegally extracted from the country's coast. Real estate development requires an estimated 30 million tons of sand every

[6] The two other major companies are the Mong Reththy Group (owned by Senator Mong Reththy) and Udom Seima Peanikch Industry and Mine Co Ltd.

year. To meet this demand coastal sand along the western seaboard and Mediterranean is increasingly extracted by both registered companies and smugglers: the Iberian companies operating in the Spanish enclave of Melila, north-west of Morocco, use sand illegally extracted from the nearby Moroccan province of Nador. Their trucks often belong to Moroccan government officials and politicians regularly transport sand for construction projects, selling it to Spanish companies such as SEROM. The quantity is undeclared and transaction tracking is increasingly difficult (Abderrahmane, 2021).

In India and Nepal the mainstream media has extensively investigated the sand mafia topic, which often entails a network of businesses and politicians involved in illegal, unlicensed and unregulated extraction of sand. In recent years, several news reports about how corruption in sand business has led to fatal consequences for reporters, journalists, activists and local communities (Rawat, 2020) have emerged. The most authoritative literature on illicit mining and the political-mafia nexus is emerging from South and South-east Asian countries. For example, in India the discourse on violent sand mafia networks is so common that it is even reflected in the title of several reports and seminars: *Inside the deadly world of India's sand mining mafia* (Salopek, 2019); *The bloody war of India's illegal sand mining* (Gupta, 2020); *Is sand mining killing our rivers?* (India Rivers Forum, 2020); and *Where smugglers kill at will and blood soaks river sand* (Kabirdoss, 2018). These works show how several regulations are violated to extract sand from riverbeds — unlicensed mining, extracting more than what is permitted, mining regions without permits, loading lorries with sand beyond the permissible limit, tax evasion — and how any investigation into the matter has been followed by killings and deaths.

J. Jeyaranjan's account of the il/legal mining in the South Indian state of Tamil Nadu shows how profits procured from sand mining — by a single family that has monopolised sand mining by getting 71 out of the 83 leases from the government — are directly or indirectly injected into political vote banks and electoral funding, and very often government officials, journalists and reporters who investigate the matter are transferred to another unit or physically assaulted by those involved in the sand business (Jeyaranjan, 2019). However, 'sand mafia assemblages' in the context of North India are formed not just

between political parties and mafia, but are also socially embedded to lock in anyone who is involved in their business, thereby blurring neatly defined distinctions between organised and unorganised crime (Michelutti, 2019). Indian media has widely reported on rampant sand extraction from rivers in Kerala, Tamil Nadu, Goa, Madhya Pradesh, Bihar, Assam, West Bengal, Delhi and Uttar Pradesh. Mining activities since the 1980s are also closely linked with political mafia networks. The situation is similar for adjoining regions such as Nepal (Sayami & Tamrakar, 2007), Bangladesh (Khan & Sugie, 2015) and Sri Lanka (Piyadasa, 2012). In the case of Nepal, Hoffmann shows that sand mining is carried out by a decentralized mafia network, in which work is built on the system of *jugaad* (putting things together in a makeshift way) and the uncertainties of sand mining are dealt with through shamanistic practices; such is the nature of this extractive industry (Hoffmann, 2021). This gives interesting insight into how psychologically stabilizing agencies are created and sustained in extractive industries to cope with uncertainties and precariousness in the emerging mafia assemblages.

Sand and (international) initiatives

Across the globe, efforts to avoid sand shortage and implement more sustainable practices are getting more attention. Most prominently, the United Nations Environment Programme met for a roundtable conference in Geneva in 2018 to discuss the growing problem of sand mining. The primary solution for sustainable consumption and production of sand that they discussed focussed on efforts to reduce sand extraction for building and construction. A year later, in 2019, they came up with the report *Sand and Sustainability: Finding new solutions for environmental governance of global sand resources*, in which sand mining was called 'one of the major sustainability challenges of the 21st century' (United Nations Environment Programme, 2019). The report proposed that putting sustainable solutions in place did not only imply that one had to keep waiting for new laws and rules on sand mining and governance for international cooperation (UNEP, 2019, p. 11) but involved working with the existing legal systems. The report, like many others, has called for better governance practices, reduction in sand mining activities, and search for alternatives (such as plastic in road building) to sand.

The focus on 'mining' as the extraction of minerals imported by the Global North from the Global South has profoundly shaped policy and led to neglect of 'development minerals', which includes sand (Franks, 2020). This section addresses how existing initiatives, including due diligence, could be applied or extended to sand mining. Efforts to ensure that natural resources contribute to economic and social development in the Global South have been for decades a focus of policy in these countries and internationally, with renewed attention in the late 1990s and early 2000s (EITI, n.d.a.). In resource-rich areas

of the Global South, extraction-related externalities unfold close by the facilities where extracting and processing take place, while associated opportunities and benefits are amassed elsewhere (Lamb, Marschke, & Rigg, 2019).

Growing sand scarcity due to overextraction shows a need for regulation at national, regional, and global levels. In contrast with other commodities, there is no international regulatory system for trade; nor does sand 'have "an architecture of non-state certifying bodies to influence management practices and structure the direction and volume of trade"' (Bridge, 2008, p. 415, quoted in Lamb, Marschke, & Rigg, 2019, p. 1513). Despite sand's relatively recent commodification and integration into global trade, it has not yet been priced or regulated nationally or internationally (Bisht, 2021a).

As has already been mentioned above, before policy options can be meaningfully debated, more information is needed on sand extraction and trade. This does not only include more quantitative data on production levels and trade, but also on the means of extraction, transport and trade itself, and on individuals and communities– including women and girls – whose livelihoods depend on sand, in the form of sand extraction and/or trade. Of particular interest, as we shall also argue below, are efforts to gather data on artisanal and small-scale mining (ASM), a category to which some sand extraction belongs. A number of already existing platforms could be used or extended to collect and share data related to sand. In 2019 the Association of Southeast Asian Nations (ASEAN) and the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) held a workshop on sustainability in mining that brought together ASEAN (and Chinese, Japanese, and Korean) member state officials, as well as industry representatives, academics, and civil society (IGF, 2019). Delve is a global online platform for the collection of data on ASM. This ASM Global Data project is funded by the World Bank's Extractives Global Programmatic Support (EGPS) Multi Donor Trust Fund (Delve, n.d.). The Kufatilia platform for reporting and monitoring incidents related to mineral production, transport, and sale in eastern Democratic Republic of Congo (DRC) is an example created with backing from the European Partnership for Responsible Minerals (EPRM). Antwerp-based International Peace Information Service (IPIS), with CEGEMI and Ulula, executed this project and is now extending Kufatilia (IPIS, n.d.).

ASM and formalization

While development minerals have been neglected to a large extent, a lot of possible policy options and pitfalls have been debated in the literature on artisanal and small-scale mining (ASM), and its relation to large scale extraction. During the 1980s and much of the 1990s, artisanal and small-scale mining was scarcely on development agenda. With time, recognition grew of the link between ASM informality and negative impacts (Hilson, 2016). Yet it is now widely acknowledged that in a number of countries, many of which are African but also Asian countries such as the Philippines (Verbrugge & Besmanos, 2016), profits from mining gold and other high-value minerals allow agricultural communities to increase their income (Afeku, 2020, p. 488). This includes women in many parts of the Global South (Lahiri-Dutt, 2015). In turn there has been enhanced attention to legislation and policy-making, particularly formalization including by integrating ASM into the formal, legal economy (ICGLR, n.d.d.) through granting permits, supporting miners' cooperatives, adapting licensing requirements and other measures. The process of formalization can include "the introduction of legal and regulatory frameworks, providing legal access to mineral information about geological data, organizing miners into flexible and dynamic organizations such as cooperatives, and providing access to capital, equipment, and technical assistance." (IMPACT, n.d.) Yet Hilson and Maconachie (2020) argue that donors and governments have repeatedly failed to consider ASM's needs, though formalizing and providing support for ASM could help governments, including in Africa, meet the Sustainable Development Goals. Approaches based on (transnational) regulation and formalization must incorporate local actors to prevent negative on-the-ground impacts of regulation, including costs of certification, which financially burden already-precarious actors in small-scale mining (Küblböck, 2021). Formalization efforts must take into account the complex local interdependencies of artisanal and small-scale mining (Geenen, 2012), including women's extensive involvement (Bashwira, 2014). One example is the 2019 formalization of sand mining in the Dar es Salaam region, where a balance was sought between the livelihoods of small-scale artisanal miners, and large-scale contractors, with both legal arrangements and informal accommodation at the local level forming part of the mix (for more details see: Shitima & Suykens 2022).

Regulatory efforts focusing on sand mining, should take stock of the governance efforts (and their pitfalls) already in place for ASM with its focus on manual labor. While it is generally ('illegal') small-scale extraction—which UNEP only puts at 10-15 per cent of extraction of all aggregates (UNEP, 2019)[7]—of sand that uses manual labor, in regions of labor surplus, large-scale extraction can be carried out manually (Bisht, 2021). While the vulnerability of those who are active in these sectors should not be overstated (see the case of Nepal above), it has been argued that people in this employment, like in ASM generally, 'often belong to socioeconomically vulnerable sections of society, rural and previously agrarian peasant populations suffering from declining returns on traditional livelihoods [...] thus engaging in fluid or flexible low-skill work as a form of income diversification' (Bisht, 2021, p. 6). As with ASM more broadly, in many countries sand mining's informal and overlooked nature is likely to have contributed to 'occupational health and safety (OHS), child labor, community relations, environmental, organizational and productivity challenges', leading to great demand for assistance (Franks, 2020, p. 458). Yet it is important not to be overly negative on the development possibilities linked with local sand mining, given literature pointing to ASM's greater contribution, compared to large-scale mining, to local economies (Radley, 2021). Development Minerals necessitate less capital and have shorter preparation times (Afeku, 2020), which compared with high-value mining, could be advantageous for ASM sand miners.

Belgium's support to the World Bank "Extractives Global Programmatic Support Multi Donor Trust Fund", including the facility on ASM, further points to ASM as a key potential entry point for Belgium when it comes to social, environmental, and economic dimensions of sand governance. This could include working with national and local governments in sand-extracting countries to raise awareness of ASM of sand and provide the necessary resources for the sector to better manage its activities and environmental impact. As suggested by the discussion above, any Belgian direct or indirect support for ASM, including formalization efforts, should be subject to ongoing

[7] This might be an underestimation for sand, as gravel might be more commonly mined from crushed rock quarries, while construction sand needs particular material qualities which makes river sand particularly valuable.

gender impact assessments to ensure that potential adverse effects for women and men are identified and addressed well before implementation (IMPACT, 2020). Therefore, support for women involved in ASM, including women's associations, should also be considered.

'Development minerals' and development approaches

Some scholars and practitioners speak of 'development minerals' to highlight their potential for national development. Development minerals[8] are 'minerals and materials that are mined, processed, manufactured and used domestically in industries such as construction, manufacturing, infrastructure and agriculture.' (Franks, 2020, p. 455) The term came about in the context of the Africa, Caribbean, and Pacific (ACP)-EU Development Minerals Programme (carried out in collaboration with UNDP) 'to reflect the huge development potential' of these minerals formerly categorized as Low Value Minerals and Materials and consequently 'neglected by many countries as drivers of domestic economic development' (Afeku, 2020, p. 489). Unlike with precious metals and stones, development-mineral commodities are destined for domestic, rather than international, destinations, highlighting the need for better research, knowledge, and data on these supply chains. Good data on production, export, and employment are lacking, as the sector has been peripheral to the agenda for international development (Hilson, 2016). Franks (2020) points to a preoccupation with value, rather than the importance for local economies and development of 'Low Value Minerals and Materials'. Policymaking in Africa, the Caribbean, and the Pacific has reflected the failure to allocate resources to understand how the development-mineral economy is structured in order to design regulations (Hilson, 2016). Yet there have been some achievements in gathering trustworthy data, including in Cameroon and Zambia, as part of the ACP-EU Development Minerals Programme (Bisht, 2021a).

Afeku & Asamoah Debrah (2020) point to the sector's steady contributions of revenue to GDP. In Ghana, the sector's contribution to GDP has exhibited

[8] This term should not be equated with 'sustainable development', given the multiple social and environmental issues linked with the sector (Franks, 2020, p. 455).

strong growth since 2009; as of 2020 mining and quarrying accounted for about 8% of GDP. Since governments' priority in Africa and elsewhere has been to develop High Value Minerals for export, their laws and policies have been focused accordingly (Afeku, 2020, p. 490). Yet high-volume, low-value commodities with a relatively limited transport range, like sand, offer 'relatively stronger opportunities for broad-based linkages with local and national economies than high value minerals.' (Akong, 2020, p. 467) Exploiting construction minerals 'is labor intensive, with relatively minimal technology inputs'; these 'minerals are widely abundant, requiring low investment in geological information' (Akong, 2020, p. 467). It has been argued that greater support for Development Minerals, particularly with respect to their limited technology and skills, and usage elsewhere in the economy, can stimulate local industry development (Afeku, 2020). These minerals' development potential relates to meeting local needs domestically, and development through economic linkages (and to a lesser extent government revenue) (Franks, 2020). In terms of linkages development minerals are characterized by 'large numbers of relatively low-skilled jobs and significant contribution to domestic value addition, tapering to modest government revenue' (Franks, 2020, p. 455).Frameworks to foster natural resources' contribution to countries' development include the UNDP-developed ACP-EU Development Minerals Program, 'the first major output of the ACP Framework of Action on the Development of Mineral Resources Sector, adopted by ACP ministers in 2011, itself a response to' the African Union's Africa Mining Vision (AMV). The Development Minerals Program is focused on capacity building, including for artisanal and small-scale miners, quarry workers, and small and medium-sized enterprises (Franks, 2020). At the continental level, Africa's Agenda 2063 'emphasizes acceleration of the transformation and industrialization of African economies through beneficiation and value addition of natural resources by implementing the AMV' (Afeku, 2020, p. 492).

Agenda 2063 is Africa's overarching plan and strategic framework for ensuring sustainable, inclusive development on the continent, a tangible expression "of the pan-African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance." Agenda 2063 prioritizes "inclusive social and economic development, continental and regional integration, democratic governance and peace and

security amongst other issues aimed at repositioning Africa to becoming a dominant player in the global arena." (African Union, n.d.a.)

The Africa Mining Vision, adopted by Heads of State at a 2009 African Union summit, is clearly relevant when it comes to sand extraction and governance, given its emphasis not just on mining regimes, taxation and resource income spending, but more widely on "integrating mining much better into development policies at local, national and regional levels." The AMV therefore emphasizes mining's potential contribution to local development through ensuring that communities and workers genuinely benefit from large-scale industrial mining "and that their environment is protected." The AMV also argues that countries should be in a position to negotiate contracts with multinationals that ensure fair rents for their resources and require the use of local inputs for mining operations. Regionally, it is noted, mining should be integrated into trade and industrial policy, de-enclaving mining to help ensure Africa no longer functions only as an "exporter of cheap raw materials to manufacturer and supplier of knowledge-based services." The AMV therefore focuses on creating the social and economic linkages to help ensure that mining contributes to development and growth (African Union, n.d.b.).

While the AMV clearly emphasizes issues related to large-scale, particularly industrial, mining, and corporate relations, which may only be partially relevant for sand, it offers pathways for improving sand governance, given its focus on "mutually beneficial partnerships between the state, the private sector, civil society, local communities and other stakeholders" (African Union, 2009, p. v) and full knowledge and geological mapping of the continent's mineral endowments (ibid, p. 2). According to the founding document, moreover, the mining sector should incorporate "lower value industrial minerals at both commercial and small-scale levels" as well (ibid). Much sand is probably not exported beyond national borders (see above), but there should be consideration of how and to what extent value is added, e.g. through cement production. Support to AMV goals in the context of sand governance should include assessing the potential downstream, upstream, and side-stream linkages from the sector. The AMV also highlights the importance not only of how resource rents are acquired and used, but also of the safety, health, gender

and ethnic inclusivity, respect for the environment, and social responsibility, including with respect to local communities. Consideration should therefore be given to the extent to which local communities receive benefits from sand extraction in the areas where they live. Given the close links between sand mining and the construction sector/infrastructure, there is a need to assess potential trade-offs in terms of the sector's contribution to bettering African lives, and the negative impacts of sand extraction/transport at the local level. The AMV also emphasizes investing in skills and building capacity, which can be applied to sand workers, including when it comes to environmental protection and limits to sand extraction. Support to ASM in order to foster entrepreneurship, enhance livelihoods, and increase social and economic development in rural areas is also in line with the AMV (African Union, 2009).

Other sand-specific recommendations in line with the AMV could include:

- Developing research clusters on sand bringing together government, academic, industry, community, and other actors
- Fostering knowledge-sharing commercial bodies such as industry associations to share information on sand extraction and best practices for environmental protection
- Encouraging and supporting small- and medium-scale enterprises, particularly those with a good track record in terms of environmental protections and accountability to communities
- Develop government capacity to create standards for and monitor sand extraction
- Ensure that industry players comply "with the highest standards of corporate governance, and environmental, social and material stewardship" (African Union, 2009, p. 4)
- Seek alternatives to sand extraction for construction and for bigger infrastructural projects, including through targeted research by the above-mentioned research clusters

- Clarify beneficiation from sand extraction and develop appropriate taxation and redistribution policies

- Emphasize regional cooperation to shed light on the trade and its social and environmental impacts

Other regional economic communities, like the the Association of Southeast Asian Nations (ASEAN) and the East African Community (EAC) may also provide a venue for Development Minerals policies (Afeku, 2020) in general, and a targeted, coordinated regional response to sand-related issues in particular.

BELGIUM AND DEVELOPMENT APPROACHES

The Extractive Industries Transparency Initiative (EITI), which Belgium supports, offers a potential forum for improving sand governance, including when it comes to the role of civil society as a "watchdog" for improvement and progress on sand governance. As highlighted below in the discussion of potential due-diligence approaches to sand regulation, regional (economic) bodies, initiatives, and instruments, including the ACP-EU Development Minerals Programme and the African Union (and its Agenda 2063, which includes a focus on developing an African commodities strategy), could provide a key entry point for Belgium when it comes to improving sand governance. This is particularly the case given the nature of sand (high volume and low value) and the fact that it is typically regionally traded. Such involvement would be in line with Belgian support for and involvement with the African Union and other regional bodies. Support for the ACP-EU Development Minerals Programme, which at present has limited scope in terms of numbers of countries but is seeking to expand, would allow Belgium to move beyond its traditional focus on high-value minerals such as gold and diamonds.

Bilateral diplomatic, aid- and development-related, trade/shipping, and other relationships with sand-producing or -exporting countries could also provide a leverage point for encouraging improved sand governance and encouraging the implementation of national and international conventions. This is important given that national governments have a significant role to play, particularly in the context of the "return of the state" when it comes to economic development, and given that much sand is used domestically in the country of extraction. Belgium could for instance draw on its special relationship with Vietnam (as its sole direct development cooperation partner in Asia) in this regard. Both Morocco and Tanzania – the selected case-study countries in this project (see Lahcen & Katz-Lavigne 2022; Shitima & Suykens 2022) – are partner countries of bilateral Belgian development cooperation. Given the importance of VLIR-UOS university cooperation and other funding for research partnerships, targeted funding for research on sand extraction and trade could help to address the gap in knowledge surrounding sand mining/trade particularly in the Global South. This would moreover be in keeping with, for example, Belgian support to universities in Latin America and the Caribbean, in different fields of research including life sciences and the environment.

Transparency, disclosure, and corporate social responsibility (CSR)

It should first be noted in this section that there is a difference between corporate social responsibility (CSR), which are non-binding measures that only commit the companies who adopt them to a course of action, and (albeit voluntary, as they are non-binding) initiatives like the Extractive Industries Transparency Initiative (EITI). EITI is a multistakeholder initiative that includes support for building capacity for governance for government/administrations as well as for civil society (the latter plays a key role in monitoring resource-revenue governance). Designed in the beginning "as a voluntary process of extractive sector revenue disclosure for payments between companies and governments, the EITI has evolved into a broad instrument seeking to improve transparency and accountability along the whole natural resource management value chain, including corporate beneficiary ownership" (Rustad, Le Billon, & Lujala, 2017, p. 151). Martin (2018) argued that for decades, disclosure has been perceived as a remedy for all corporate problems. Following liberalization of the mining sector and international financial institution-led retreat of states in Africa (Campbell, 2012), there was an evolution of discourse related to resource governance and economic development. The focus in the 1990s and 2000s was payment and revenue transparency, disclosure, and accountability. These approaches were part of efforts to promote good governance and development, avoid or reverse the 'resource curse', and avert civil wars. According to Besada and Martin (2015, p. 4), this shift entailed 'new private, voluntary, and transnational initiatives' to increase transparency in extractive sectors. The Extractive Industries Transparency Initiative (EITI), a multistakeholder organization launched in 2002 (EITI, 2020), builds on initiatives backed by the World Bank, business, and civil society, like Publish What You Pay (Cusato, 2021). EITI puts into practice a global standard for the promotion of accountable and accessible resource management in oil, gas, and mining (EITI, n.d.a.). EITI requires host state and company disclosure of information on oil, gas, and mining governance, 'including the allocation of contracts and licenses, exploration and production, revenue collection/payment and spending.' (Cusato, 2021, p. 6). While its effect on corruption is still uncertain, EITI and related schemes saw revenue transparency established as a transnational legal norm (Cusato, 2021; Rustad, Le Billon, & Lujala, 2017).

Corporate transparency and disclosure approaches have been critiqued on grounds that companies use transparency for their own aims, passing off the responsibility for implementation to civil society groups that lack capacity (Ostrowski, 2020). Social impact assessments often make selective or misleading use of data to demonstrate community approval (Parsons & Luke, 2021). In the Nigerian oil sector, corporate and governmental figures are often lacking in consistency (Watts & Zalik, 2020). Besada and Martin (2015) question whether voluntary international programs like the Kimberley Process and EITI, reliant on transnational corporations' willingness to monitor themselves, can change how resource revenues are distributed.

Nonetheless, the EITI's success at meeting its institutional goals and relative success at meeting some of its operational goals, particularly when it comes to auditing standards; reporting; and the involvement of civil society in multi-stakeholder groups (Rustad, Le Billon, & Lujala, 2017) show promise when it comes to sand governance as well. As an example of EITI's potential relevance for sand governance, Ukraine has published four reports for EITI (2013-2017), reporting on quartz sand among other components of its extractive sector (EITI, n.d.c.). Countries can be encouraged to report on sand volumes and revenues (including payments to sub-national governments) and companies involved in sand extraction can be encouraged to provide data as well; training and support could be provided to government ministries to this end (Rustad, Le Billon, & Lujala, 2017). Tanzania is currently an EITI member and can therefore be encouraged in this regard, while Morocco is not (EITI, n.d.b); Tanzania's EITI reporting centers on oil, gas, and minerals (not seemingly including sand) (EITI, n.d.d.). Meanwhile, civil society organizations in sand-extracting countries can be trained and supported to extend their monitoring and watchdog role to the sand sector as well, which would both ensure greater monitoring and oversight as well as increase overall public awareness regarding the importance of the sand sector. EITI's emphasis on more effective institutions, and transparency around extractive-industry revenues, would shed welcome light on this under-researched and underreported sector of the economy. Increasing pressure on governments and companies to gather and share data could also potentially provide entry points for further intervention, including on environmental and social dimensions as well. EITI's multistakeholder structure bringing together governments, civil society, and

the private sector can help foster a more sustainable sand sector. However, EITI's limited scope (with its focus on revenue transparency, which alone does not guarantee accountability) and uneven adoption across resource-rich countries demonstrates that complementary approaches should also be adopted for sand (Rustad, Le Billon, & Lujala, 2017).

Given Belgium's support for transparency and good governance in general and for EITI in particular (through the World Bank "Extractives Global Programmatic Support MultiDonor Trust Fund", particularly the facility on EITI), EITI is a way forward for improving governance and particularly transparency in the sand sector. More specifically, this could include Belgian companies like Deme and Jan De Nul that are involved in domestic and overseas sand-mining projects through activities like dredging, encouraging transparency on any payments to government in sand-extracting companies, while governments should make public details of any payments they receive in connection with sand extraction. Civil society actors should receive training on sand extraction and could be supported to conduct research and data gathering on the sector. This could include efforts to ascertain the beneficial ownership of actors involved in sand extraction (Rustad, Le Billon, & Lujala, 2017), given the likelihood - as demonstrated by the Morocco case study (Lahcen & Katz-Lavigne 2022) – that some of them may be politically exposed persons (PEPs). Participatory research with actors involved in sand-mining activities is also an important way forward. This is a crucial point, for EITI's emphasis on civil society – which may be based in capital cities (far from sand-mining areas in some, though not all, cases) - should not be to the detriment of involvement and consultation of communities in the sand-mining areas themselves. EITI implementation also tends to focus on resource governance at the national, rather than local level (Rustad, Le Billon, & Lujala, 2017).

More and more, companies are attempting to tackle social issues like poverty, environmental degradation, and public health emergencies, particularly in 'developing' countries (Girschik, 2020). Companies rarely address these governance gaps solely for philanthropic reasons but do so to 'realise market opportunities' (Girschik, 2020, pp. 775-776). A problem with social change driven by businesses is that when corporate and societal goals conflict, there

is a risk that business interests will be dominant (Girschik, 2020). Corporate social responsibility also receives criticism for being overly reliant on self-reporting, and for the lack of sufficient evidence for evaluating CSR efforts. The fact that companies themselves define, present, and promote CSR is a significant constraint on its transformative potential (Girschik, Svystunova, & Lysova, 2020). It has been argued that emphasizing transparency comes at the expense of considering resource extraction's environmental and human costs (Bassey, 2020; Zalik & Osuoka, 2020). Companies also only unevenly allow local actors to participate in decision making, depicting some stakeholders as legitimate and others as illegitimate (Hönke, 2018). Wettstein (2021) argues that companies use CSR to shield themselves from calls for legislation on business and human rights. EITI and the Organisation for Economic Co-operation and Development (OECD) Due Diligence Guidance can be positioned within CSR schemes that favor governance through self-regulation instead of regulation by public authority. Such transnational normative frameworks are dependent on voluntary processes and privatized governance systems (Cusato, 2021).

Transparency, disclosure, and CSR offer lessons when 'powerful, international, larger-scale extractive players' are present. For example, marine sand mining in Kenya is Japanese International Cooperation Agency-funded and employs the Dutch ship Willem van Oranje (Bisht, 2021a). Funding bodies such as (development) banks and international financial institutions can play a role in ensuring the respect of environmental and social standards for large-scale projects, as the International Finance Corporation (IFC), a World Bank sister organization, does for mining projects. Yet such an approach may be of limited usefulness when it comes to the involvement in the sand trade of countries that can mobilise significant funding through their own (state-owned) enterprises and institutional banks, like China. In the context of sand – less dominated by large companies than oil, gas, and large-scale mining – research on the social responsibility in supply chains of small and medium enterprises may yield more insight for emerging markets (Oldham, 2021). At the same time, the limited role of transnational trade and transnational companies in the sand sector (apart from large-scale, mostly marine, dredging) might limit the use of transparency, disclosure and accountability as a catch-all approach to monitor and govern sand (see also below).

‘Conflict minerals’ and due diligence

The ‘illegal’ exploitation of resources in societies affected by conflict resulted in law making at the international and transnational levels. From the late 1990s there was ‘a proliferation of transnational initiatives aimed at addressing the connection between resource exploitation, violent conflict and human rights abuses’ (Cusato, 2021, p. 5). The mainstream response was corporate standards and regulatory regimes: the Kimberley Process Certification Scheme for Diamonds (KPCS), EITI, and the OECD Due Diligence Guidance on Responsible Supply Chain of Minerals from Conflict-Affected and High-Risk Areas (CAHRAs). The KPCS was created in 2003 to regulate the ‘legitimate’ diamond trade and keep ‘conflict diamonds’ out. This certification scheme at the international level is based on states’ voluntary commitments (Cusato, 2021). The OECD created the Due Diligence Guidance in 2011 ‘‘to help companies respect human rights and avoid contributing to conflict through their sourcing decisions’. The Guidance, to be used by firms that source metals or minerals such as the 3Ts (tin, tantalum, tungsten) and gold from CAHRAs, ‘provides a framework for risk-based due diligence’ (Cusato, 2021, pp. 7-8).

These developments have influenced laws domestically and regionally, particularly the U.S. Dodd-Frank Act Section 1502 on ‘conflict minerals’ from the DRC and EU Regulation 2017/821, which delineates the due diligence obligations of EU importers of the 3Ts and gold from CAHRAs. Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act requires companies listed in the U.S. to disclose any use of so-called “conflict minerals” (tin, tungsten, tantalum and gold), and if any of their supply of these minerals originated in the Democratic Republic of Congo or a neighboring country (OECD, 2011). Section 1504 of the Dodd-Frank Act addresses payment disclosure by resource extraction issuers, “requiring resource extraction issuers [...] to disclose payments made to the U.S. federal government or foreign governments for the commercial development of oil, natural gas, or minerals.” (U.S. Securities and Exchange Commission, n.d.). The Due Diligence Guidance developed by the OECD ‘has become a global standard and is referenced in several legal instruments,’ particularly at EU level, and in the Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains (Cusato, 2021, p. 8). While many countries of course do not feature on the list of CAHRAs under EU Regulation 2017/821 (EU, n.d.), ‘the list is indicative and does

not spare companies from implementing risk management strategies' in other regions (Küblböck, 2021). The EU Conflict Minerals Regulation came into force on January 1, 2021, requiring firms that import these minerals to verify that their sourcing processes do not add to human rights abuses and conflict. This step represents the first introduction of mandatory HRDD for EU-based companies. While the regulation can be critiqued for its narrow scope, 'its application offers relevant lessons for the EU's forthcoming wide-ranging due diligence legislation', which could cover a wider range of materials (Küblböck, 2021).

These policy responses have been critiqued for not seeking to counter structural realities that contribute to abuses by companies, dispossession, and armed violence (Cusato, 2021). One line of critique is that these 'normative regimes' that rely on extractive-sector actors as a partner in the promotion of peace legitimize activities in countries coming out of conflict (Cusato, 2021, p. 5). Rules that guard foreign investment often overlook the negative social and other consequences of large-scale extraction projects, which include greater inequality and persistent violence (Katz-Lavigne, 2019). Another criticism is that transnational agreements that aim to reduce human rights abuses linked with extraction in conflict-affected areas disregard concerns about resource distribution at the heart of these conflicts (Musamba & Vogel, 2021). Meanwhile, both Congolese and international scholars argued that 'conflict minerals' measures negatively impacted artisanal miners and their dependents (Katz-Lavigne, & Hönke, Jana, 2018). For these reasons, it has been argued that "When it comes to managing ASM in the contexts of limited government capacity, good practices and education may be preferable to licensing and regulation" (Katz-Lavigne & Hönke, 2018).

Having developed into the favored instrument to increase corporate accountability for human rights abuses resulting from business operations abroad, due diligence is now integrated into several soft-law instruments like the UN Guiding Principles on Business and Human Rights and OECD Guidelines for Multinational Enterprises. Human rights due diligence (HRDD) is the process undertaken by businesses to 'assess actual and potential human rights impacts; act to prevent and mitigate these impacts; track the effectiveness of responses; and communicate externally how impacts are addressed.' (Cusato, 2021, p. 16) Globally, HRDD is developing into a central, if not the central, conceptual framework for understanding and operationalizing corporate responsibility for abuses.

Recent developments have included rapid and widespread institutionalization in international and national law, in 'soft' and, increasingly, 'hard law' (Landau, 2019, p. 222). At EU level and in member states, mandatory initiatives are multiplying, which includes forthcoming EU legislation.

Critics of due diligence have argued that corporations' role 'as 'active regulator'; influencing and even creating transnational rules' highlights power imbalances 'among actors involved in the negotiation and implementation of regimes regulating extractive activities in conflict countries' (Cusato, 2021, p. 17). This is in line with a longer trend of international financial institution involvement in rolling back the power of the state to regulate the extractive industries, particularly in Africa (Campbell, 2012). Firms' habit of relying on social audits may not lead to authentic compliance with requirements for reporting, or push companies to act on human rights-related risks (Ford & Nolan, 2020). 'Cosmetic compliance' refers to when companies implement official requirements but do not decrease or eradicate negative human rights-related effects. Indeed, the formulation of the UNGPs and other national and international legislation gives companies significant freedom of action (Landau, 2019). The European Commission observed that 'just over one-third of big companies assess all their human rights and environmental impacts, and only 16% do this across the entire value chain.' (Davis Plüss, 2020) A study on multi-stakeholder initiatives (MSI) for holding companies accountable and protecting human rights found that the vast majority do not 'meaningfully engage communities affected by the operations of participating companies in either MSI governance or implementation' (MSI Integrity & the Duke Human Rights Center at the Kenan Institute for Ethics, 2017, p. 3).

Due diligence-type frameworks have centered on 'critical' minerals imported into the EU. Given the domestic or regional nature of most trade in sand, and despite the great dynamism of developments in the due diligence realm, regional instruments or initiatives other than due diligence, as well as initiatives centered on degrowth, may be better suited to addressing development challenges related to sand. Meanwhile, the (perceived) externally-driven nature of such measures may limit their effectiveness, legitimacy, and take-up at local and regional levels in conflict-affected and high-risk areas and beyond (IMPACT & RESOLVE, 2021).

BELGIUM AND DUE DILIGENCE

On April 22nd, 2021, the Belgian federal parliament took the first steps on the path towards its own due diligence legislation by voting in favor of considering a legislative proposal on due diligence and companies' responsibility throughout the entire value chains. This proposal would mean that Belgium would join a growing group of European countries that already have their own due-diligence legislation. Such a proposal could require all firms established in (or with activities in Belgium) to identify and prevent risks related to human rights, social, and environmental violations in their entire value chains (as well as within their subsidiaries) and to remedy any damage caused. The Corporate Accountability campaign welcomed the fact that the proposed law takes up some of the proposals contained in its October 2020 memorandum. The proposed law provides for companies' legal liability for the absence or inadequacy of precautions taken to avoid or remedy harms, and for access to justice for people affected by such harms (Le Centre national de coopération au développement (CNCD-11.11.11), 2021).

Depending on the form that the law will take, such legislation could potentially entail responsibilities – and potentially even liability for harms abroad – for large Belgian companies with sand-related dredging, construction, engineering, and transport activities, such as Jan De Nul Group and DEME Group. This could also be the case when it comes to upcoming, mandatory EU due diligence for international supply chains (European Parliament, 2020). Such mechanisms would provide an opportunity to ensure corporate accountability for corporations' involvement in sand mining-related activities and possible environmental and social harms resulting from these practices.

An entry point to ensure local involvement in and ownership of efforts to ensure corporate accountability could include empowering social, environmental, and community-based organizations and associations (broadly defined), including women's groups, to create awareness of and monitor sand mining and governance. This could include partnering with artisanal miner associations to counter-balance industrial and large-scale mining interests which are often better integrated into government networks. Support to local organizations would be in line with Belgian support to NGOs in different regions. In Latin America and the Caribbean for instance, Belgium has developed close relationships with NGOs working on a range of issues including poverty reduction and governance.

Regional dimensions

Of note is the regional interconnectedness of sand extraction, linked to sand's comparatively small transportation range. Numerous 'large river basins also span several countries, making it difficult to report and enforce regulations and international laws.' (Bendixen, 2019, p. 30) The extraction and trade in sand from Cambodia to Singapore includes regional actors of several origins. Interest in imports of sand from Myanmar materialized when sand exports were banned elsewhere in Southeast Asia (Lamb, Marschke, & Rigg, 2019).

Regional approaches to illegal extraction and cross-border smuggling – which deprive national treasuries of tax revenues – may offer useful lessons. As noted, regional bodies like ASEAN and the South Asian Association for Regional Cooperation (SAARC) provide a potential venue for coordinated policy on sand mining and use. The International Conference of the Great Lakes Region (ICGLR), with 12 member states, is an inter-governmental organization of the African Great Lakes Region countries. Its launch acknowledged the regional dimensions of conflicts and political volatility (ICGLR, n.d.a.). The ICGLR Regional Initiative against the Illegal Exploitation of Natural Resources (RINR) addresses the connection between resource supply chains and ICGLR member states' economies. Resource extraction and trade in the region are often carried out illegally, which means that 'the wealth deriving from natural resources is very unequally distributed and often finances rebel activities' (ICGLR, n.d.b.). RINR seeks to break the connection between mineral profits and rebel funding by addressing smuggling and mineral fraud (ICGLR, n.d.c.).

As mentioned before, such an approach would need a careful mapping of cross-border linkages and trade in sand commodity chains. Without in-depth knowledge of current regional smuggling networks—only the Southeast Asian networks towards Singapore are relatively well mapped—building regional partnerships to control smuggling and resource fraud is highly challenging.

Another regional dimension of sand extraction pertains to cross-border river systems. As has been witnessed in discussions on large-dam projects, large scale irrigation and drinking water, transborder water sharing can

be a source of conflict (see e.g. India-Bangladesh or multiple conflicts over the Nile). The large-scale extraction of sand can have detrimental effects downstream, including flooding, as well as affect downstream fisheries. At some point their might be discussions about the equal sharing of sand as well. Sand might thus emerge as an element of conflict in the future. This is likely to depend on the sustainability of sand extraction processes in individual countries along on cross-border river system. Regional organizations, as well as existing water sharing bodies and committees might form the ideal platform to further these discussions. One example is the Rhine basin where the International Commission for the Protection of the Rhine which involves Austria, Belgium, France, Germany, Italy, Liechtenstein, Luxembourg, Netherlands, and Switzerland and the International Commission for the Hydrology of the Rhine basin (CHR) which convenes scientific institutes from Switzerland, Austria, Germany, France, Luxembourg and the Netherlands work for the sustainable development, including dredging and sand extraction, of the Rhine basin. Expertise from within these organizations could very well be used in developing sustainable sand management policies both in individual countries and in particular for transborder river systems.

Sand as a common pool resource

An alternative framework, much less focused on transnational trade or rooted in debates around mining, and potentially adaptable to different contexts is offered by work on Common Property Regimes. Perhaps best known from the work of Nobel Prize winner Elinor Ostrom (1990), CPR 'refer to a property rights arrangement in which a group of resource users share rights and duties towards a resource' (McKean & Ostrom, 1995). This framework highlights the importance of consulting and working with local communities – through participatory fora or similar arrangements that are inclusive of women and girls – as resource users to strive towards equitable and sustainable management of sand resources. Contrary to Hardin's (1986) Tragedy of the Commons, CPR research has focused extensively on sustainable forms of the use of common pool resources by local communities, which depend on these resources to meet their day-to-day activities and livelihoods practices. While Hardin argued that individualistic incentives can lead to a "crisis" of the commons, Elinor Ostrom (1990) argued that key institutional design

principles could ensure sustainable management of the commons. Her work also provides an alternative to state or private resource management, with communities (however defined) at the heart of many common property regimes. Previously, it has been used in agriculture, horticulture, irrigation, forestry, and fisheries that build local cooperatives, self-help groups, or other forms of communal structures to manage the resources.

Thinking about sand as commons has a number of advantages. Potential overuse and misuse of resources are an ongoing concerns in CPR and CPR institutional designs should actively attempt to discourage this. There is also an implied expectation that production and consumption patterns can be attuned to minimalize impacts on nature and the environment (counter to the tragedy of the commons argument). Moreover, the incomes and financial streams generated from CPR should mainly benefit communities dependent on or living in close proximity to the resource (Hagedorn et al., 2019). CPR research might thus contribute to thinking about community involvement in the control over river resources, including sand. Finally, it has been used in analyzing complex systems, where different types of resource use and users overlap. This might be particularly useful, as it is a highly challenging task to bring all stakeholders around a particular potential sand extraction site on board. It might help to think through how fisherman, farmers, sand miners and businessman with highly diverse interests might be able to reach accommodation. A commons framework, if capable of accounting for these challenges, can be helpful.

CPR thinking would clearly impact differently on different types of sand extraction. It would be most useful in those context where artisanal and small scale extraction is taking place, as the capital necessary, as well as the ecological impacts of large scale sand extraction seem beyond the scope of CPR. Even then, CPR might be more suitable for thinking about particular locations of extraction. While coastal, near-shore marine or (small-scale) quarry resources might correspond relatively well to the territorial boundedness which is an important element of CPR, riverine extraction, with its highly complex impacts both upstream and downstream, would demand a thorough reflection on the nature of interlocking extractive regimes across river systems. This in particular pertains to trans-boundary river systems discussed above.

However, sand also poses a number of fundamental challenges when thinking of it in the context of CPR. Most work on CPR has focused on resources and contexts where patterns of long-term use of a particular resource have enabled the formation of fairly durable institutions guiding resource use. Given the fairly recent boom in sand, there are hardly any such institutions present, and sand extraction might even come into conflict with existing CPR relating to the use of waterbodies. Second, as mentioned above, CPR research has focused extensively on sustainable forms of the use of common pool resources. The sustainability of current extraction practices is highly debatable. There is not one example we know of a region where sand mining was conducive to the environment or clearly benefited local communities, unless as temporary (and often unsustainable) livelihood opportunities. Third, and most importantly, sand mining, unlike collection and use of other resources from forests or rivers discussed in the context of CPR, is primarily done for commercial purposes—it only has value in bulk, and local communities have only limited use of sand, thus defying Ostrom's focus on user groups. It is exactly the commercial demand side of the resource that has been described as the main problem driving unsustainable extraction.

Conclusions

Most of the ideas on better sand governance are premised on the belief that better regulation, monitoring and management of sand alongside more quantitative and qualitative analysis of the licit and illicit extraction and use of sand, will help control the sand-mining 'crisis.' While we might be less optimistic, what is clear is that we need better data to be able to better judge the size of both global and national sand production and to devise meaningful policies to govern sand sustainably. The use of cement as a proxy is limited. Similarly, we should have more research on sand trade, specifically to ascertain the role of informal trade (smuggling) particularly, but not exclusively, in overland cross-border trade.

Although we can only present fairly rough estimates of volumes of sand produced, some key trends stand out. First, China is by far the biggest sand producer, accounting for almost two-thirds of global sand production. India is the second largest producer, and while its production is large when compared to other countries, it is only a fraction of China's sand production. A second key trend is a reduction in sand production in older economies (like Japan, South Korea, Germany, Italy or the United States), while many new economies (like Indonesia, Vietnam, and Brazil, but also Turkey) see a rise in sand mining. The second key issue is the very low level of international trade in sand, where, apart from Cambodia, no country exports more than ten per cent of its sand production. Also, in most cases, sand imports are very limited, with Singapore and Belgium as well as the special administrative regions Macao and Hong Kong as notable exceptions. This impacts on the

kind of policy tools—and certainly those developed in the context of other minerals—that can be used to better regulate sand extraction.

Moreover, issues of wealth redistribution and improved (local) management of sand resources must not be overlooked when it comes to efforts to ensure more sustainable sand governance. This is of particular importance given that the mining of sand in Southeast Asia, for instance, produces wealth for a few individuals in Cambodia and Myanmar, supports Singapore's prosperity, and yet produces 'new articulations of poverty' at extraction sites (Lamb et al., 2019). Enhanced global monitoring and regulation must be based on local inputs and perspectives. Alternative or improved regimes for sand extraction should make it possible to reduce poverty and prevent the loss of biodiversity (Bisht, 2021a), which, it is increasingly understood and accepted globally, must be informed by the input of Indigenous and other local peoples.

We have to be careful that policy measures to shift away from current sand extraction practices will not create new frontiers of sand extraction. There is a growing drive to meet the demand for sand by looking at newer sites of extraction alongside use of alternatives such as M-sand in construction. For this purpose, glacier meltdown, which will bring down more sediments leading to rise in water levels, has been proposed as an 'opportunity' for deep-sea mining as potential sites of sand exploitation. Discussions to shift from river or coastal extraction to deep-sea sand mining should be treated with care, as this would likely impact heavily on one of the final ecosystems largely untouched by human intervention. More research and experiments are being carried out, for example, in the Greenland regions where glacier meltdown and rise in Arctic Sea level is seen to be a major reason for 'exploring' for sand (Bendixen, Overeem, et al., 2019; Doyle, 2019). The focus here is on large-scale mining that includes marine dredging (Torres et al., 2021). Such an approach should only be taken following significant social and environmental impact assessment, especially in the already fragile Arctic and in close consultation with the Inuit who live in relation with the land.

It is key to stress and act on sand's primary uses: a rise in urbanisation has a direct correlation with rise in sand mining activities (Padmalal & Maya, 2014; Welland, 2010) thereby engendering regimes of regulation, taxation and

governance. In this respect there is also a prospective push for degrowth (see e.g. Kallis, Kerschner &Martinez-Alier, 2012; Weiss & Cataneo, 2017) or post-growth, a substantial decline in excessive use and dependence on the product, that focuses on the supply side. These debates, although not extensively discussed in the scarce literature on sand, provide a lens towards protecting sand and environment rather than exploiting sand. According to this logic, a move towards degrowth will help in curbing the high demand for sand for the purpose of infrastructural growth. If sand continues to be extracted at the current rate, there will be both intergenerational and intragenerational scarcity, and this extraction will lead to serious repercussions for the social and environmental justice system (Bisht, 2021a). A post-growth approach would involve five elements: reduction of consumption; degrowth of cities; vernacular architectures, designs and knowledges; thinking about life beyond concrete; and discouraging unnecessary production of megastructures (Bisht, 2021b).

Policy recommendations

Understanding and adapting to the diversity of on-the-ground dynamics: There is a need for further monitoring amounts, speeds, and areas of sand extraction. Increasing sustainability in sand mining must recognize the diversity of the sector, which involves different forms of extraction, including commercial (corporate) and artisanal and small-scale sand mining. Bendixen et al. (2019) call for a UN Environment Programme (UNEP) and World Trade Organization (WTO)-led 'global monitoring programme for sand resources', including 'accounting processes for sand flows in, and sand extraction from, rivers — both legal and illegal.' The World Bank, a more developmentally-oriented international financial institution (at least in theory) could also play a role, given that it is already involved in supporting research and policy on extractives. However, data collection and classification should not be uncritically embraced, and must be informed by ethical considerations and risk assessments, given policymakers' tendency to favor large-scale extraction over artisanal and small-scale mining. Debate surrounding the ethics of data collection on local populations must be informed by the views of local actors, including those most affected by sand mining.

Afeku and Asamoah Debrah (2020, p. 495) argue that '[d]etailed, clear, coherent and sustained policies and strategies on Development Minerals, especially at the sub-regional level are required to ensure that national policy and regulatory frameworks [...] do not remain skewed towards the development of High Value Minerals'. They argue for appropriate regulatory and fiscal policies in addition to improvements in knowledge and linkage promotion.

There is a need for 'an international and/or multilateral framework and set of good practices for regulation and governance' (Bisht, 2021, p. 8).

Sand export bans: Sand extraction often takes place in ecologically delicate and biodiverse areas, Indigenous peoples' sacred territory, habitats and corridors for endangered animals, and important eco-systems including river systems, lakes and beaches. It is necessary to designate some zones and activities where sand extraction is forbidden, to ensure 'intergenerational and intragenerational equity and access'. A ban could involve 'coral reefs, mangroves, and sacred and culturally significant aquatic bodies' and even 'extraction dedicated to specific applications which are extremely harmful', like fracking (Bisht, 2021, p. 9). Encouraging reductions in sand consumption is an option that fits in with the wider global trend towards degrowth, particularly in and for the Global North. Yet the potential benefits must be weighed against equity considerations like the pressing need for infrastructural development – and therefore sand. There is a need to prioritize non-luxury developments and essential infrastructure. Ethical considerations should also be taken into account when exploring possible alternatives to using sand in construction.

Governance alternatives: Since sand is often extracted under regimes in which a small, locally influential group appropriates its value, there is a need to explore potential alternatives. Here, the literature on common property regimes could offer interesting insights. '[A] more decentralized, localized regulatory and governance framework for extraction' could help ensure greater benefits for 'the people closest to the negative externalities of continued patterns of sand extractivism.' (Bisht, 2021, p. 8) It should be noted that enforcing bans on extraction may prove challenging and could lead to conflict (and/or further collusion) between 'sand mafias' and state forces. Moreover, while export bans were put in place in parts of Southeast Asia, outright bans on extraction itself seem an unlikely policy option for most countries given the importance of large scale infrastructure projects in current thinking about economic development. Bans should however be put in place in particularly fragile eco-systems, given the well-documented negative impacts of sand mining on biodiversity. In this context, strengthening environmental management systems in countries aiming to develop sand extraction, or planning

high levels of infrastructural development is mandatory. Other challenges include relations with communities (Franks, 2020) and how local communities can benefit from their resources, a need highlighted by community resistance and protest (Lamb et al., 2019). This includes protection of (local) activists (Bisht, 2021) and recognition of local rights and claims undermined by the sand trade (Lamb et al., 2019) – including cultural commons and Indigenous peoples' rights (Bisht, 2021). It is essential to take into account women and girls' needs and the role that women's cooperatives, like the African Women in Mining Association (AWIMA), can play (Franks, 2020). There is however also need to consider locally legitimate forms of self-organization beyond cooperatives, given research from the DRC that highlights cooperatives' weaknesses in terms of genuine representation.

Illegality: Bisht (2021a, p. 9) argues that for 'alternative governance regimes' to function in the context of 'enclaves captured by illegal actors with no legal/formal markets for local trading', 'building effective and efficient local markets can help provide avenues for fair income generation, thus disincentivizing illegal extraction.' It is also important to redistribute value accumulated by large private entities. The District Mineral Funds in India is one example, collecting extractive royalties and eventually providing funds for local projects (Bisht, 2021a, p. 9)), though the example of southeastern DRC highlights challenges with ensuring that regional and local royalty funds are disbursed as intended. The example of Tanzania (Shitima & Suykens, 2022) shows that in regularizing sand mining, large scale, mechanized extraction can go hand in hand with artisanal extraction although the longer-term effects, on the environment and on local communities, of formalization in this context are still uncertain.

The size and extent of illegal sand mining represent a multifaceted challenge requiring engagement from communities, government, and civil society. Policy proposals include 'institutionalizing decentralized, open-access digital platforms for community-based, anonymous, and real-time reporting that are publicly accessible', to help trace illegal activities and seek accountability for perpetrators. Another proposal is for state-created institutions and digital platforms for monitoring (Bisht, 2021a, p. 9). Yet blockchain, which some actors have embraced for traceability in the cobalt sector, has been

criticized for being overly technocratic and failing to address issues on the ground. Calvão and Archer (2021) argue that the use of digital tech for mineral traceability could 'create new forms of control and exclusion or exacerbate existing social, political, and territorial dispossession through asymmetric relations of power and knowledge'.

Due diligence: 'Conflict minerals' and due diligence approaches have multiplied to address issues of illegality, conflict linkages, and increasingly, human rights violations. Yet the growing number of transnational initiatives to regulate these issues have been critiqued for a range of reasons, including their largely externally imposed nature, frequent lack of congruence with domestic priorities and on-the-ground realities, and negative unintended consequences. Initiatives closer to home, such as regional bodies in Asia, the Regional Economic Communities in Africa, and the Africa Mining Vision, as well as development minerals-oriented approaches may be more locally legitimate and responsive in addition to their likely far greater relevance in a context in which most sand is not exported. Yet the complexity and persistence of 'sand mafias' demonstrates a need for a coordinated approach that is likely to involve bigger commercial actors, including those involved in shipping.

Civil Society: Measures should be taken to support and strengthen civil society and community-based organizations to trace and report on human rights and environmental violations in the context of sand mining. Given the violent nature of sand extraction in a number of reported contexts, activists and journalists reporting on the issue have been attacked and even killed. International support for organizations both at a global, national and local could strengthen the capacity of organizations and individuals to report and monitor sand commodity chains and empower communities to demand benefit sharing from sand extraction on their territory.

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