



Trading sand, undermining lives: Omitted livelihoods in the global trade in sand

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Title Page**Title: Trading sand, undermining lives: Omitted livelihoods in the global trade in sand****Abstract**

Sand is a scarce resource, extracted from rivers and coasts at rates that exceed its natural renewal. Yet, little is understood about the political economy of sand extraction, the livelihood vulnerabilities produced, or why sand grabbing is occurring at unprecedented rates in particular locations. Drawing together literature on global production network approaches in economic geography and debates on sustainable livelihoods in development geography--two literatures rarely in conversation with one another--we reveal the links between new, globalized, cross-border articulations of poverty and prosperity and the sand trade. We situate our sand case in Southeast Asia across three sites, namely in: Singapore, the world's top sand importer; Cambodia, a top-ten global exporter of sand; and an emerging exporter, Myanmar. We examine how sand mining impacts, directly and indirectly, a range of livelihoods, specifically fisheries in Cambodia, riverbank agriculture in Myanmar, and migrant labor in Singapore. Drawing on our empirical work, we argue that linking these two literatures with empirical data on sand provides an approach which is broad in its connections and simultaneously grounded in specific practices, places, and people. This enables us to better account for often overlooked aspects in the production, erosion, and transfer of value.

Keywords: *Sand mining; global production networks; livelihoods; precarity; Southeast Asia*

Introduction

The sand¹ industry was valued at US\$1.71 billion globally in 2016 (DESA/UNSD 2018). Sand is now extracted at a rate that exceeds its natural renewal, producing a newly scarce resource (UNEP 2014; Sutherland et al. 2017), with sand and gravel the most extracted group of materials globally besides fossil fuels and biomass (Torres et al. 2017). Yet, despite these metrics, there remains a knowledge gap in terms of the precise magnitude of sand mining, a general lack of public awareness of the issue, and shortcomings in its global monitoring. Data discrepancies between sand imports and exports are rife, with sand being subject to rampant illegal extraction and trade. The fact that the industry is often deemed “a matter of national security” (Comaroff 2014, 141-142) sometimes creates a climate of secrecy. This is further compounded by limited collaboration or coordination between the scientific community and sand industry (UNEP 2014). Significantly, even less is understood about the production networks of sand, the livelihood vulnerabilities produced as a result of sand extraction, and why sand mining continues at unprecedented rates in particular locations. This paper is a starting point to addressing these intersecting lacunae, and highlighting some of the reasons why they exist in the first place.

To understand the broader effects of sand extraction, linked to a situated and embedded understanding of sand-linked livelihoods, we make a case in this article for connecting scholarship in two areas. We draw on, first, work in economic geography on global production networks; and second, on sustainable livelihoods approaches within development geography. We bring these together with our empirical work to reveal how value produced in one field can effectively overlook and sometimes undermine value in another. Importantly, this omission is not just due to matters of state and commercial

secrecy, but because conceptual models direct our attention in particular ways, towards particular activities, evidenced using particular metrics. This creates a mode of accounting in trade networks that overlooks certain social groups, type of activities, and forms of value (Bair and Werner 2011, Werner 2016, Tsing 2015, Gibson et al 2017). Or, as Tsing writes that “there is a rift between what experts tell us about economic growth, on the one hand, and stories about life and livelihood, on the other” (Tsing 2015, 132).

Following Tsing, we argue that mainstream economic geography approaches in the analysis of value chains and production networks often omit or undervalue important features, particularly those relating to livelihoods, that do not fit the approach’s epistemological framing. We make this case through the empirical lens of sand mining in Southeast Asia. Singapore is the world’s top sand importer; Cambodia is a top-ten global exporter of sand; and Myanmar is emerging as an important regional sand exporter (DESA/UNSD 2018). Bringing this work on global production networks into conversation with livelihoods analysis, and its broader assessment of “value”, we connect two largely unconnected literatures, enabling us to place livelihoods in broader geographical context and to see how people’s living and livelihoods are shaped by flows and networks beyond the local. In doing so, we make visible areas of life, living, and work that might otherwise be overlooked in the sand trade.

We open the article with an overview of approaches in economic geography on global production networks, and the links to livelihoods through sustainable livelihoods in development geography, emphasizing why connecting these two literatures can offer new insights into Southeast Asia’s sand trade. We then provide an overview of sand imports and exports across Cambodia, Myanmar, and Singapore, noting the data mis-match in terms of

reported exports and imports. This mis-match presents a challenge for studying sand extraction, prompting questions not only about discrepancies in global sand metrics but also of value. We construe value broadly, moving beyond economic or commercial value, to include ecological and livelihood values (Scoones 1998, 6). This provides an entrée for a focus on specific sites of sand export and import, examining how sand mining impacts fisheries-based livelihoods in Cambodia, riverbank agriculturalists in Myanmar, and migrant labor in Singapore. Our analysis highlights how sand mining results in multiple transformations across the social-ecological system, transformations that severely impact people's livelihoods and local ecosystems.

Linking value and commodity chains and production networks with livelihoods

Coe (2011, 390) encapsulates global production approaches as “all [being] centrally concerned with the globally coordinated interorganizational relationships that underpin the production of goods and services, and the power and value dynamics therein”. Global production networks (GPNs),² for example, are broad in scope, bringing into the frame of analysis actors beyond lead firms and suppliers, attending to a broader swathe of institutions including national governments, trades unions, and NGOs. In contrast to other global production approaches, GPN takes social and institutional embeddedness seriously (Hess and Yeung 2006). That said, the majority of attention has focused on leading firms in high-technology and high-value sectors and in advanced economies, with less attention paid to SMEs in the global South (Murphy 2012, 229).

For some time there has been a concern that the GPN approach has failed adequately to incorporate the ‘dark side of economic geography’, in particular losing sight of the socially

and spatially uneven nature of the development process (Phelps et al. 2018). More recent scholarship has, certainly, shown a willingness to broaden global production approaches to debates over ethical or fair trade and corporate social responsibility. Much of this has focused on the question of labor conditions (Arnold and Hess 2017, Barrientos et al. 2011, 321-322; Riisgaard 2009; Barrientos and Smith 2007; Hughes 2000; see also: notes on the work on labor within GPNs in Coe 2012, 273). While this work is important and valuable, it has tended to be empirically quite narrowly framed on the workers and producers directly connected to the chains or networks under consideration. Thus, scholars write of gender value chains in ethical trade in African horticulture (Tallontire et al. 2005) and ethical learning in GPNs (Hughes 2006 and Hughes et al. 2008) with a consequent focus on labor standards, practices, and relations. This is understandable against the backdrop of GPNs' primary interest in inter-organizational relations.

It is also worth noting here that natural commodities, like sand, have not tended to be objects of concern within global production approaches, and we see a greater focus on agriculture and manufacturing, and to some extent services (Coe 2011; Phelps et al. 2018: 241). Bridge's (2008) work is an exception, whereby linking oil extraction and GPNs reveals how the non-renewable character of oil is a key consideration in understanding extraction networks (see also, Murphy 2012). There has been no such analysis of sand, and unlike other commodities sand has no international regulatory system for trade, nor does it have "an architecture of non-state certifying bodies to influence management practices and structure the direction and volume of trade" which exist in other commodity sectors (Bridge 2008, 415).

In our analysis of the sand trade in this article, we bring GPN as a frame to illustrate the connections between production and consumption, but we also present the unrecorded effects of sand mining and the trade in sand. We are, therefore, making the connection between micro-processes and macro-forces (Burawoy 2009) and also between historical inheritances and geographical conditions. In these assertions, we echo Glassman's contention that the global production literature tends to overlook geopolitics and therefore "has so far largely steered clear of forms of political and geo-political contestation that illustrate some of the worst violence and messiness of 'actually existing globalization'" (2011, 162). However, while Glassman may be concerned to politicize and historicize GPNs, his focus is still on the network and the actors who are connected to it.

Notwithstanding growing interest in matters of labor and geo-politics in GPNs, we believe three important groups or actors are neglected in such analyses and this neglect has a significant bearing on whether we can view any given network or chain as constitutive of good or just development. These three groups are:

1. Those whose living is implicated in global production approaches but in a manner that is characteristically unrecorded and uncounted because it lies out of the line of sight of such networks or chains. For example, subsistence and semi-subsistence farmers who cultivate river margins and sand banks. This group is directly impacted by sand mining, as the farming practices on which their livelihoods depend require sandy banks.
2. Those whose livelihoods are connected to sand, but indirectly, and are therefore commonly framed-out of consideration. Here attention is paid to how a natural commodity is transformed and how value is re-assigned during this transformation.

With regard to sand, for instance, we might point to its role in sustaining the productivity of small-scale fisheries. Sand mining and the sand trade is evidently generative of value for sand miners and industry, but for those fishing in estuarine or near shore coastal areas, it degrades livelihoods and produces poverty.

3. The third group comprises migrant construction workers whose livelihoods are founded on a sand-dependent industry, but their employment is characteristically precarious. This precarity is trans-locally produced. It is partly a product of employment conditions in migrant receiving countries such as Singapore (see Ye and Yeoh 2018; Baey and Yeoh 2018). However it is also reflective of processes of immiseration and marginalization in sending countries, like Cambodia and Myanmar.

These groups fall outside the frame of reference of global production approaches. The first because the activity is semi-subsistence and/or constitutive of a different economic realm, and the second and third because the connection is hidden or indirect, which in Southeast Asia has been a “persistent vestige” in scholarship on local economies (Gibson et al 2017, 131). In this way we see the ‘business’ of sand connecting livelihoods across space and national and livelihood contexts: undermining fishing and gardening in one livelihood space while creating new, albeit precarious, livelihoods in another.

To discern the links between fishers, riverbank agriculturalists, and construction workers within the sand trade, we take a livelihoods approach to complement the insights offered by GPN, particularly the links between production and consumption. The livelihoods approach dates back to 1987 when an advisory panel to the World Commission on Environment and Development first set out an operational definition of sustainable livelihood security. The

approach was popularized by fieldworkers and development practitioners, particularly an early Chambers and Conway paper (1991), arguing that livelihoods encompass the capabilities, assets, and activities that are necessary for making a living. Livelihoods are sustainable when they can “cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation” (Chambers and Conway 1991, 6). As such, livelihoods are dynamic, complex and often unpredictable, with goals, preferences and resources constantly being reassessed in light of shifting conditions (De Haan and Zoomers 2003). A livelihood analysis recognizes value -- of livelihoods, financial capital and redistribution -- that GPNs might easily miss (Rigg et al 2018, 336).

Thus, while providing complementary insights, we also recognize the critiques of sustainable livelihoods analysis which have focused on three areas of perceived weakness: a lack of concern for issues of politics and power, especially in structural terms; a tendency to fix livelihoods in space and time; and the approach’s instrumental tone, reflected in the tendency to write of livelihood strategies (de Haan and Zoomers 2005, Rigg 2007, 29-35, Scoones 2009). The second of these concerns has been partially addressed by work on livelihood pathways or trajectories (Scoones 2009, de Haan 1999, de Haan and Zoomers 2003). As de Haan and Zoomers (2003) argue, household livelihood strategies may differ greatly from their livelihood histories. A livelihood encompasses a complex web of activities and interactions: livelihood activities are not neutral, rather they engender processes of inclusion and exclusion. Notwithstanding these trenchant critiques of the livelihoods approach, we regard it as a valuable, complementary lens to global production approaches because it expands the productivist frame to reveal a significant but overlooked facet of the

sand trade: livelihoods impacts. We also recognize the value that GPN sensibilities bring to a livelihoods approach, focusing attention on vertical connections across scales and the (growing) importance of commercial and business actors and factors in shaping 'local' livelihoods.

We appreciate that in connecting the sand production network to livelihoods we are expanding the scope of a field which has already been criticized --in GPN's case-- as being so broad that it can include all links, transfers, and connections resulting in a lack of analytical boundary or clarity (Sunley 2008, 8). However, if we are interested in the effects or impacts of such emerging networks on marginal groups and omitted actors then it is necessary to consider associations and dependencies that lie outside the general line of sight of such studies, "what a GPN framework does see, and...the dimensions of developmental change that a network approach might miss" (Kelly 2013, 84).

By bringing in a people-centered sustainable livelihoods approach we are, therefore, seeking to humanize the field of production networks, a field that has been critiqued as having limited interest in human agency (Challies and Murray 2011). Notwithstanding growing attention paid to labor conditions, ethical trade, and gender, this effort is still corralled within the framework of the chain or network, so that more distant and less visible connections and inter-relations are often neglected.³ While GPN theory aims to show how GPNs are embedded in local institutions and social relations, in practice the scholarship is not locally situated. Werner explains that in attempting to reveal "constitutive exclusions", like that of dispossession within the GPN framework, "there is no clear parallel here with the mainstream literature, which continues to focus primarily on entities that are 'transactionally linked' to global production networks" (2016, 464). There are other stories

that get missed, including the erasure of “offsite” impacts. Perreault (2012, 1064), for instance, identifies how the ‘unintended’ effects of accumulation impact communities and that this is both linked to dispossession and the accumulation of toxic sediments in mining territories, but that these impacts remain outside a mainstream framing of accumulation by dispossession. Labor scandals across commodity chains speak to this (Marschke & Vandergeest 2016; Rigg 2015), including the erasure of off-site impacts (c.f., Kelly 2013; Werner 2016). It is this narrowness that lies behind Phelps et al.’s (2018, 238) recent invitation to explore the dark side of economic geography. Yet, livelihoods and ‘the arts of noticing’ (Tsing 2015) that we take on here are hardly limited to the dark side.

To see the links between actors in production networks, we privilege life and livelihoods and bring into view the actors and, more particularly, the activities that are characteristically omitted from more usual analyses (Glassman 2006, Perreault 2012). These livelihood activities have tended to be dismissed in the region and elsewhere by a long history which sees more legible practices, like paddy rice agriculture (Scott 1998), and tends to obscure more informal local economies (Gibson et al 2017, 135). We also contend that in contrast to work on land grabbing in the region, the marginal actors in Myanmar and Cambodia are not only being dispossessed of this resource in the manner of land grabs, for instance. The impacts on livelihoods occur in many cases indirectly, almost through sleight-of-hand. The land resource may be degraded, but it is not obviously being grabbed; it may be common property, but it is not being enclosed; and it may be used by local people, but usually not directly. Notably, while there has been a good deal of attention paid to the violence and illegalities associated with the sand trade (Beiser 2018), there is relatively little that pays attention to local economies and livelihoods. At the same time, when we consider those

GPN studies that *have* taken livelihoods seriously (e.g. Neilson and Shonk 2014; Kelly 2009 and 2011; Carswell and De Neve 2013), they pay attention to those actors who are connected to such networks, whether through their labor or through kinship (household) relations. Here we focus on livelihoods which are linked to commercial activities recognized in GPNs and impacted by uneven development.

Linking the global production and sustainable livelihoods approaches provides a means to humanize the former and globalize the latter by bridging the vertical perspective embedded in global production approaches, where connections are traced along regional and global economic lines of connection, with the essentially horizontal perspective taken by livelihoods scholars, with its emphasis on local social relations of production and reproduction (Carswell and De Neve 2013, Bolwig et al. 2010). In other words, we contend that a sustainable livelihoods approach can help GPN as an approach move towards achieving a situated, socially embedded analysis. Figure 1A, "Tracking value in the sand trade and livelihoods", schematically sets out the sand context and how the global production and livelihood approaches map on to the processes and inter-relationships described in the paper. There are two aspects particularly to note. First, the way in which each approach tracks a different and discrete set of effects, but which can all be linked back to sand. And second, the gap that exists at the point of sand extraction between livelihoods and the sand trade. Both rely on sand, but from that point onwards are tracked through very different discursive realms, determined by the approach adopted. At the risk of simplifying, these are: vertical versus horizontal; economic versus social; production versus reproduction; and unbounded versus bounded. Finally, in considering this approach, it is important to emphasize that the livelihood outcomes we discuss below are not accidents,

and nor are they incidental. They are constitutive of the sand industry and wider globalization processes, how value is measured, and the way in which sand as a commodity for construction and land reclamation discounts sand's place in livelihoods.

Methods

To further develop these arguments, this article draws on primary and secondary research into livelihoods, sand, and sand mining across sites in Cambodia, Myanmar, and Singapore carried out over the past decade by the authors. Together, we conducted more than 100 interviews in Cambodia and Myanmar directly related to livelihoods and sand mining, with secondary research and observation conducted across Cambodia, Myanmar, and Singapore. Material on Singapore is secondary, although one of the authors is based in the city state and land reclamation is highly visible. The DESA/UNSD United Nations Comtrade database was analyzed for regional trade patterns.

In Cambodia, sand mining controversies, particularly in terms of how sand mining impacts coastal fishing villages in south-western Cambodia, were followed since 2007 through research with coastal villagers, NGO advocates, and policy makers. Approximately 50 semi-structured interviews over a ten-year period have been conducted in English and Khmer, in some cases with the help of a research assistant. In Myanmar, research was conducted along the Salween River in the cities of Hpa An and Mawlamyine in 2014, 2017, and 2018. Interviews were conducted with local officials, NGO staff, sand and gravel companies, fishermen, and riverbank gardeners; in total more than 50 semi-structured interviews done in a mix of English, Karen, and Myanmar languages with the help of a research assistant.

Sand and Sites

Studies of sand mining have assessed the environmental impacts of riverine and marine sand mining across many countries and ecological contexts (e.g., Adedeji et al. 2014 on Nigeria, Sreebha and Padmalal 2011 on India, Cho 2006 and Kim & Grigalunas 2009 on Korea; Bravard et al. 2013 on Mekong; Beiser 2018 globally). For UN Environment, the “negative effects on the environment are unequivocal and are occurring around the world” and in places the “problem is now so serious that the existence of river ecosystems is threatened in a number of locations” (UNEP 2014, 251). Moreover, the scale of mining is rapidly increasing, rather than stabilizing or diminishing, reflecting global rates of urbanization and industrialization.⁴ While a substantial literature on the environmental effects of sand mining is emerging, combined with hints of illegal crimes and shady practices that can be connected to sand extraction (Rege 2016), less attention has been paid to how sand mining occurs or the impacts on local livelihoods.

Sand in Singapore

Singapore is the world’s largest consumer of sand, on a per capita basis and, in many years, the world’s largest importer of sand. Extensive construction along with large-scale reclamation and no domestic resources to speak of has necessitated massive imports of sand. In 1965 when the city state gained its full independence, Singapore’s land area was 581 km² compared with 719 km² in 2015, an increase of over a fifth. This expansion is set to continue so that by 2030 Singapore’s land area will have grown by 30 per cent since 1965 (De Koninck 2017, 21). Initially sand was imported from Indonesia and Malaysia; when both these countries either banned or limited exports, the trade moved to Cambodia, Myanmar, the Philippines, and Vietnam (see Figure 2A: Singapore Sand Imports, 2007-2016).

Singapore's economic vitality and sustainability is based, in no small measure, on continuing imports of sand. The expansion of the country's land area through land reclamation is essential to its continued economic growth, while sand for construction is an equally important element in the city state's development strategy. It might be argued that livelihood sustainability -- in the sense of the continuing prosperity of Singapore's inhabitants -- is predicated on continuing flows of sand and gravel from neighboring countries. As Comaroff asserts, Singapore's sand security is linked to Singapore's political survival: "The need for sand, then, is a kind of original debt: for the territorial state to survive, land must continually be introduced" (2014, 142). The state, since the first Prime Minister Lee Kuan Yew's premiership (1965-1990), has made land reclamation, and therefore sand imports, a "pragmatic necessity" (Jamieson 2017, 398), almost a matter of national survival. Even with the average price of imported sand rising more than 60-fold between 1995-2001 and 2003-2005, from \$3 to \$190 per ton, Singapore's consumption has continued unabated (UNEP 2014, 8).

While the Singaporean government (specifically, the Ministry of National Development) states that "strict criteria for imports of sand" exist (Au-Yong 2017, np), Global Witness presented evidence that "the government does itself purchase sand" and in fact "stockpiles" it (2010, 29). At this moment, however, it is not possible to identify the full range of firms or specific companies dealing in sand. While tracing this network is not our main intention, it is worth noting that in understanding the sand trade linked to Singapore, it includes firms and contractors in Singapore relying on imports of a variety of sands from across the region, as a single development project at various stages will require a variety of sand and aggregate.⁵ For construction, builders favor sand from rivers, but sea sand can be used if washed for

salt. For land reclamation “fill”, contractors can be less picky, utilizing a variety of sea or river sands (Beiser 2018, 9-10).

This sand and the land and economic activity that it produces helps to sustain a migrant labor force in Singapore of almost 1.4 million workers, or 40 per cent of the total workforce. In 2016, 327,000 of these workers were employed in the construction sector. Their breakdown by nationality is not publicly available (Tan 2014) but we know that the construction sector is the biggest migrant worker employer (Ye & Yeoh 2018). As Baey & Yeoh (2018, 5) note, “In the context of transnational labor migration, material and symbolic conditions of precarity may lie across borders. Migration ... may quickly metamorphosize into a journey of perilous gamble.” We do not have evidence that links migrant workers as individuals in Singapore back to our sites of sand extraction in Cambodia and Myanmar. But this is entirely plausible and to entertain such a notion highlights the point, long recognized in political ecology (Huber 2017), that one person’s accumulation is another person’s degradation. Sand not only sustains Singapore’s economic growth, generates prosperity in the city state, and is critical to national security (Comaroff 2014), but its excavation is, at the same time, compromising livelihoods in source sites.

Sand in Cambodia and Myanmar

In Cambodia and Myanmar sand is extracted from rivers and beaches for domestic use and for export to support Asia’s construction boom, particularly to Singapore. Between 2007 and 2016, for example, Singapore trade statistics record imports of 80.22 million metric tons of sand from Cambodia and more than 27 million metric tons from Myanmar, comprising 44 per cent of the 108 million tons of sand imported by Singapore over this nine year period

(see Figure 2A: Singapore Sand Imports, 2007-2016). Recorded exports of sand from Cambodia and Myanmar do not begin to match the import figures for Singapore (Figure 3A: Sand Trade Data Gaps: Reported exports and imports of sand for Cambodia, Myanmar, and Singapore, 2007-2016), leading analysts to assume that there is a significant illegal trade in sand, a claim that the Singapore authorities have disputed (Global Witness 2010, Au-Yong 2017). Furthermore, in this same time period, the price per metric ton of sand (sea and riverine) imported from Cambodia and Myanmar has decreased, from a 2007 high of over USD\$20 per metric ton of sand to less than USD\$5 per metric ton in 2016 (Figure 4A: Singapore's sand import price from Cambodia and Myanmar, 2007-2016). Although sand prices will range over time and geographic location, sand from Cambodia and Myanmar fetches a lower price per metric ton of natural sand (not including silica or quartz sands) than seen in other countries in Asia (DESA/UNSD 2018).

The data 'mismatch' and lowering prices underlines how some of the sand trade is likely illicit and speaks to the difficulty of identifying specific firms and their networks. Operators may have military or 'mafia' links, and the multiple layers of the production network can obfuscate responsibility. In Cambodia and Myanmar, primary research by Authors 1-2 and reports (Global Witness 2010, Thompson 2017, Ei Ei Thu and Kean 2015, MCRB 2017) show a mix of companies with backing from a range of actors involved in not only extraction, but also in the ferrying of sand from the site of extraction to large barges to ship across the ocean to Singapore. The range of actors are not limited to: local entrepreneurs, military and ex-military, ethnic armed organizations, Cambodian, Singaporean, and Chinese firms, as well as joint venture companies.

In Cambodia, coastal sand mining emerged in the mid-2000s (Marschke 2012). While inland sand mining was banned in the late 2000s, coastal sand mining continued at a sustained pace through to 2017 when it, too, was officially banned. Although sand extraction has shifted in terms of location, the activity has continued to significantly affect people, their livelihoods, and local ecosystems. The vast volumes extracted at one site, Koh Sralao, has negatively impacted already precarious livelihoods, as discussed in more detail below. These impacts are both direct and indirect: direct in the form of mangrove estuary bank collapse; and indirect in fisheries decline and the driving of migration flows as people search for alternative livelihood opportunities within Cambodia and abroad.

In Myanmar, the scope, scale, and attention that sand mining has attracted has been more limited. Nonetheless, the trade is far from insignificant: there are diverse sand mining practices and operations, with sand mining taking place along rivers and beaches across the country (ICEM 2017, Global Witness 2010, 28). Yet, while the industry seems to be expanding, there are challenges and problems in measuring and documenting the volumes and impacts of extraction. Like Cambodia, there is a lack of baseline data in terms of both the industry activity and the river flows and ecologies and, thus, deciphering impacts is difficult, and studies on the livelihood impacts, non-existent. Research along the Salween River in Karen State (described further below) illustrates a range of impacts on riverine livelihoods, particularly for those engaged in the riverbank and alluvial island cultivation of vegetables. Sand extraction is in direct competition for the fertile sands that support riverbank gardens, a seasonal practice undertaken as part of a broader livelihood portfolio. If Cambodia's ban on coastal sand mining holds and is effective (admittedly, a big 'if'), it may be that Myanmar will see an increased demand for its sand. For example, the 2010 Global

Witness report shows how an interest in sand imports from Myanmar emerged as sand was exports were banned from other parts of Southeast Asia. This points not just to increasing international demand for the commodity, but also sand extraction's regional inter-connections.

Connecting Singapore with Cambodia and Myanmar

Between these different sites, then, sand becomes a commodity that links livelihoods across national space, such that the prosperity and poverty of distant population groups are implicated. While this does not necessarily mean that the prosperity of Singapore is predicated on the poverty of Cambodian fishers and riverside cultivators in Myanmar, such that these conditions are co-produced, they are not unconnected. Demand for sand in Singapore, the associations between Singapore's territorial expansion and national development, and the ways that sand extraction compromises the livelihoods of fishers and riverbank cultivators, intersect in important ways and tracing those intersections is our aim. In thinking through these connections, we follow Bebbington and Bebbington (2011, 142) who explore the impact of resource extraction on indigenous groups in Bolivia, Ecuador, and Peru and observe how "value is taken from certain spaces and distributed to others", such that the "spaces that bear the brunt of the externalities generated by extraction are in the vicinity of the wells, mines, pipelines and smelters... [while] ...benefits and opportunities accrue in other spaces – in departmental and national capitals".

In addition, however, we argue that the reason such connections are sustained, often with little comment, is because of the way sand's role in livelihoods takes such different forms, requiring that we think of sand not as a commodity for land reclamation or construction

alone, but vicariously -- as a habitat for fish and land for subsistence farming, for example. The need to go beyond dominant viewpoints where what we see and take as important is connected to economic value is second nature to most development geographers but, we suggest, is not normally part of global production network approaches, let alone capitalism's repertoire. Tsing (2015, 121) calls this the 'problem of alienation', where "things are torn from their life-worlds to become objects of exchange", a process she applies to both nonhumans and humans.

Livelihoods unexamined and at risk

At present, there has been no detailed livelihood analysis about how global flows of sand impact people making a living from in the sites of extraction, even if the media have usefully reported Cambodian villagers' stories, the illicit sand trade across Asia, and rapid rise in demand for sand globally. Yet, sand has a critical role in sustaining livelihoods -- shallow coastal waters are important nursery and fishing grounds, and home to important mangrove wetland systems which serve as shelter from winds and storms. Even with the emerging media attention, little analysis is given to the different livelihood choices people make in the face of sand mining, or the interactions between livelihoods, human-induced ecosystem change, and everyday life.

In assessing the impacts of sand mining on sites of extraction, we consider the livelihoods in our case sites that would be otherwise overlooked in the value chains or networks of sand as a commodity for export. In doing so, we show how the processes of sand extraction can be detrimental to livelihoods, with sand extraction practices placing already marginalized farmers or fishers into more precarious political and increasingly peripheral geographical

positions. How sand mining intersects with livelihoods can be easily obscured in global production approaches, but are significant in the production and transformation of value. In essence we suggest that accumulation processes are being smoothed and de-problematized by the quite discrete and particular ways that commodities are counted, valued, and tracked. After analyzing the livelihood implications across two of our case sites, in Cambodia and Myanmar, we turn to an analysis of the extended networks of value in the production of sand as a commodity by examining livelihoods transition (and mobility) in Singapore and its links (back) to Cambodia and Myanmar.

Livelihoods unexamined and at risk in Cambodia

Sand is both valued and functions in a variety of ways *in situ*, such as supporting the formation of alluvial islands, ecosystem functions, and resource-based livelihoods, including fisheries and floodplain agriculture. In Cambodia, one village that has been impacted by a decade of coastal sand mining is Koh Sralao, a 350 household mangrove-estuarine fishing village accessible only by boat on the country's southwestern coast. The illegal sand mining industry has been in full force since late 2007, shortly after Indonesia banned the export of coastal sand (Global Witness 2008). Although sand mining operations began in just a handful of sites in and around the village, by 2010 there were an estimated twenty-seven extraction sites within this area (Global Witness 2010), with sand mining continuing (Marschke 2014) until its ban in 2017.

Initially, Chinese military staffed the boats (Global Witness 2008), although over the decade this shifted to Cambodian-owned boats with their own workers. According to a former sand dredger (Interview transcript, March 2018), licenses were bought from a prominent

Cambodian business person who controlled sand mining in Koh Kong and had high level political connections (Global Witness 2010). Local business people operated boats that either dredged or transferred sand to larger boats at sea, where they were paid for the sand. In recent years these larger boats were, according to our interviews, Singaporean-owned and operated. Sand dredging was risky, in that payment for sand could be patchy, resulting in a rotation of people involved in the sector. While exact estimates of the sand extracted are unknown, the vast majority of Cambodia's sand exports to Singapore have come from this part of Cambodia.

Over the decade that sand mining was active, operations moved in and around Koh Sralao village. At times the dredging could be heard all night long; at other times operations were a few kilometers or more away. This village lies within a national wildlife sanctuary, and yet, no comprehensive environmental impact assessment ever took place (Marschke 2012).

While sand mining operations did shift with time to involve more Cambodian businesses and workers, they were not generally coming from Koh Sralao or other fishing villages; instead, workers were typically connected to boat owners or sand dredgers, who come from the provincial town and beyond. Other than in a few cases, sand dredging has not involved villagers from Koh Sralao as artisanal miners or as workers for larger operations.

While coastal villagers have not been part of the sand mining industry in the area, they have relied on marine resources including shrimp, crab, and various marine fish for decades as critical components in their livelihoods. People fish with mechanized boats using gill nets or crab traps in and around the mangrove estuarine area or within a few kilometers of the coastline (Marschke 2012). Although the main livelihood is crab fishing, a diversity of other fishing activities are also pursued by villagers (green mussel culture, grouper fishing), along

with various non-fishing activities (small shops, farming, animal raising), that are linked to a fishing economy. Livelihoods in the village have never been easy, with fishers having experienced fish declines since the 1990s (Marschke and Nong 2003); even so, sand mining in and around Koh Sralao has further compounded fisheries declines and biodiversity loss, as seen elsewhere in Asia (Larson 2018). In the short-term, fish habitats and seagrass beds have been destroyed. The removal of sand for commercial use deepens shallow channels, which are critical nursery grounds for various aquatic species, and destroys aquatic habitat in the process; fish migration routes are also disturbed, and the water is deemed by local residents to be more turbid. Sand mining has taken place near the margins of the mangroves, partially damaging some trees and completely ripping out others (Marschke 2014). The landscape is changing, with villagers noting that one of the island inlets near the village disappeared in 2015. Several minor landslides have also reportedly taken place. Fishers' lives have been dramatically altered in terms of their ability to fish in local fishing grounds, since shallow-water estuary areas is also where sand mining typically occurs.

While the precise impacts or effects are difficult to trace, it is evident that jobs for fishing villagers have not been created from this endeavor (with the exception of a few day laborer jobs in recent years), and the military presence in the ocean space limits what villagers or others dare to do. Sand mining operations take place at all hours of the day and night, and the constant noise of such operations has been described by villagers as an irritant. While livelihoods have transformed as a result of sand mining, the mobile nature of fishing enables people to compensate for the sand mining, responding to immediate habitat destruction and fish declines in particular areas by fishing other grounds. Sustained sand mining activities adds another strain, turning livelihoods that were always vulnerable into

increasingly precarious ones (Marschke 2017). Vulnerability, in this context, is seen as an inherited condition tied to making a living from the land and sea, as distinct from precarity which is produced by wealth-creating activities (Rigg et al. 2016), such as sand mining. In the Cambodia case, local livelihoods do not enter into the accounting equation in the production of sand, creating an epistemological gap.

Sand extraction on the Salween and its livelihood impacts in Myanmar

Our second case is from Hpa An, the provincial capital of Myanmar's Karen State. Here, sand mining operations, both medium- and small-scale, are impacting the Salween River and local livelihoods linked to the river. We see impacts not only on fishing but perhaps most pointedly on riverbank gardening, both of which are important sources of food and livelihoods for this city-town of approximately half a million residents (GoM-MoIP May 2015). Located near to the Myanmar border with Thailand and only 50 or so kilometers (30 miles) away by boat from the Port of Mawlamyine, local sand operations in Hpa An are ideally positioned for both international export and to supply materials for the rapidly industrializing surrounding region (Myitmakha News 2016). Sand extraction here is a mix of commercial and artisanal mining in rivers, with sand and gravel being extracted at multiple sites and scales destined for a mix of destinations. This is quite distinct from the kind of sand and the scale of operations described in Cambodia, which has largely focused on coastal sand mining for export to Singapore. However, that the sand operations are linked to Singapore, that they are having an impact on local livelihoods and landscapes, and that these impacts are being overlooked are similar across both cases.

In the Myanmar case, research reveals an acute impact of sand mining on river morphology and livelihoods. According to interviews carried out in 2017, 2018, and previous visits to Hpa An since 2014, traditionally the Salween's alluvial islands and banks in and around Hpa An have been allocated for the cultivation of vegetables, which were produced for household subsistence, for sale in local markets, and for export to Thailand. The majority of gardeners undertake this activity nearly year-round (across 2-3 seasons), as their main source of income and food. Compared with the Mekong, where farmers tend to cultivate for one season only with an estimated value of approximately USD\$25 million per year (ICEM 2010, 13), those engaged in the practice on the Salween are more reliant on the activity across multiple seasons (Lamb 2014). Alternative opportunities are fewer and therefore, we speculate, the implications of river bank and island degradation for livelihoods that much more significant.

Local riverbank cultivators were the first to highlight the rise in sand mining, and they pointed to the demand for sand and gravel for construction and development domestically in Myanmar as well as for export to Singapore (Myitmakha News 2016, Interviews May 2017). For instance, in a group interview with elder riverbank cultivators from Hpa An, interviewees explained that there had been a "double increase in the sand and marble production! Not enough to supply the demand. Lots of construction in the city. Everyone wants a concrete house now, not a wood one" (Interview transcript, May 2017).

As noted in a recent ICEM (2017) assessment of rivers across Myanmar, sand mining is a challenge but there is no data available on demand domestically. In 2016, as an indication of sand demand (as sand and cement are combined roughly 2 to 1 or even 3 to 1 to make concrete), cement demand within Myanmar was 8 million tons, so domestic demand can be

estimated somewhere between 16 to 32 million tons. Moreover, the demand for construction materials is growing both domestically and to sell not only to Singapore but also China (ICEM 2017, 70).

The increase in the scale and scope of the sand mining operations on the Salween was further identified by local sand and gravel companies and local authorities in Hpa An (Interview transcript, May 2017). In an interview with city officials, they explained that while removing sand from the river for construction is a long established practice, the way it is being done today and its impacts are new. One local official stated that “there are lots of problems with sand mining. It is faster now than in the past, we used to use people who would be in a line and then reach from bucket to bucket. Today, machines: we use boats, loaders, and trucks. Along with production, it has environmental impacts” (Interview transcript, May 2017). As reported in the Myanmar media (Myitmakha News 2016, Eleven Myanmar 2018) and as told to [Author 1] in interviews, Star High Pacific Limited had contracts for dredging Yangon River and Salween River, with the sand exported to Singapore.

According to interviewees, the recent rise of sand mining and the removal of sand has seen dramatic impacts, in terms of island formation and accelerating the erosion and sedimentation processes of the river’s banks. Sand mining also impacts local agricultural production: cultivation relies on seasonal flooding to deposit the river’s fertile sediments on riverbank gardens and islands. Moreover, as new alluvial islands emerge in the river, a normal occurrence in this area, sand and gravel companies rather than local cultivators are allocated access rights. This is contrary to the traditional practices of land and island allocation. According to Hpa An residents interviewed such practices are based on

generations of local land governance. New alluvial islands are claimed, after they emerge and are stabilized, by local groups based on proximity and then by lottery. The nearest communities (either villages or districts, which could be two or more) make claims to the island, and the land is divided into sections and then marked out as individual plots. Within the community a lottery is held to decide who will receive one of the plots within the community's designed portion. If companies continue to claim these islands, with the intention of their extirpation by mining, this also, and self-evidently, removes them from cultivation. Many questioned whether or how they would be able to continue with this kind of seasonal cultivation, which as noted is a long-standing practice.

Along the Salween River in Myanmar and in Koh Sralao, Cambodia, we see changes in the use and value of sand as it has moved from being implicated in a way of life, to becoming a business: new actors, using new technologies, for new uses, and with new flows and networks. In the burgeoning of a lucrative industry such as the sand trade it is easy to elide local and traditional resource uses and users. At an elemental level, subsistence and semi-subsistence fisheries and riverside farming are not captured by national statistics. In addition, approaches in economic geography that count value and track networks in narrow ways similarly shade such activities and the implications of their denudation from view. So where might a livelihoods approach to sand take us, as distinct from a global production network approach?

To begin with, it would attend to matters of livelihoods, matters of reproduction and redistribution, not just of production. It would therefore include subsistence and semi-subsistence activities and the (re)distribution of the product of these activities, often by exchange rather than sale, within extended families and, even, across communities.

Livelihoods, transformed

It might seem that Singapore's role in the story is only as the destination for the sand that has compromised livelihoods in Cambodia and Myanmar, as we outline above. But not only do we connect prosperity in Singapore with precarity in Cambodia and Myanmar, we also see the country's migrant workforce as indirectly implicated in these flows of sand both through the work that it provides and the precarity that it creates. Migrant construction workers form the largest group of migrant workers in Singapore (Ye & Yeoh 2018). While Singapore does not offer migrant workers a home, it does provide them with work. Relative to opportunities in their home countries, this work is often well remunerated and notwithstanding abundant evidence of exploitation, abuse, accidents, even death (Kitiarsa 2014), is often regarded as positive in terms of economic value and the contribution that such work delivers to the material conditions of the wider household. From a livelihoods standpoint, it is evident that this work is sometimes propelled by distress, on occasion by relative prosperity, can sometimes bolster household conditions, but in other instances produces debt-driven precarity and deepen livelihood exposure. The often aggregated and characteristically economistic perspective offered by a GPN approach obscures such intricacies of connection between sand extraction, migration, work in distant places, and livelihoods.

This absence of opportunities is partly a product of underdevelopment, but also -- and at first sight paradoxically -- of development. This is where sand mining's impacts on livelihoods in Cambodia and Myanmar come into the frame as explanatory possibilities. In both of our research sites, traditional livelihoods are being compromised, sometimes extinguished, by sand mining. Sand mining is an important sector in the national economies,

generating wealth for a few in Cambodia and Myanmar, sustaining prosperity in Singapore, and at the same time producing new articulations of poverty in the sites of extraction. This then creates the local livelihood conditions that cause people to leave their natal homes, to seek opportunities in other places, even in Singapore. In Koh Sralao, for example, between 2007 and 2010, 20 percent of households left the village because they could no longer make a living, partly for the reasons we describe above (Marschke 2012). Such out migration has continued (Horlings 2017). Households who remain generally have children, spouses, or other family members working either in other parts of Cambodia or in other countries in the Southeast Asian region (Marschke 2017).

Of course, leaving agriculture or the country to work abroad are not the only responses to sand mining in Cambodia or Myanmar, and nor is migration only a product of sand mining. There exist other changes, for instance, in relation to the shifting of livelihood practices in incremental amounts, or in re-creating subsistence landscapes locally. The changing landscape is a source of frustration for villagers in Koh Sralao, since they have been involved in replanting over 800 hectares of mangrove trees since 2000 and in community-based natural resource management activities more generally (Marschke and Berkes 2006; Marschke 2012). Villagers initially reacted to sand mining by active protest, lobbying government ministries, and, more recently, took considerable risks in working with controversial advocacy groups (Thompson 2017, see also, Baird & Quastel 2011). Livelihoods are less sustainable than ever, with (fragile) local resource use practices -- management and conservation-related -- being severely hampered as local resource management committees lose credibility since they cannot regulate or stop the sand mining (Marschke 2017). Sand mining has also led to serious tensions -- to protest, do nothing, or

to take advantage of the very few laborer jobs offered. Sand mining results in multiple transformations, impacting people's livelihoods and ecosystems.

Beyond calculation: metrics, livelihoods, and the sand trade

The available data on the global trade in sand misses much; it tends to occlude domestic data and precise cross-border connections can be difficult to discern. This in itself is a problem, but not attending to the omissions of the sand economies we detail above -- the distinct forms of livelihood precarity 'on the ground' -- reveals more than an error in global metrics of sand. In both Hpa An and Koh Sralao, local resource users have identified that their livelihoods are transformed by sand extraction. It is not just, therefore, that the things that are counted and valued, the methods used, and the interpretative frameworks employed, omit such matters; this oversight also hides some of the egregious livelihood outcomes that are tied to such processes of accumulation. As a result, the value of sand for local resource users is effectively discounted or rendered invisible, with the ways that sand feeds into subsistence and semi-subsistence activities generally overlooked in the production network. In Singapore, where much of this extracted sand lands for construction and fill, migrant workers from those same countries appear again.

It might be thought that these groups and activities can simply be drawn into the global production approach, permitting an incorporation of such actors and their livelihoods. We contend that it is not that simple because the issue arises from the nature of the approach itself. It is not by-the-by, merely requiring a broadening or rearticulation, but bedded deeply. Approaches are not 'innocent' (Burawoy 2009, 247-248); what theories we embrace, framings we employ, questions we ask, data we collect, and methods we use, are

intimately entangled and matter, often quite profoundly, in shaping the interpretations and conclusions we draw. More particularly, with regard to the global production approach we argue, and in summary, that it favors market and private values over subsistence and community values.

Thus, to better understand the impacts of sand mining on livelihoods, we argue that connecting the literatures on global production networks and livelihoods enables us to notice both connections and omissions. Whereas, broadly speaking, global production networks focus on the chain or network and livelihood analysis overlook the ways in which people and their conditions and potentialities are implicated in networks stretched beyond the arena of the local, connecting these literatures, as our sand cases illustrate, provides an approach which is broad in its connections and is simultaneously grounded in specific practices, places, and people. This enables us to better account for the overlooked, untracked, or omitted aspects in the production, erosion and transfer of the value embodied in sand. In the cases we recount we identify neither accumulation by dispossession (Harvey 2003), nor accumulation without dispossession (Hart 2006) but, rather, accumulation by omission. This, in effect, 'cheapens' sand because it overlooks the values of the livelihoods directly tied to sand, which we highlight, for riverbank cultivation and fisheries (see Figure 4A: Sand Prices). It also stops us from assuming that the "problem of poverty is fundamentally a problem of production" (Ferguson, 2015, 36) and instead, takes seriously matters of livelihood, both commercial and subsistence, as well as (re)distribution at family and community scales.

We bring together these livelihoods with global networks of sand traded throughout the Southeast Asia region as a way to underline such omissions. Or, in a context where "few

think it is important to take a closer look at the world the economic system supposedly organizes”, we underline that the stories we tell of economic growth and production tend to be foundationally disconnected to the narrations of life and livelihood (Tsing 2015, 132).

With this in mind, the approach we take identifies both sand trade networks and sand-linked livelihoods as connected and emphasizes that one value can, in fact, inhibit the achievement of the other. Skeptics might read this simply as extending an analysis of externalities, or even within the scope of an analysis of accumulation by dispossession which argues that accumulation of wealth in a capitalist economy both results in and is predicated on this dispossession. What we mean to differentiate in this approach is that the omission of livelihoods limits our understanding of accumulation. These livelihoods, distinct from ‘labor’ or ‘worker’, are not positioned against capitalist forms (Gibson et al 2017), but are an integral if hidden part of the form, and that to only view these activities as important in terms of their relations to firms or labor does not do justice to the extent to which livelihoods and local economies are lost. Taking a livelihoods approach provides the means and opportunity to interrogate the blind spots of GPN analysis, part of what Werner argues amounts to “constitutive exclusions” (2016). It provides a way to tell a livelihoods-inclusive story of the economy of sand, a story which we consider essential in understanding the accumulation of wealth and production of poverty in particular places and for particular people. At the same time, the merits of GPN can bring greater analytical precision to livelihoods analysis. Together, they reveal what each framing individually privileges -- and in connecting them, we take the opportunity to understand and reveal the implications of the global sand trade for life and livelihoods.

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Figures

Figure 1A: Tracking value in the sand trade and livelihoods.

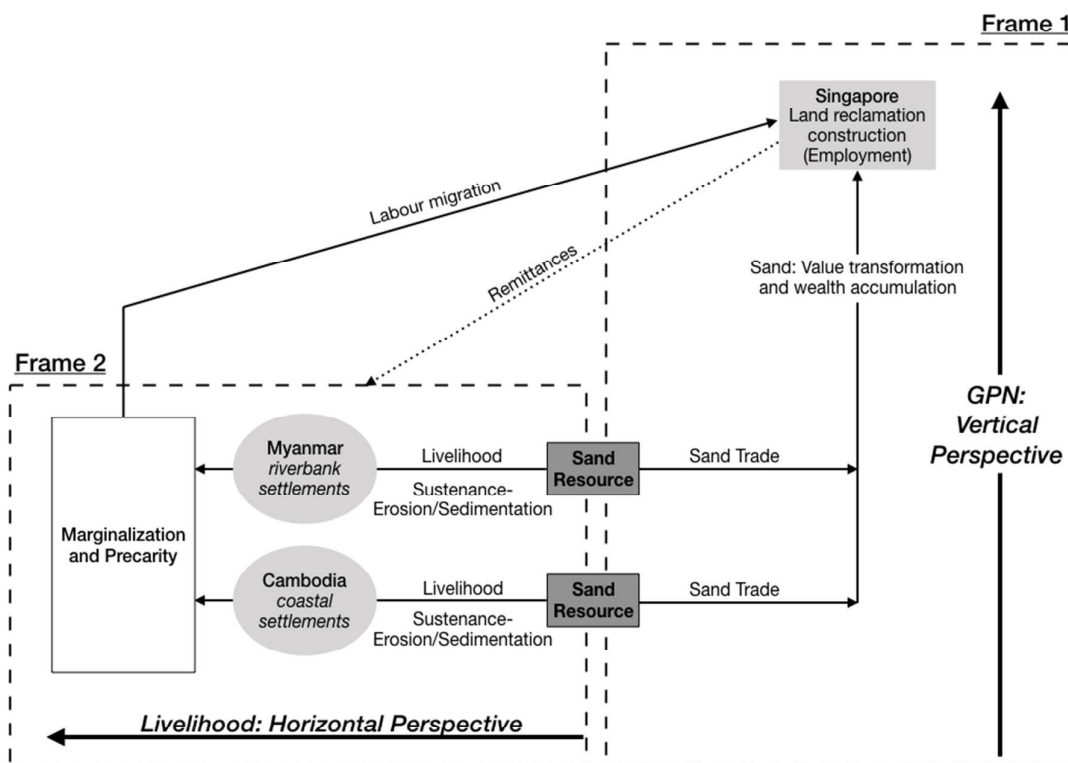


Figure 2A: Singapore Sand Imports, 2007-2016. Source: DESA/UNSD 2018.

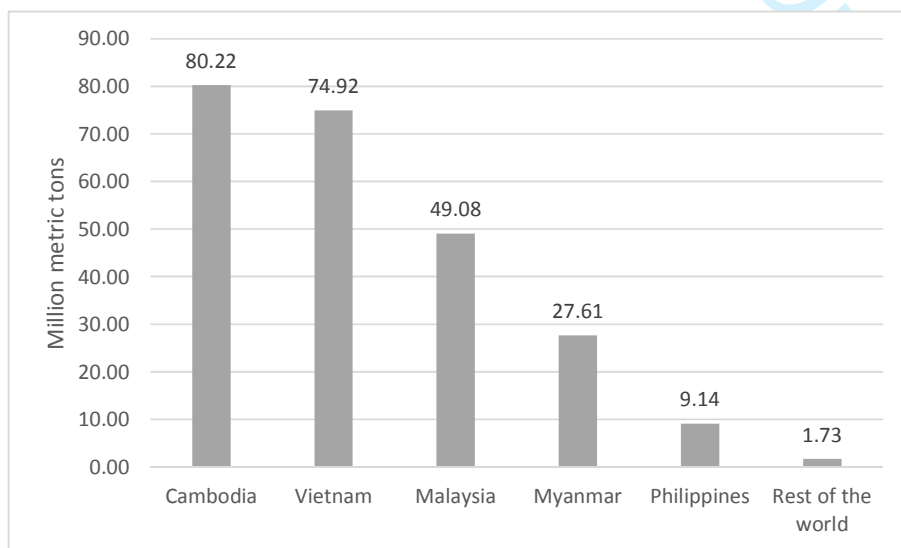
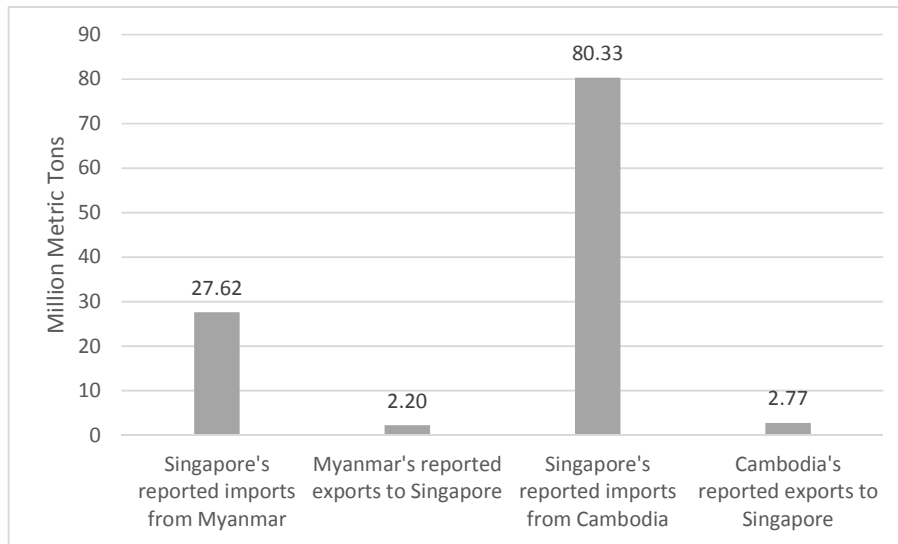
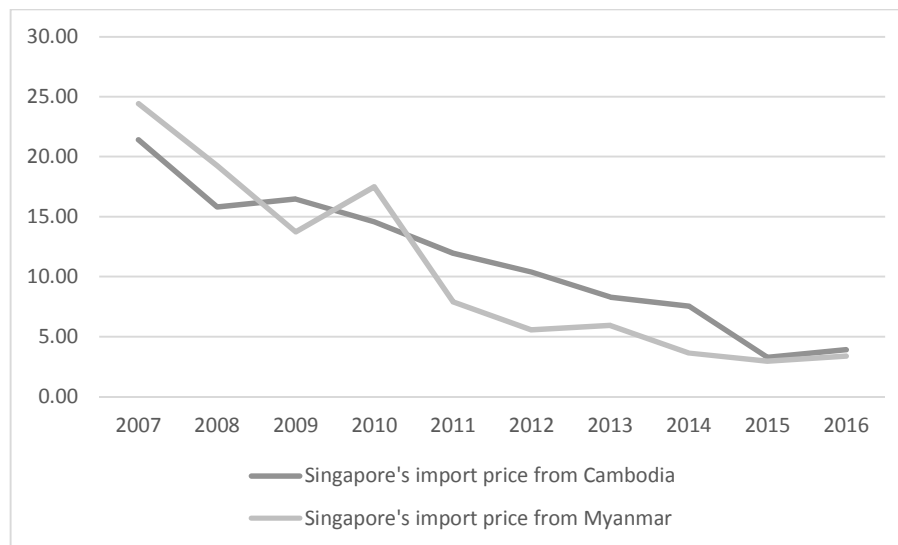


Figure 3A: Sand Trade Data Gaps: Reported exports and imports of sand for Cambodia, Myanmar, and Singapore, 2007-2016. Source: DESA/UNSD 2018.



*Note that Myanmar reported no sand exports to Singapore between 2007 to 2009 even as Singapore reported sand imports from Myanmar during this same time period.

Figure 4A: Sand Prices. Singapore's sand import price from Cambodia and Myanmar (US\$/m.ton). Source: DESA/UNSD 2018.



Note: The price of sand was derived by dividing import value by import quantity.

¹ We use the general term 'sand' throughout the article as it is used across academic scholarship, reports, and in local contexts. However, while we do not have the space to draw out the distinctions in this article, we recognise that sand and gravel can be rather ambiguous categories (i.e., silt, sediments, sand, gravel), and what counts as 'sand' can change depending on size, location, and use.

² In a 2015 article, Yeung and Coe define a "global production network as *an organizational arrangement comprising interconnected economic and noneconomic actors coordinated by a global lead firm and producing goods or services across multiple geographic locations for worldwide markets*" (2015, 32 [emphases in original]). See also, Coe 2011 on the GPN 'acronym soup'.

³ Or in other cases, livelihoods are related to 'local' economies of everyday life and are considered "unremarkable" (Gibson et al 2017, 134).

⁴ Artisanal or small-scale sand mining is prevalent globally, and can have similar – although generally more localised – economic and environmental effects (see Masalu 2002 on Tanzania and Mingist and Gebremedhin 2016 on Ethiopia).

⁵ For instance, Singapore's Changi airport was developed on reclaimed land and also saw recent expansion requiring both sea and river sand from others in the region. Other large projects, such as the Marina Bay Sands hotel and casino, also relied on imports of both. For just these two projects, investors and contractors included government, local contractors, as well as domestic and international firms, such as the Las Vegas Sands Corp.