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Sand



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Unpacking Cambodia's sand industry: livelihoods, ecologies and development

Cambodia relies on a significant amount of sand, including sand for infrastructure needs and sand as wetland infill. Sand mining drives serious ecological and social consequences that impact the environment and livelihoods, but few jobs are created in return. Working towards sound sand governance is critical for Cambodia's sand industry and overall development.

Sand, gravel, and crushed rock – known as construction aggregates – are in high demand throughout Asia. Such demand is driven by high rates of urbanization and infrastructure development: a significant amount of sand is being extracted from the region's riverbeds, deltas, and sea bottoms, only to be transported for infill or construction purposes elsewhere. This process of sand extraction and construction is a major force in shaping global geomorphological change and is also a key contributor towards climate change. Although sand is the most used natural resource after air and water, the magnitude of how sand mining and infill impact people and the environment remains poorly understood.

Cambodia is a country with significant sand operations, including a booming trade in illicit sand. Over 80 million metric tonnes of Cambodian sand were used as infill for Singapore's territorial expansion between 2007 and 2016, until Cambodia banned sand exports in 2017 (UNCTAD 2021). Sand mining continues along Cambodia's rivers, with dredgers, barges and sand pumps marking Cambodia's river system. This sand is used to meet domestic infrastructure demand as Cambodian cities grow, dams are developed, and roads are built. In the capital, Phnom Penh, new ground for development is being created through infilling local lakes and wetlands. Sand extraction supports Cambodia's ongoing real estate boom, including satellite cities emerging at the edges of Phnom Penh.

Official sand statistics are difficult to access, including the volume of sand being extracted from riverbeds or the volume of sand being used internally. While the Cambodian government does give out permits for sand mining, it is unclear how permits are awarded, monitored, or enforced. Unmanaged sand mining has serious ecological consequences, in terms of river bank erosion, sediment load changes impacting fish species, and habitat disruption.

Even as a few jobs are created, many other livelihoods are negatively affected by sand mining, including urban morning glory farmers and fishers. Enhancing sand governance is critical for Cambodia's sand industry and overall development.

Sand mining, infill and environmental change

Sand mining in Cambodia takes place in and around mangrove estuary areas or in and along rivers. Sand may be used for export, for local development, or as infill. Since some trade data are publicly available, we know that Cambodia exported extensive amounts of sand since the mid-2000s. Much of this sand was dredged in southwestern Cambodia, in mangrove estuary areas and shallow ocean spaces that are far from the capital city. Sand extracted in this part of Cambodia was sent by barge to Singapore, as part of Singapore's territorial state expansion project. Singapore expanded its' state boundaries through sand infill by a fifth between 1965 and 2015, initially relying on sand from Indonesia and Malaysia, then switching to sand from Cambodia and to a lesser extent Vietnam, and now relying significantly on sand from India and Turkey (UNCTAD 2021).

International trade data is fraught with data gaps or import and export data not mirroring each other: between 2007 and 2016 Cambodia reported exporting nearly 3 million metric tonnes of sand to Singapore; in contrast, Singapore reported importing over 80 million metric tonnes from Cambodia during the same period (UNCTAD 2021). After a decade of coastal sand exports, and only after the social-media savvy activist-group Mother Nature exposed the data mismatch, did Cambodia ban coastal sand mining exports in mid-2017.

Sand mining in Cambodia has continued, however, including along Cambodia's inland rivers. Sand mining is rampant throughout the lower Mekong River basin, which includes the Mekong, Sap and Bassac rivers. Natural replenishment levels in the Mekong watershed have decreased over the last decades as a consequence from rampant sand mining, but also due to upstream hydropower expansion in both Laos and China. Dams create obstacles to sediment transport; sand and other aggregates deposit and accumulate behind such infrastructure. Rapid urbanization in Phnom Penh and elsewhere along the Mekong further contributes to rates of sand extraction that are higher than natural replenishment levels.

This combination of sand mining and upstream damming for hydropower expansion has led to serious erosional



Erosion along the Mekong River, Cambodia. October 2019 (Photo: L. van Arragon).

processes. Houses collapsing into the Mekong River are becoming more and more common, with river bank instability being an issue (Figure 1). After sand is extracted, its movement elsewhere as infill or as a key ingredient in concrete further alters ecosystems. This poses serious sustainability challenges, including habitat disruptions that impact a range of species: macro-invertebrate, plant, aquatic, mammal, bird and, of course, human beings.

An immense amount of sand has been used as infill in and around Cambodia's capital. Although Phnom Penh is situated on an extensive flood plain, 16 of Phnom Penh's 25 lakes or wetlands are now completely filled in from sand. Phnom Penh has increased its built-up area six-fold since 1990, with land reclamation projects completed on 6,000 ha of lakes and wetlands. Many of these former lakes and wetlands now host megaprojects, led by private developers – both foreign and domestic – that, in turn, continue to rely on river sand for construction purposes. Cambodia's construction and real estate sector have emerged as major contributors to the country's economic growth.

Land infill for high-end and commercial real estate development has led to the eviction of urban farming communities, households who settled in wetland areas in the aftermath of the Khmer Rouge. For example, in the case of Boeung Kak Lake, situated in central Phnom Penh, house-

holds relied on this lake for income through fishing and growing aquatic vegetables until their eviction and re-settlement in distant camps elsewhere. The wetland infill resulted in a loss of both homes and livelihoods. Even as these evictions elicited massive protests and gained international media attention, infill continued at Boeung Kak Lake. Wetland infill from sand endures to this day, in and around Phnom Penh, greatly impacting local urban farmers and food supply (Figure 2).

Impacts on livelihoods¹

Sand mining does not appear in Cambodia's socio-economic statistics, and much of this sector operates within the informal economy. Little detailed attention has been paid to sand mining livelihoods nor to those households who are affected by sand mining operations. In addition to the ecological impacts involved with dredging and the movement

1 This section is based on fieldwork in Cambodia, drawing on the urban farming field work of Dr. Laura Beckwith (Beckwith 2020), the sand livelihood field work of Lukas van Arragon (van Arragon 2021), and the longitudinal coastal livelihood research of Dr. Melissa Marschke (Marschke 2012; Lamb et al. 2019). Also see Marschke et al. (2021) for a more detailed analysis of sand work and urban farming livelihoods.



Labourers blast water at sand in order to dislodge it so it can be pumped out of the barge through large tubes. Up to ten labourers work for an hour to empty one boat. October 2019 (Photo: L. van Arragon).

of sand, sand mining and infill drive livelihood changes for a wide range of social actors directly or indirectly involved in these activities.

Sand work

Sand work involves operating machinery at sand dredging stations, managing sand barges or transporting sand along rivers, and/or offloading sand at shore (Figure 3). This work is mobile, in that dredging stations move along rivers in response to fluctuating sand demand and sand availability. Sand jobs are mostly taken up by men who account for the majority of boat captains, sand dredgers, pumpers, and boat owners. Sand workers tend to live together in dredging or pumping stations, or they congregate on the river at night when sleeping on boats. Women may be involved as cooks, if married or related to a boat captain. Workers most often leave their family as they pursue this work, and send remittances back home.

Workers from rural areas are drawn to sand work since there are not enough jobs in the countryside to sustain rural populations. Many workers enter sand work through word of mouth and connections, as is the case for many informal jobs in Cambodia. Although workers know this work can be in relatively isolated spaces along the river, this work

is seen as a less physically-demanding job compared to construction work. Even so, the working conditions facing sand labourers are less than ideal: workers do not sign contracts, have no health and safety protections, and payment schemes vary, from a monthly rate to only being paid when there is sand to move.

Sand jobs are not that common, in part because sand dredging in Cambodia is mechanized. While sand workers are needed at various points in the sand removal cycle, there are typically only a few workers associated with any sand dredger, with more workers being hired when sand is offloaded from sand barges onto land. Workers have few opportunities to attain higher level jobs such as that of a sand barge captain. While there are jobs for captains and engineers to fix equipment, such jobs are more specialized. Much of the sand equipment, such as dredgers and barges, are owned by Vietnamese investors. Sand mining thus creates transient, relatively-marginal sand labour livelihoods.

Urban farming

Sand infill also impacts other kinds of livelihoods. For example, the steady pumping of river sand, through plastic tubing into wetland spaces (Figure 2), produces land that



Urban farming in Phnom Penh's wetlands, October 2019 (Photo: L. van Arragon).

is suitable for construction purposes, sustaining Phnom Penh's rapid urban expansion. While this happens, thousands of urban farmers, fishers, and small home business operators who make their living in these wetland areas lose their livelihoods.

Urban farming livelihoods continue to be lost to sand infill in southern Phnom Penh where Cambodia's largest satellite city, ING city, is being built on top of two of Phnom Penh's few remaining urban wetlands. Tompun and Cheung Ek wetlands expand to over 2,000 hectares in the rainy season: an immense volume of sand is necessary to complete this infill. Yet urban farming is the main source of income for over two thirds of all villagers (Beckwith 2020). Morning glory, a type of aquatic spinach, is grown on the water's surface alongside other aquatic vegetables, which are then sold to local markets (Figure 4). Households have generally been able to support their families with this farming work and, in so doing, benefitted from the proximity to the city and the public services offered.

Farming livelihoods have become less viable since work on the ING city and sand infill began (somewhere between 2004 and 2011). According to Beckwith (2020), farmers observe that they now rely on greater quantities of chemical inputs to produce aquatic vegetables, which they link with the severe skin rashes now found on their bodies. In a few

more years, most urban farmers will no longer be able to farm as wetlands will be filled and re-configured by the ongoing construction – luxury commercial and residential ventures can be seen in the distance as ING city develops. The infill of these wetlands is expected to require more sand than any other project in Cambodia's infrastructure development to date.

While some urban farmers will remain in their homes, a win given the rate of eviction seen for households living near other wetlands, their wetland farming areas will no longer exist. People recognize that sand infill will destroy urban farming, and that other livelihood strategies need to be in place by the time these wetlands are filled in. This livelihood transition is hardest on older farmers, and households focus on ensuring their children or grandchildren have an education to enable 'better' work in the city (Beckwith 2020). It is less clear if 'better' jobs will exist or be accessible.

Fishing

Fishers have long known that sand mining impacts the migratory routes of fish species. In southwestern Cambodia – Cambodia's massive coastal sand mining site for nearly a decade – local communities observed various im-



Pipes are laid across many kilometres, allowing sand to be continuously fed into a wetland area (Photo: L. van Arragon, October 2019).

pacts from sand mining, including: an absence of particular aquatic species (especially crab), persistent noise, shifting sediment loads in mangrove estuaries, erosion of estuary banks and mangrove trees, and significant habitat disruption for fish but also bird and other wildlife species. Fishers, when their boats could handle it, shifted their fishing grounds away from sand dredging areas; others left their villages to pursue non-fishing livelihoods. Out migration from coastal areas has been a consistent livelihood strategy for many households throughout the 2000s, with the sand mining boom perhaps being the tipping point for some households.

Although communities complained and attempted to stop sand mining for nearly a decade, only with the savvy campaigning of the Cambodian activist-group Mother Nature did the Cambodian public become outraged at both the amount of sand being exported to Singapore and the lack of transparency in the process. Cambodians were incensed that so much sand had gone illicitly to Singapore, to the benefit of a few elite officials and business people. This ground swell of support for local fishing communities was a game changer. The important work of Mother Nature, who has continued to expose challenges with sand mining throughout Cambodia (including river sand and silica sand mining), was recognized with the Asian 2021 Front-Line Defenders Award. This activist group has persistently

challenged and rankled the Cambodian government, in spite of Cambodia's current authoritarian turn, and is able to sustain its work even as key members are jailed.

Research from other regions of Asia suggest that the negative ecological impacts from sand mining can be reversed, or at least halted, when sand mining stops. Fish stocks, as an example, can recover relatively quickly, although it is unclear if this has happened in coastal Cambodia now that coastal sand mining for export has been banned. Fishing challenges are also seen throughout Cambodia's rivers and in the Tonle Sap Lake, linked in part to sand mining. However, ecological shifts are complex to tease out given that Cambodia's rivers simultaneously face challenges spanning climate shifts, over-fishing, dam development and sand mining. Fishing is not unique in this sense: there are many unintended consequences of sand mining that have significant livelihood and ecological implications, some being felt immediately, and some manifesting through time.

Reflections on Cambodia's sand challenges

Persistent sand dredging leads to serious ecosystem impacts across Cambodia's rivers, wetlands and riverbank regions,

but also for the people that predominantly rely on natural resources for their livelihood. Sand is a vital ingredient for Phnom Penh's urban development process: as infill, to enclose wetlands or lakes to help build up the cities' land mass, and again in the concrete and bitumen used for building the infrastructure that fuels urban expansion. Yet Phnom Penh's prioritization of luxury real estate and commercial development comes at the expense of the urban poor and local wetland ecologies.

Sand work is low paid and temporary in nature, and does not employ that many workers given the mechanization levels found in Cambodia's sand industry. Sand workers often remain in entry level jobs, while the consequences of sand infill are dire for urban farmers. Although wetlands sustained urban farming livelihoods at one point in time, morning glory farmers are being squeezed out of this livelihood as sand creeps in to take over the wetland. Fishing livelihoods are also diminished by sand mining. In sum, sustained sand exploitation drives major social-ecological repercussions, and these are set to multiply in the future.

Sand is an indispensable natural resource in Cambodia's development process. People need houses, dams can be part of a 'green energy' transition, and sand is a vital ingredient in so many products. However, what has been seen to date suggests that Cambodia's sand resources are not well managed. Sound governance throughout the sand system is critical, including thinking carefully about where sand mining occurs, volumes extracted, the roll of sand as infill, worker health and safety, and riparian livelihood impact mitigation strategies. Sand supply chains, within Cambodia or beyond, tend to be opaque in nature, where a few actors may make huge profits. Cambodia's sand supply is not infinite, and a thoughtful, transparent approach to sand governance will be critical to support future development needs. Regional and transboundary sand governance mechanisms and strategies also stand out as solution to halt the ever-shifting cycle of sand exploitation and livelihood loss.

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