

# **Exploring Sand-Mining in Yangon, Myanmar: Status, Regulations and Impacts**

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## **A Practitioner Report**

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And accepted on the recommendation of

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## **ABSTRACT**

### **Exploring Sand-Mining in Yangon, Myanmar: Status, Regulations and Impacts**

**Bethia Kadoe**

Sand is one of the most exploited commodities in the world and yet the issue of sand-mining is often overlooked amidst today's environmental challenges. Climate change, coupled with exponential population growth, contributes to the need for more sand and to meet this need through sustainable means. The government of Myanmar, a developing country in Southeast Asia, is beginning discussions on how to manage this important resource as it is drafting its National Environmental Policy. Myanmar's political and economic progress in the last decade has propelled the country to consume more raw materials than ever before. This report seeks to provide an overview of sand market in Myanmar by a) establishing a baseline understanding of sand-mining activities by focusing on the sand consumption rate of the capital, Yangon Division and b) the current regulatory framework and c) outline the main environmental and social impacts associated with sand mining.

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## Glossary

DWIR - Directorate of Water Resources and Improvement of Rivers

GA – General Administrative Department

Sud - Unit of measure for a volume of sand having 10 feet length, 10 feet width and 1-foot height

Kyat - Currency of Myanmar. Officially known as Myanmar Kyat (MMK)

EIA – Environmental Impact Assessment

SIA – Social Impact Assessment

EMP – Environmental Management Plan

## **1.0. Introduction**

The issue of sand mining has only recently emerged to the forefront of environmental concerns which weigh many developing and developed countries today. A report by United Nations Environment Programme (Peduzzi, 2014) detailed that globally between 47 and 59 billion tonnes of materials, 68% to 85% of which are sand, and gravel are mined every year and that the amount being mined is increasing exponentially, mainly because of economic growth in Asia.

Sand, a key ingredient for making concrete and asphalt, has been exploited in the last two decades particularly, as the world's cities need to develop housing units and commercial towers for the world's growing population. Cities are expanding at unprecedented rates than at any other time in history. According to United Nations Department of Economic and Social Affairs' Report on World Urbanization Prospects, the largest urban growth would take place in India, China and Nigeria, which accounts for 37 percent of the projected growth of the world's urban population between 2014 and 2050. (UNDESA, 2014)

Sand mining is ultimately, a global problem. To accommodate the needs of urban population growth, and industrialization, construction has to keep up building livable spaces. Shanghai, for example, has added 7 million new residents since 2000, which came up to more than 23 million. (Beiser, 2017) The sand used

for the new high-rise buildings in Shanghai came mainly from China's biggest freshwater lake, Poyang Lake. Hundreds of dredgers could be seen on the lake on any given day. A study by Lai et al. (2014) estimated that 236 million cubic meters of sand are extracted from the lake annually. This had negative consequences such as lower water levels, increased drought risk, and a wider and deeper outflow channel of the lake.

Rising population aside, sourcing the sand is also a difficult task for the procurers as there are only limited sources. Desert sand cannot be used as a source because it has been eroded by the wind and therefore too smooth and rounded to be combined with other construction materials. As a result, sand miners turn to riverbeds, floodplains and beaches to meet the demands by a growing urban population.

Due to its limited sources, sand is mined and delivered to the buyer, sometimes at great social and economic costs. Illegal mining in India has been a problem, largely ignored by its own government as it is trying to pursue its own Agenda, affordable "housing for all" program. (Gopalan and Venkataraman, 2015) The resulting consequences are that the states of Gujarat and Maharashtra are hotspots for illegal mining within Vasai creek. Workers earn 1,000 rupees (approximately, US\$15) for a day of diving into the creek to dig sand and each diver brings 2000 to 4000 kg of sand every day. (Srivastava, 2017) Violence has

erupted, and blood has been spilled to curb the efforts of the villagers, local and state officials by the sand mafia, a collection of business men who profit from daily operations of sand mining activities (Sugden, 2013).

Illegal sand mining is also reported in Singapore, the top importer in the world with 517 million tonnes of sand in the last 20 years (UN Comtrade, 2014). Singapore imports most of its sand from neighboring countries such as Indonesia, Malaysia, Thailand and Cambodia although Indonesia banned its sand export after the disappearance of 24 Indonesian sand islands (Peduzzi, 2014). Singapore uses most of its sand for land reclamation purposes as it needs ever increasing amounts of land for development purposes.

Therefore, there is a real need for knowledge to tackle the complexities of sand trade as it is a common problem facing all the countries of the world. The country of Myanmar, where this research was carried out, has its own local sand supply sources, mainly the Irrawaddy River and Ngapali Beach. (Hulst, 2015) This report seeks to answer questions such as:

1. How much sand is being extracted from the river annually?
2. What are current regulatory framework on the sand-mining industry?
3. What recommendations can be made to lessen the negative impacts of sand mining based on existing literature?

## **2.0. Background**

Myanmar is a participating country in the global sand trade. In recent years, similar to the path of its neighboring countries, Myanmar's sand and gravel mining sectors have been rising rapidly due to population growth and migration of people from rural to urban areas. Yangon Division, which includes the Yangon, the previous capital of Myanmar, has the highest consumption rate out of all the 7 States and 7 Divisions to accommodate rising standards of living for a population of more than 7.3 million in 2014. (Yangon, Myanmar Population and Housing Census, 2014) Roughly 69% of Myanmar's population live in rural areas and 31% live in urban regions although this gap is projected to close in 2040. (UNDESA, 2018)

In addition to national consumption, Myanmar exports a substantial amount of sand to its neighboring countries. 4 million cubic meters of sand was exported to Singapore for a value of US\$12 million between 2011 and 2014 according to Eleven Weekly media which interviewed local representatives. (Myanmar Business Network, 2014) Almost all the exported sand came from Myanmar's southern coastal region such as Myeik and Kawthaung Areas. Not all exported sand, however, is not accounted for. Frontier Myanmar (Hulst, 2015) reported that beach sand was being mined illegally in Ngapali Beach on the Bay of Bengal in Rakhine State.

While estimates vary on how much construction sector contribute to the national economy, according to Asian Development Bank, the construction sector comprised 5.3% of the GDP in 2013 and 5.8% of GDP in 2015, which came up to roughly US\$3.4 billion and US\$3.67 billion respectively. Construction industry is growing rapidly over the last 10 years as can be seen by the growth of cement industry in Fig. 1.

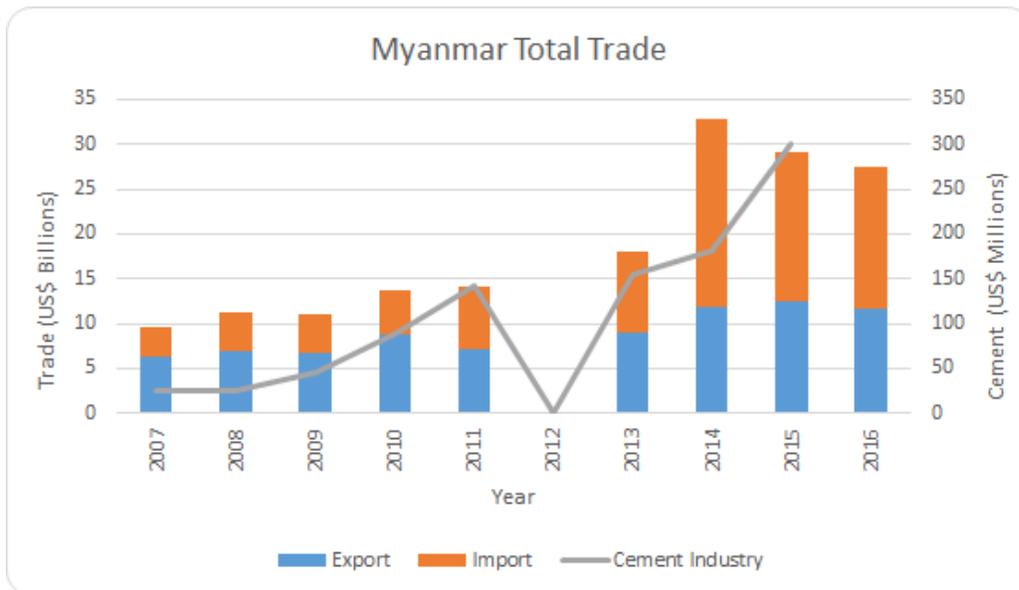


Figure 1. Total Trade of Myanmar from 2007 to 2016. Lack of available data in 2012. Source: Chart made by the author based on data from U.S.Geological Survey Minerals Yearbooks (2007 - 2015) and the Observatory of Economic Complexity (2016)

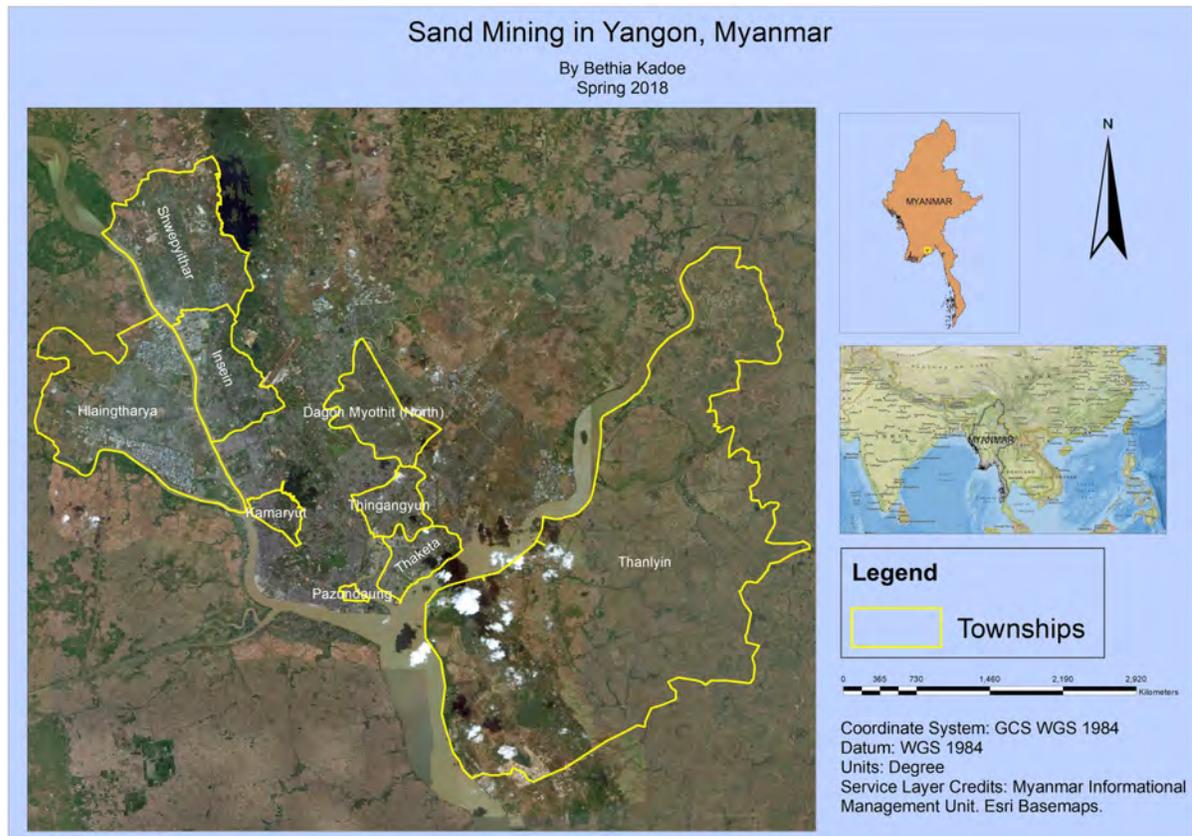


Fig. 2. Study Area Townships

### 2.1. Existing laws and regulations

The newly democratic government, brought about by the political revolution that began in the 1980s, made significant changes to the laws and regulations regarding sand mining. Sand, considered as a natural resource, is owned by the state. As such, under Article 37 of Myanmar's 2008 Constitution, the Union is the ultimate owner of all lands and all-natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union. Therefore, it

can enact necessary law to supervise extraction and utilization of these State-owned natural resources.

The Directorate of Water Resources and Improvement of Rivers, under the Ministry of Transport, oversees the operations of sand mining as one of its duties for river training and navigation. Together with the General Administrative Department, the DWIR gives mining licenses and renewals. Myanmar drafted the Environmental Conservation Law which was enacted in March 2012. The objectives of this law are to provide interim management guidelines for different industries while the Ministry of Natural Resources and Environmental Conservation drafts a detailed National Environmental Policy with the help of United Nations Development Programme. It is expected to be published in 2018. (Myanmar Ministry of Information Announcement, 2017)

According to the Conservation of Water Resources and Rivers Law implemented in 2006, Chapter V, Article 13, "no person shall carry out sand suction, sand dredging, sand excavating, river shingle suction, panning for gold, gold mineral dredging or resource production for commercial purpose in the river-creek boundary, bank boundary, and waterfront boundary, without the recommendation of the Directorate." Similarly, Article 14 dictates that "no person shall carry out sand suction, sand dredging, sand excavating, river shingle suction, panning for gold, gold mineral dredging or resource production from the sandbank

maintained for prescribed river training work, prohibited place in the river and creek or the watercourse.”

### **3.0. Methodology**

This project aims to provide an overview of sand market in Yangon by

1. Determining the locations and amounts of sand distribution.
2. Identification of the main environmental and social impacts associated with sand mining based on existing literature.

To seek answers to components of Part 1, an aggregate mining survey (Appendix A) is used as a guide to ask the sand mining businesses, categorized into extraction and distribution sites. Maps depicting the locations of sand mining in Irrawaddy was provided by World Wildlife Fund-Myanmar survey team who has been tracking the sand mining boats and barges from satellite.

For Part 2, existing literature and data were reviewed concerning environmental and social impacts that result from sand mining.

## **4. Findings and Discussion**

### **4.1 Survey Results – Status of Mining by Town/Ward**

The results of the survey are shown in Table 1. 113 sand and gravel mining businesses were surveyed to determine the length of operation years, and the amount of coarse sand, small gravel, large gravel distribution centers and volume of sand and gravel sold.

According to the survey results, Hlaing Thar Yar and Shwe-Pyi-Thar townships have the most number of businesses. The average length of operation range from 1.5 years in Thilawa to 20.5 years in Thingangyun. Coarse sand distribution centers are greater in number than small gravel distribution although there are many businesses that sell both as they are both complementary goods for making cement. The total volume of sand sold is more than 3.5 million cubic meters and total volume of gravel sold is 473,191 cubic meters estimated for the year 2016-2017.

Region or District	Township or Ward	No. surveys completed	Av. Length of operation (yrs)	No. Coarse sand distribution	No. Small gravel distribution	No. Large Gravel Distribution	Vol of construction sand sold (m3)	Vol. Gravel sold (m3)
Yangon	Hlaing Thar Yar	30	7.4	27	18	4	864,000	86,685
	Insein Ywar Ma	8	12.6	7	6	5	180,768	36,904
	Kamaryut	8	10.5	5	3	3	165,272	25,470
	North Dagon	7	10	4	2	2	304,721	10,188
	Pazundaung	4	8.5	4	4	0	77,471	43,355

	Shwe-pyi-thar	36	8.8	30	18	16	1,479,693	157,205
	Than Lyin	12	5.6	9	9	9	299,557	76,693
	Tharkayta	4	5.3	3	2	0	46,483	15,494
	Thilawa	2	1.5	2	0	0	56,671	0
	Thingangyun	2	20.5	2	2	2	92,965	21,197
Total		113	9.07	93	64	41	3,567,601	473,191

Table 1. Results of the aggregate mining survey in Yangon

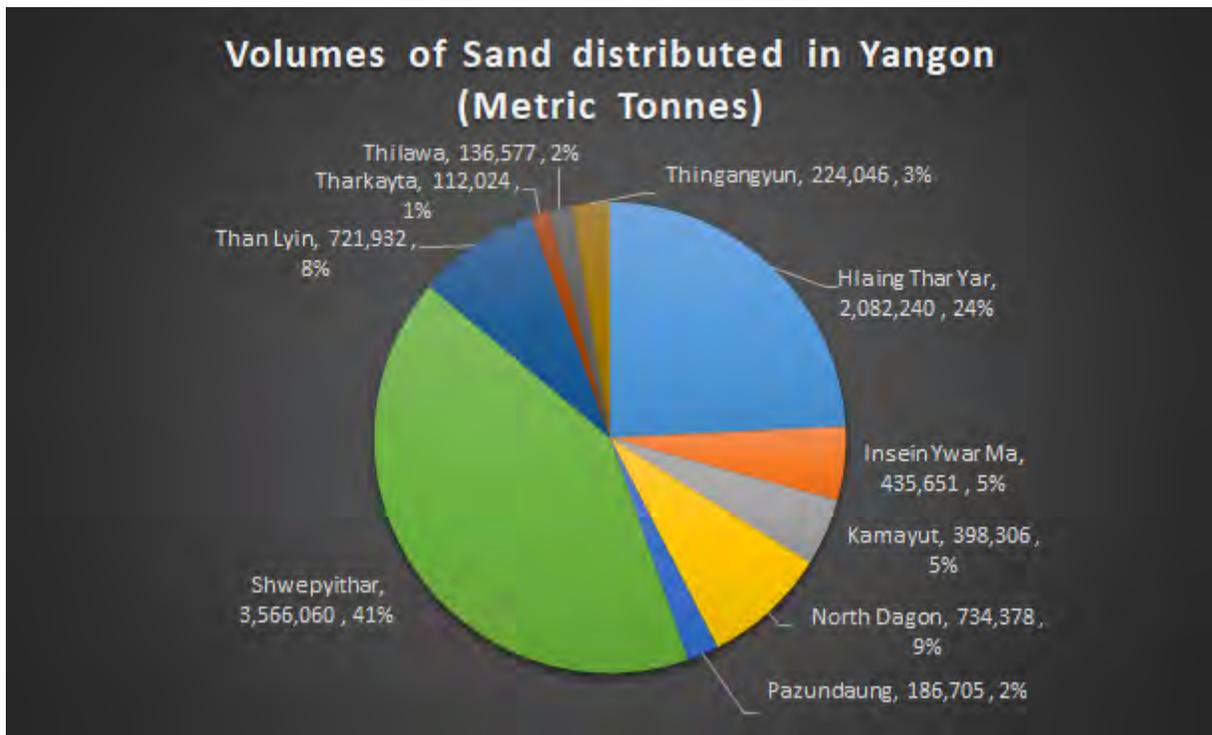


Fig. 3. Volumes of Sand distributed in Yangon

According to Fig. 3, 41% of the sand is distributed in Shwepyithar Township, 1323.328 acres of which is officially designated as industrial zones.

(Myanmar Industries Association, 2018) Hlaing Thar Yar township, which houses the Shwe Lin Ban Industrial Zone, occupies the next highest distribution rate, 24%. The rest of the townships visited do not house any industrial zone and therefore consumes relatively small amounts of sand compared to Shwepyithar and Hlaing Thar Yar.

#### 4.2 Technology and Practice

Most sand mining businesses have all kinds of machinery such as boats, small tractors, wheel loaders, large trucks to transport and distribute sand and employ local workers both on the boat which extracts sand from the river and in the distribution site for customer service. Image 1 and 2 were taken in near Pyay, right above Yangon Region in the Irrawaddy River. Sand is mined in the river with boats.



Images 1 and 2: Sand being mined by boats in Pyay



Image 3: Extracted sand from the boat is again mixed with water to be spread onto dry land.



Images 4 and 5: Two distribution sites showing sand being collected on land through connecting pipes



Images 6 and 7: Examples of sand collection sites



Image 8: Sand is distributed around town to the customers

The sand mined from the river is mixed with water and the boats tend to carry as much as they can of this mixture on the boat. The water from this mixture

is expelled back into the river. This process is done in the river, on the journey back to the distribution site until the water is gone.

When the boats reach to their respective distribution sites, often located next to their local home shops, the sand is mixed with water again as shown in Image 3. Images 4 and 5 show sand being collected in two distribution sites. Images 6 and 7 are included to show the size of the collection sites, which can collect up to thousands of suds. The collected sand is sold and delivered to customers over the next few days or weeks. Some sand mining businesses have contractual agreements with construction companies and will not hesitate to buy and resell from other distributors to fulfill their contractual obligations.

In addition to uses by the construction industry, the sand is bagged and used locally by villagers to prevent flooding of the houses, on the streets and in the neighborhood in the rainy season and to combat fire in the fire-prone hot and dry season. There are two types of sand sold in the businesses: fine sand and construction sand. Locals use fine sand for non-construction purposes. Some distributors combine the two types and sell them as construction sand as both can potentially be used for construction.

Yangon division does not receive any gravel deposits in the Irrawaddy River. Therefore, it does not grant any gravel mining permits. According to the Department of Waterways and in Yangon Division, there was no limit to suds (1

sud = 10 ft length x 10 ft width x 1 ft height) per plot before 2015. Those who applied were usually granted a license. After 2015, when a business applies for a license, they are considered for two factors.

- 1) Is the location suitable for sand-mining? This is determined by the survey teams of DWIR.
- 2) What is the size of the boat? Only boats which have a carrying capacity of less than 30 suds is granted.

There are several plots in Yangon division ranging from 40-50 in a given year. The guidelines that come along with a sand-mining permit are that a company is allowed only 2 boats, each boat carrying less than 30 suds of sand at a time. Businesses are also only allowed to dredge sand for only up to 1 meter under the existing bed level although this guideline is not adhered to in practice.

#### 4.3 Monitoring/Compliance

Monitoring is performed by a survey team either employed or contracted out by the DWIR each year when the licenses need to be renewed. In the past, because the licenses are applied and granted throughout the year, the survey teams also work throughout the year. In the future, the DWIR hopes to create a timeline during which there is a call for application, a period of consideration, surveying and granting of licenses.

Regarding the survey procedure, the team is sent out to the plot which holds the interest of the business in the application. Usually, it is a plot they held in the previous year or a new plot they are interested in. Then, the team conducts the survey and reports the results to the DWIR.

#### 4.4 Licensing and Operations

The requirements for a license include the application for the license and a map showing the plot/s of interest and a survey fee of 30,000 Kyats for the Directorate of Water Resources and Improvements of Rivers and a fee of 500 Kyats per sud allowance to the General Administrative Department. The procedure to obtaining a license is as follows:

1. The business submits the application, the map and the application fee to the GA
2. The GA corresponds with the DWIR to conduct a survey
3. Depending on the survey's results, the DWIR either supports or discourages the GA to give the license.
4. The business is either granted or denied the license.

#### 4.5 Business Operations

The license is renewed yearly. The businesses have to pay taxes to the Municipals for collecting sand on their own properties/sites and a “profit tax” to the Business Association for conducting business.

The sales of a typical sand-mining business varies throughout the year. The end of the rainy season (end of September or beginning of October) signals the beginning of an intensive construction period for the Building Sector. Free from the encumbrance of rain and the high heat which is inevitable in the hot season, the construction businesses consume a large flow and volume of sand and gravel for making cement in their daily operations. The price of sand increases to 7,000-8,000 Kyats or doubles depending on the location of the business. The price of construction sand is often higher than that of fine sand. Sand businesses normally operate yearlong with the exception of the Thingyan Festival, which marks the Burmese New Year during the month of April.

#### 4.6 Sand Mining Locations

Sand consumed by industries in Yangon is mined mostly in Hlaing River, near Ba-Yint-Naung and Warr-Ta-Yar and also near the convergence of the three waterways, namely the Yangon River, Bago River, and Pa-zun-taung Chaung (creek). Although sand mining in the creek was allowed in the past, the GA banned this practice and as a result, land mass has filled the creek and some gravel

businesses are operating on top of this newly filled land. There are no sand-mining in the Pan Hlaing River due to the lack of usable sand. The type of sand preferred by construction companies is coarse sand which has good binding properties with other construction materials.

#### 4.7 Sand Mining and Environmental Impacts

Sand is mined by dredging boats in the Irrawaddy River. When the aggregate particles are too fine to be used, they are rejected by dredging boats, releasing vast dust plumes and changing water turbidity. This can in turn result in major changes to aquatic and riparian habitats over large areas. Reported incidents of landslides and river erosion due to dredging up the Dawei River basin for sand is an example. (Myanmar Business Network, 2014)

For the purpose of this practitioner report, only the main environmental impacts are shown in Table 2.

Medium	Main Impact	Consequences
Air	Increase levels of air pollutants concentration	Human health risks
Flora and	Habitat loss	Alteration of fish population,

Fauna		Increasing level of weed infestation
	Physical disturbance of the habitat	Degradation of aquatic biota, Alter number of animal species
	Vegetation is destroyed	Reduction of farmlands and grazing lands
Water	Increase water turbidity	Reduced light penetration, and oxygen levels that affect aquatic populations, changes in nutrients parameters, increase infections and death risks for aquatic animals.
	Increase soil and coastal erosion	Seawater intrusion Affect infrastructure projects
	Water quality deterioration	Increase water salinity, alternation of water sources, increased water treatment costs
	Deformation of riverbeds and banks	Drying up wells around the river, lateral channels erosion and

		instability, negative effect on groundwater, waterways siltation, influence the uncertainty of slopes and levees
Soil	Decreased soil quality	Increase infertility on otherwise fertile soils due to lowering groundwater levels, changes in soil geochemistry (increase concentration of lead, arsenic, mercury, etc.)
	Soil erosion	Watercourses, wetlands and lakes pollution

Table 2. Main environmental impacts of sand mining (Source: Marius Dan Gavriletea, 2017)

In addition to producing negative environmental consequences on air, flora and fauna, water, soil and land, there are also other social costs associated with sand mining. Mohapatra et al. conducted a study on hazards and health risks encountered by using manual sand dredgers in Udipi, India. They found that most of the workers were unaware of health problems such as hypertension or diabetes mellitus. Majority of their participants (73%) showed bilateral sensory deficit of

hands and varied levels of diminished sensation and trench feet due to prolonged exposure to non-freezing cold water. (Mohapatra et al. 2017)

## **5.0. Limitations**

Due to the short period of the survey conducted over 3 weeks in August 2017, the findings do not capture the entirety of the sand mining sector in Yangon, Myanmar. Some businesses were temporarily closed due to the seasonality effects (construction slows during the rainy months) and some were closed because their production sources were halted by the sudden ban upstream for gravel mining by the DWIR Ayarwaddy Division. Additionally, efforts to seek official documents from the DWIR Yangon division were not successful.

## **6.0 Conclusion and Recommendations**

According to the findings, 8.5 million metric tonnes of sand were distributed in Yangon between 2016 and 2017 as reported by 113 sand mining businesses. Therefore, we can conclude that at least 8.5 million metric tonnes were extracted from the river.

Recognizing the implementation of the impending National Environmental Policy to be released in 2018, this report makes several recommendations for three

stakeholders: DWIR Yangon Division, sand mining businesses, and the locals who live in sand-mining locations.

For DWIR Yangon Division:

- State/Regional Governments should undertake a regional or strategic environment assessment of sand and aggregates mining throughout their State/Region, to determine where and how it may be undertaken sustainably without causing environmental harm, and ensure that arrangements are in place for obtaining revenue from the practice.
- There should be a special unit for monitoring and surveillance and this unit should patrol the sand mining locations either on a weekly or bi-weekly basis and can be called upon as necessary when incidents arise.
- Create an online database where legally registered boats are tracked.
- Have a merit-based system that rewards law-abiding businesses, and/or certification of "sustainable mining".
- On the basis of this assessment, licenses for sand and aggregates extraction should be issued on the basis of a transparent tender process, with clear rules to prevent environmental damage, and effective monitoring and enforcement.

For sand mining businesses:

- Ensure licenses are obtained legally, and have penalties for illegal activity.
- Report accurate information to the DWIR and GA.

- Ensure that the contractor hired for writing an EIA or SIA has a good reputation as some contractors have been reported to provide these documents without careful assessment of the site in place. According to Annex 1 of the EIA Procedure, No.132, the Criteria for Extraction of Rock, Gravel or Sand from a River or Marine Waters should be  $\geq 1,000 \text{ m}^3/\text{a}$  but  $< 50,000 \text{ m}^3/\text{a}$  (for IEE type economic activities) and  $\geq 50,000 \text{ m}^3/\text{a}$  (for EIA type activities).
- Adhere to the regulations provided by the DWIR and GA: have incentives to comply and penalties for non-compliance.
- Report any incidents of riverbed deterioration or water level oddities to the officials.

For Locals:

- Understand the laws and regulations surrounding sand mining and learn about the environmental and social impacts of the practice.
- Participate in workshops given by government officials or organization such as MCRB to promote “sustainable mining” practices.
- Avoid letting children play in sand collection sites without clothes, shoes or supervision: these sites are hazardous. *Educate children about hazards.*

I believe that future studies of sand mining in this region will benefit greatly from extensive interviews with state or local government officials at the beginning of the research. By learning more through collaborations among the stakeholders –

sand miners, regulators, locals and researchers – we can create best practices and promote sustainable mining in Myanmar. This can be a model for other nations in Asia and elsewhere.

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## Appendix A – Surveys Used

### A1: Aggregate Mining Survey

#### DISTRIBUTION SITE QUESTIONS

1. Distribution site information:

General information about the site

State or Region:

Township:

Nearest town or village:

Company name (if there is one):

Name of person interviewed (not required)

GPS point & photos

2. What is being extracted? Stored? Transported?

Category of sediment			Present price per Sud (Gyin)?
Fine sand	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Construction sand	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Gravel	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Pebbles	Yes <input type="checkbox"/>	No <input type="checkbox"/>	

3. If transported, means of transport (barge, large truck, small truck, rail)

4. Where is the material from?

Material	River	Location / State / Township

Fine sand		
Construction sand		
Gravel		
Pebble		

5. Approximate size of storage or extraction site.

6. Number of people working on site?

Number of full time staff	In mining	A distribution center
Less than 3 people		
4 to 10 people /		
More than 11 people		

7. Equipment vehicles operating on site. Take photos if possible

Type of equipment	Extraction method (if known) & number	Distribution sites & number	Comments
Small tractor /light truck			
Large truck			



Limite d oper.												
Intensi ve oper.												

12. Is there a difference in price between months or seasons?
13. What is the most sought after grain size?
14. Is there ever a problem obtaining supply?
15. Estimation of quantities distributed annually from site

	Approximate quantity sold / year
Fine sand	
Construction sand	
Gravel	
Pebbles	

Quantity can be in tons, cubic metres or truck loads (if trucks, get a photo of the standard vehicle)

16. How many other distributors are there in this area?
17. What is the demand trend for each produced category?

Category	Trend
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fine sand	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
coarse sand	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
gravel	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
Pebbles	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>

18. What is the availability trend for each material?

Category	Trend in Availability	Trend in Availability	Trend in Price
Fine sand			
Coarse sand			
Gravel			
Pebble			

19. Changes to supply. Do you receive material from more than 1 extraction site?

Has this changed over time?

Increase in supply sites because of growing demand?

Decrease supply sites because of replenishment rates?

Change in supply sites but no increase or decrease

20. Have you observed an increase in different sizes in gravels or pebbles being supplied?

### **A.2: Extraction Site Survey**

Nature of the extraction:

General information about the site

State or Region:

Township:

Nearest town or village:

Company name (if there is one):

Name of person interviewed (not required)

GPS point & photos

1. What size material is targeted for extraction?
2. Is this led by market demand or availability on site?
3. Are the different categories of materials found at different locations in the site? (emerged islands, beaches, river banks, thresholds, rapids, different depths under water, different places in the river bed)

Category	Location
fine sand	
coarse sand	
gravel	
pebbles	

4. If different categories are available on site: do you specialise in one (or two) grain size(s) only , or will you extract whatever is available?

5. Estimation of quantities produces annually per category
6. Where are the best extraction sites in this area?
7. Is there a competition for the concessions on the best sites?
8. How are concessions distributed?
9. To your knowledge, are there any other active in-stream dredging operations within ten km of this operation?

Yes  No

List any other operations on a separate page

10. How do you identify the sites that will be good for extraction?

Ex: Downstream areas with lateral erosion? Empirically?

11. What is the availability trend for each produced category?

Category	Trend			
fine sand	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
coarse sand	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
gravel	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>
Pebbles	Same every year <input type="checkbox"/>	Increasing <input type="checkbox"/>	Decreasing <input type="checkbox"/>	Don't know <input type="checkbox"/>

12. Are changes to the river occurring? If so where in the river bed are those changes occurring? (emerged islands, beaches, river banks, thresholds, rapids, different depths under water, different places in the river bed)

13. Changes in quantities extracted over time?

a. Increase in extraction/sales because of growing demand?

b. Decrease because of reduced replenishment rates?

c. Other

If other, please describe:

14. Has there been a change in the depth for extraction (need to dredge deeper) and/or islands disappearing or changing shape?

Yes  No

If yes, please describe:

Can you estimate the increase or decrease in depth (50 cm, 1 m, 1,5 m, 2m)

15. Have you observed changes to the size of gravels or pebbles being extracted?

16. Did you observe silt at extraction sites of other categories (fine sand; coarse sand, gravel)

17. Are taxes paid on quantities extracted?