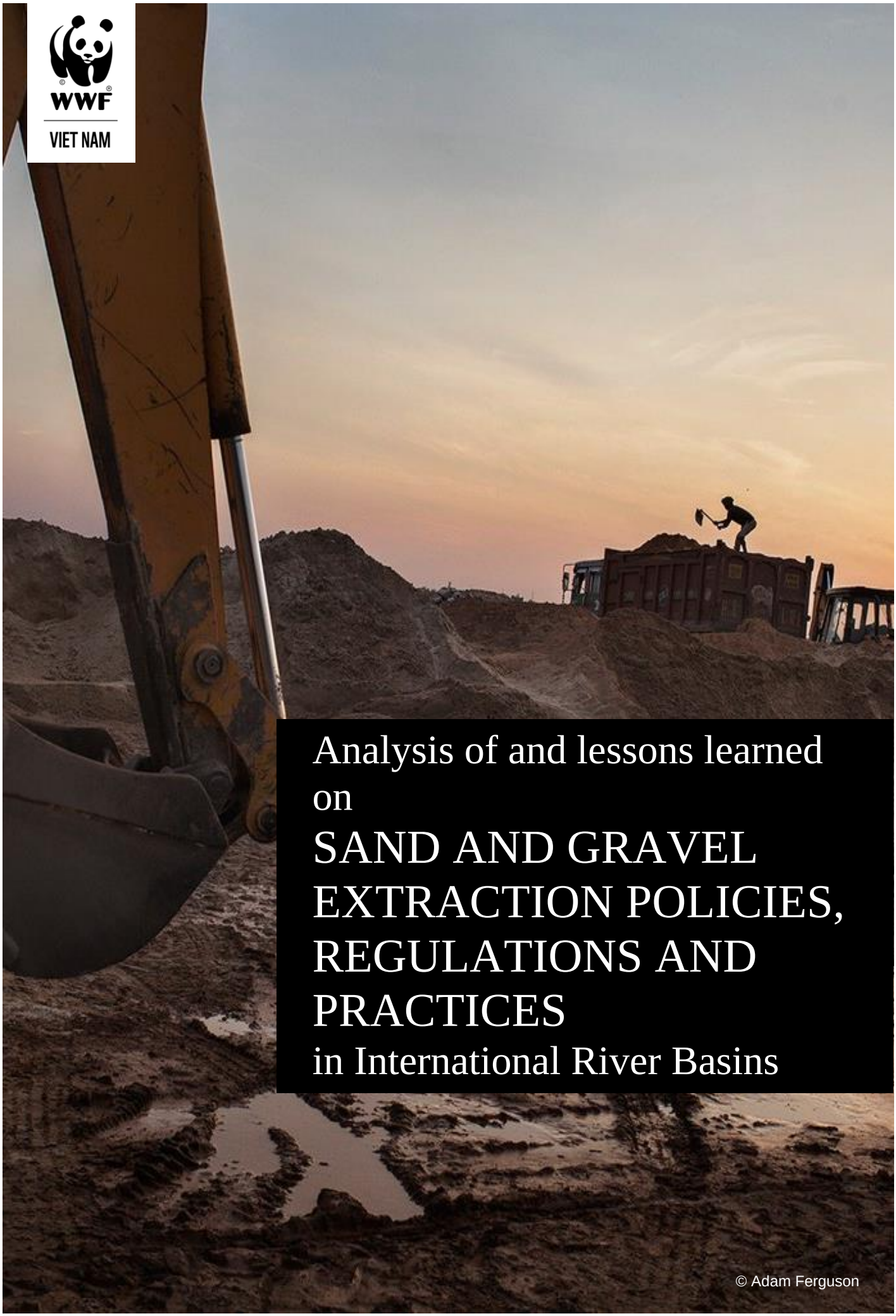
WWF
VIET NAM



Analysis of and lessons learned on

SAND AND GRAVEL EXTRACTION POLICIES, REGULATIONS AND PRACTICES

in International River Basins

Working togther toward sustainable sand mining and management.

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

INTERNATIONAL CLIMATE INITIATIVE

ANALYSIS OF AND LESSONS LEARNED ON SAND AND GRAVEL EXTRACTION POLICIES, REGULATIONS AND PRACTICES IN INTERNATIONAL RIVER BASINS

PROJECT CODE: 40001883/402576

IKI SMP POLICY REVIEW CONSULTANCY

FINAL REPORT FOR WWF VIET NAM

BY

JIM O'BRIEN and PETER J HODDINOTT

as

JIM O'BRIEN CSR CONSULTING

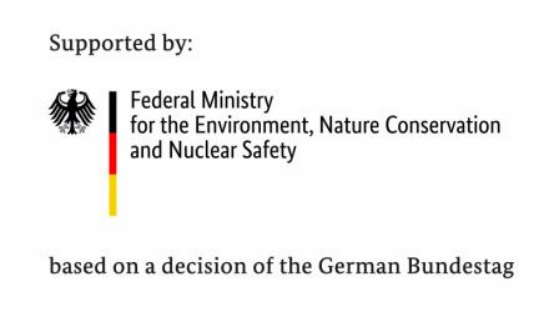
MAY 2021

ACKNOWLEDGEMENTS

The study draws on the extensive real-world experiences of the Global Aggregates Information Network (GAIN™), which has, amongst other key industry topics, recently focused on challenges of river sand extraction globally. Relevant case studies from China, India, Malaysia, Colombia, Mexico, USA, Canada, New Zealand, UK, Netherlands, Myanmar and Japan are presented and provide key insights, these leading to a set of key recommendations proposed for implementation in Viet Nam.

This study was funded by the International Climate Initiative (IKI).

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag.



ABSTRACT

Under the Project *"Drifting Sands: Mitigating the impacts of climate change in the Mekong Delta through public and private sector engagement in the sand industry"* funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) - International Climate Initiative (IKI), WWF Viet Nam appointed Jim O'Brien CSR Consulting to investigate the challenge of over-extraction of sand and gravel in the Viet Nam Mekong Delta (VMD). The Final Report analyses this challenge in the context of global aggregates industry experiences and then makes recommendations as to how the challenge might be better managed in Viet Nam.

These recommendations range from suggested amendments to Viet Nam legislation, to designation of a strongly-empowered single VMD regional authority to implement a rigorous permitting regime, using internationally-proven technical extraction guidelines, backed up by certification of professional operators, comprehensive compliance monitoring and strongly increased royalties, penalties and deterrents. International experiences also indicate the desirability of a project-specific manager or champion to successfully implement these changes, which could also be greatly assisted by a professional national aggregates association and/or a construction industry association.

Recommendations also encourage alternatives to river sand, such as manufactured sand and use of recycled and other secondary materials, which can reduce the river sand demand within the VMD to within its annual sedimentation budget. Commercial incentives to promote this shift can be achieved by using legislation to substantially reduce demand and increase the extraction costs of river sand. The consultants are convinced that implementation of these proposals through a "carrot and stick" approach can lead to a more sustainable extraction and construction industry in the VMD, as well as benefitting its fishermen, farmers, ecosystems and the wider community.

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ACRONYMS

AOD	Above Ordnance Datum
AQA	Aggregates and Quarrying Association
ASGA	Alberta Sand & Gravel Association
ASOGRAVAS	Asociación Colombiana de Productores de Agregados Pétreos
BMAPA	British Marine Aggregate Producers Association
BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CAA	China Aggregates Association
C&D	Construction and Demolition
CDW	Construction and Demolition Waste
CSR	Corporate Social Responsibility
DID	Malaysia Department of Irrigation and Drainage
DWIR	Myanmar Directorate of Water Resources
DoNRE	Department of Natural Resources & Environment
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
EU	European Union
FDI	Foreign Direct Investment
GAD	Myanmar General Administrative Department
GAIN™	Global Aggregates Information Network
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GMS	Canterbury Regional River Gravel Management Strategy
GPS	Global Positioning System
HCMC	Ho Chi Minh City
IFC	International Finance Corporation
INDC	Intended Nationally-Determined Contribution
IKI	International Climate Initiative
JCSA	Japan Crushed Stone Association
LMB	Lower Mekong Basin
MARD	Ministry of Agriculture and Rural Development
MEAI	Mining Engineers' Association of India
MoNRE	Ministry for Natural Resources & Environment
mm, m, km	Millimeters, meters and kilometers
MPA	UK Mineral Products Association
MQA	Malaysia Quarries Association
NEQG	Myanmar National Environmental Quality Guidelines
NGO	Non Governmental Organization
NSSGA	National Stone, Sand & Gravel Association of USA
NWRC	Myanmar National Water Resources Committee
RCA	Recycled Aggregates
SEA	Strategic Environmental Assessment
SMP	Sand Mining Project
t, mt, bnt	Tons, millions, billions of (metric) tons
TCVN	Vietnamese National Standards
ToR	Terms of Reference
UEPG	Union Européenne des Producteurs de Granulats
UMB	Upper Mekong Basin
UNEP	United Nations Environment Programme
UK	United Kingdom

UPME	Colombia Planning Unit of the Mining Ministry
UPTC	Technical University of Colombia
USA	United States of America
USACE	US Army Corps of Engineers
VGBC	Vietnam Green Building Council
VICEM	Vietnam Cement Industry Corporation
VMD	Viet Nam Mekong Delta
VNCA	Viet Nam Cement Association
VND	Viet Nam Dong
VSI	Vertical Shaft Impactors
WWF	World Wildlife Fund for Nature

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1. INTRODUCTION TO THIS STUDY

In response to unsustainable sand and gravel extraction from the Mekong Delta, WWF Viet Nam is undertaking a 4-year project to contribute to better maintaining key ecological functions, reducing socio-economic vulnerability to climate change in the Mekong Delta, and is working with key actors in the public and private sector to develop and propose improved policies and practices in relation to sustainable sand and gravel mining.

As part of this project, a study has been commissioned from Jim O'Brien CSR Consulting to "produce an analysis of, and lessons learned on, sand and gravel extraction/management policies, regulations and practices in international river basins".

"The overall objective is to derive and consolidate, in a structured manner, lessons learned from the review of river aggregates (sand) extraction and management regulations, mechanisms, practices or instruments from major international river basins to help identify proven approaches to, and good examples of, sustainable regulation of coarse aggregates (sand) management and extraction, with the purpose of assessing the applicability or adaptability of the findings to the context of the Viet Nam Mekong Delta (VMD)".

The goal is also to "collect and document best sustainable management/regulatory framework cases and provide with a clear analysis of benefits to the river basins and inter-connected socio-economic nexuses and why these should be relevant for the Vietnamese context".

Based on the above Terms of Reference, this report presents the Consultants' findings as follows:

- **Section 2 Reviews the current challenges and opportunities of sand extraction in the VMD.**
- **Section 3 Provides an overview of global aggregates supply and demand, and then contextualizes these in the context of Viet Nam.**
- **Section 4 Summarizes the twelve international case studies and derives the key learnings. Thereafter, deducing seven key success factors that could be adopted and applied with these international learnings to the situation in Viet Nam.**
- **Section 5 Presents an overview of the relevant legislation in Viet Nam and derives key learnings from Vietnamese legislation and regulation.**
- **Section 6 Goes further in proposing technical alternatives to river sand, particularly manufactured sand and recycled aggregates, and suggests how these opportunities might be developed.**
- **Section 7 Presents the report conclusions and recommendations.**
- **Section 8 Lists the main references supporting the report findings.**

Based on their findings, the consultants are confident that there exists an exciting opportunity to now comprehensively address the challenges of over-extraction in the VMD that can also produce a positive outcome for the region not only in a more sustainable sand supply, but also of achieving greater environmental sustainability with wider social benefit.

Note:
In this report, the generic term "aggregates" includes primary materials like crushed stone produced in hard-rock quarries, and sand and gravel from rivers, the sea and dry pits. It also includes secondary materials such as manufactured and recycled aggregates. The term "sand" is understood to be the fine component of aggregates of generally less than 5mm particle size, though at times also includes coarser gravel. All aggregates are by definition destined for use as construction materials.

2. BACKGROUND ON THE MEKONG DELTA

Figure 1. Map of the Mekong River Basin

The Mekong River flows through six countries: China, Myanmar, Lao PDR, Thailand, Cambodia and Viet Nam. Approximately 70 million people live in the basin: about 60 million in the Lower Mekong Basin (LMB) and the remaining 10 million in the Upper Mekong Basin (UMB).

The Mekong River is the tenth longest river in the world. It originates on the Tibetan plateau and flows through a narrow, deep gorge roughly parallel to the Salween (which also originates on Tibetan plateau, flows through China, Myanmar, and Thailand) and Yangtze Rivers (the third longest river in the world, flows entirely within China), which together is known as the 'Three Rivers Area'. The Mekong River continues through Myanmar, Lao PDR, Thailand and Cambodia before finally draining into the sea creating a large delta in Viet Nam.

Covering an area of ~40,500 km² in 13 provinces, the Vietnamese Mekong Delta (VMD) is home to some 18m people, with a further 9m people living in the adjacent greater Ho Chi Minh City (HCMC).

While the region is undergoing rapid economic growth, the livelihood and food security of most of the Mekong River Basin's population still are directly linked to the Mekong River.

The Mekong is a nutrient-rich sediment river. This is in part a consequence of the river's flood pulse character, whereby at any given period, mainly post-monsoon, large volumes of water are moving through the system along with associated sediments.

The fine materials are rarely deposited but suspended in water and generally carried through the system to the sea. Depending on the flow velocity and discharge of the river, slightly coarser material may end up on flood plains and riverbanks, where it helps farms with natural fertilizer and food for fisheries. Larger particles such as sand and gravel may take decades or longer to be transported and are often temporarily stored in the river channel in sandbanks or on riverbanks. This whole process of natural distribution of these particles have been happening over a long period of time throughout the human history, thus contributing to the river geomorphology and bank stability. Therefore, the less exploitation of natural materials which maintain the balance of inherent state of the river, the more sustainability of creating resilient channels and providing important ecological habitats and navigation routes.

The construction of hydropower dams (see Fig 2) and extraction of sediments (see Fig 3) for a booming construction sector have reportedly reduced sediment transport to the Mekong Delta by about 77% between 1992 (160mt/year) and 2014 (75mt/year), which by extrapolation may now be less than 50mt/year.

These figures are for suspended sediment, mostly silt and clays, and are thus marginally relevant to sand mining. The statistic for sand alone is believed to be of the order of 20-30mt/year pre-1990 and only 3-5mt/year today. Sand demand now greatly exceeds natural supply, and strong measures are urgently needed to alleviate further deterioration of the Delta itself and of local farming, rice production, fishing and biodiversity. It is also reported that the available sand is becoming finer, making it less attractive for use in concrete, probably also requiring higher cement content.

Figure 2. Dams on the Mekong river

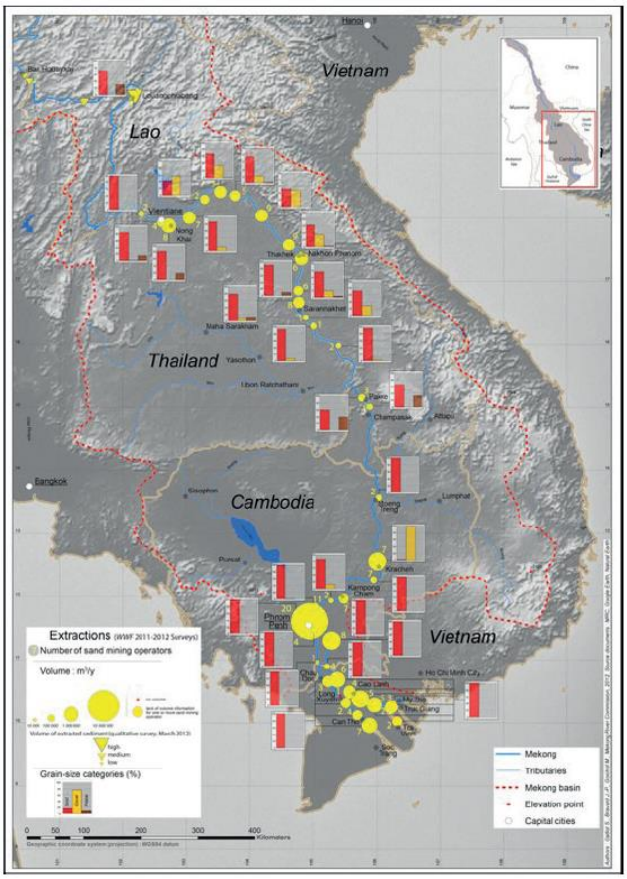


Figure 3. Sand mining locations along the Mekong river

Over-exploitation and its impacts have been analyzed and described in several publications in recent years as listed in references 1 to 14. These studies report both specifically on the sand deficits in the Mekong Delta[1,4,8,11], as well as the negative impacts on ecosystems, biodiversity, agricultural productivity, navigation and local communities[2,3,5,8,9,14]. Within Viet Nam, public and press awareness of unsustainable river sand mining practices are rising sharply[19], arguably providing a social foundation for legislative and enforcement change.

Such impacts are by no means limited to the Mekong Delta. For example, Koehnken et al[12] carried out a Quick Scoping Review of 505 international publications (75% from the previous 5 years) on the impacts of riverine sand mining on freshwater ecosystems worldwide, identifying 107 different impacts. These were broadly divided between changes to the channel morphology, alterations to the composition and movement of sediment, changes to larger scale river features, alterations to the flow regime, and impacts on water quality.

The paper concluded that "*the most prevalent impacts were changes to channel morphology, with channel incision most common. Contrasting impacts were reported from different systems reflecting the site-specific nature of impacts, including channel widening and narrowing, reductions or increases in sediment transport (due to exposure and transport of fine sediment during mining and changed channel hydraulics), flow increases or decreases, and increased or decreased flood control.*"

3. SETTING THE SCENE – AGGREGATES SUPPLY AND DEMAND

3.1. Aggregates supply globally

	Crushed Stone	Sand & Gravel	Recycled	Total
China & NE Asia	14717	6239	71	21027
India Continent	2733	4443	25	7202
Europe	2021	1756	431	4208
Continent	1725	1412	88	3225
North America	1198	1827	0	3026
Africa	1090	1537	0	2627
South-East Asia	750	650	0	1400
Middle East	560	636	10	1207
South America	237	240	12	488
Oceania	179	179	0	357
Central Asia	53	79	0	132
Central America	47	70	0	117
Caribbean				
Totals	25309	19068	637	45014

Figure 4. GAIN estimates of global aggregates production (mt) by region in 2019[(129)]

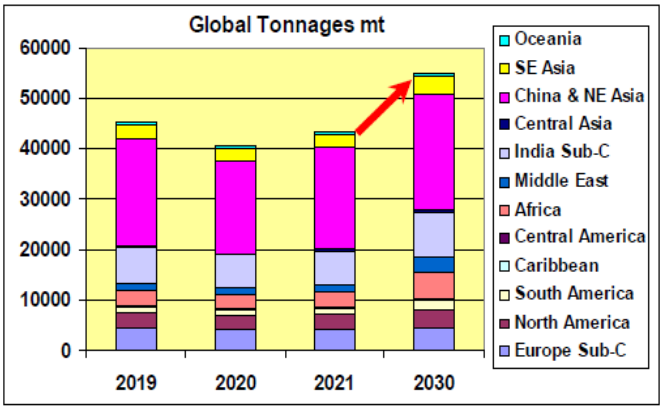


Figure 5. GAIN estimates of global aggregates growth in mt to 2030

Global 2019 aggregates production (as built up from data from GAIN members) is estimated at 45 billion (metric) tons (bnt) (Fig 4). While there was only a 10% decline in 2020, recovery is expected in most regions (particularly in Asia) in 2021, with steady growth anticipated out to 2030 (Fig 5). The aggregates industry has proven itself surprisingly resilient through the COVID-19 pandemic.

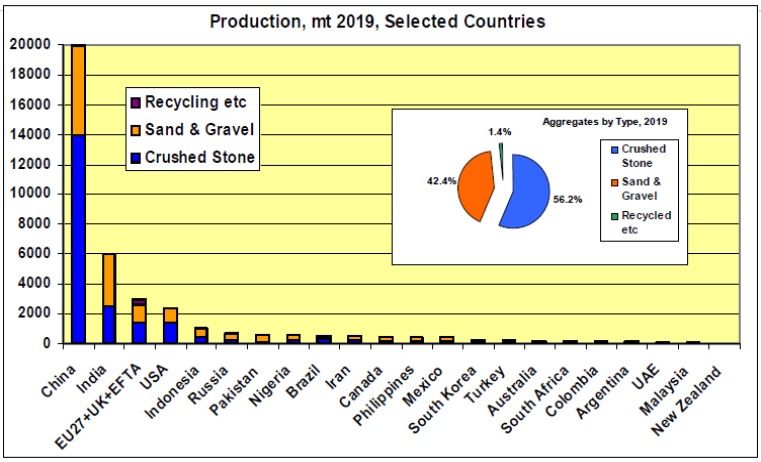


Figure 6. Production by country in 2019

Fig 6. The graph shows the 2019 production by country, led by China at 20bnt, then India, European Union (including EU27+UK+EFTA) and the USA.

The inset pie chart shows the split by type, 56% crushed stone and 42% sand & gravel with the balance of ~2% comprising recycled and other types of aggregates (although these latter are probably under-reported).

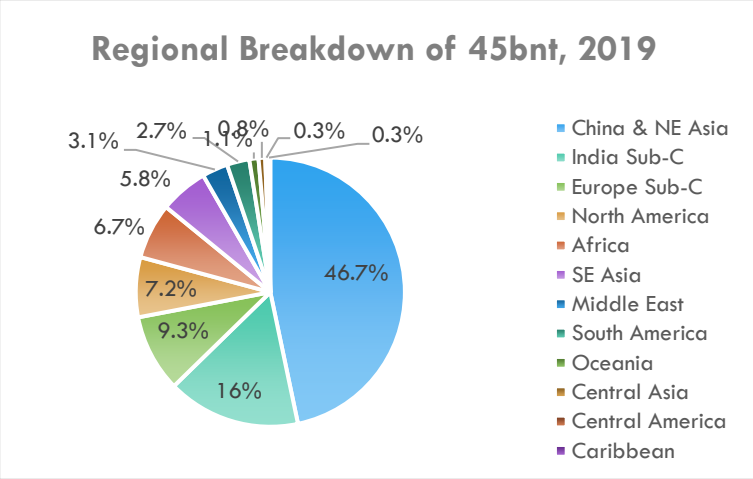


Fig 7. The pie-chart at left shows the regional breakdown, led by China at 47%, followed by India at 16%. Vietnam is included within the SE Asia group.

Asia, including China and India, produces over two-thirds of global aggregates, and that also is the highest-growth region.

Figure 7. Regional breakdown

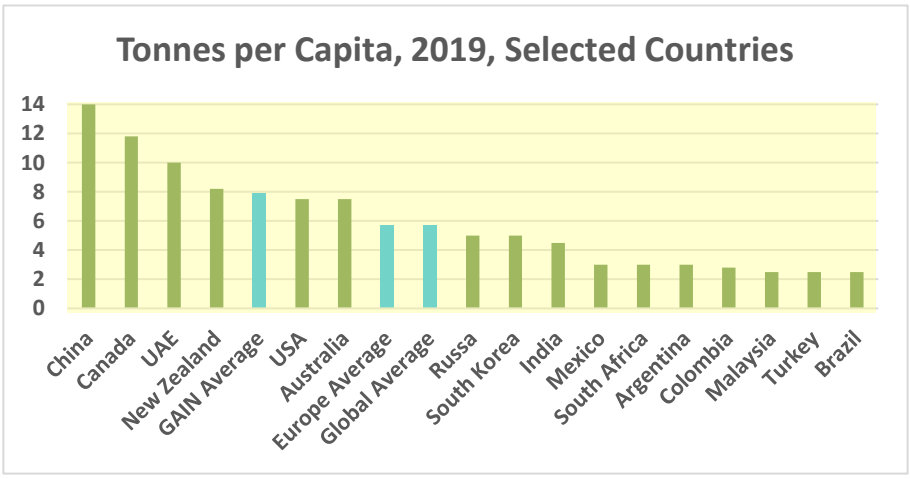


Fig 8. The graph shows the production of aggregates by tons per capita (t/c).

China leads at 14t/c, with the global average at just under 6t/c.

Developing regions typically produce only ~3t/c, with Viet Nam estimated at 4t/c because of its strong economic growth.

Figure 8. Aggregates per tons per capita

The aggregates sector is, by far, the largest global extractive industry. Aggregates are high volume, low-value commodities (typically $6-12/t ex quarry, but prices can spike when supply is limited), usually based on the available material extractable from local deposits. The global annual turnover of the aggregates industry is estimated at about $350bn/year, similar to that of cement.

Transport of aggregates to market (most often by truck) is the largest logistics business on the planet, and transport costs to the customer can often be close to or even exceed the ex-quarry price. However, within Asia in particular, there is considerable transport by ship/barge, driven by low production costs and high market prices, for example in Singapore and parts of China.

Consumption end uses of aggregates vary significantly by country and its specific developmental and construction needs. As a rough estimate, the following global ranges of applications can apply:

Table 1 Consumption end uses of aggregates by country and its developmental and construction needs

Estimated breakdown of global aggregates applications:	Estimated range as bnt/y	Estimated range as %
Concrete	≈20-25	≈45-55%
➢ Ready mixed plus site mixed	9-11	
➢ Other concrete products, including precast and architectural	5-6	

➢ Informal site and hand-mixed including block-making	6-8	
Cement-bound and unbound materials for road base, foundations and fill materials	15-16	30-36%
Asphalt mixes for roads	2-3	5-8%
Railway ballast	1-2	1.5-2.5%
Armor rock and other miscellaneous	≈1	≈2%
Total	**≈45btn/y**	**100%**

Of the global aggregates production of 45bnt, it is estimated that 25-30%, as used in concrete and as fill material, will be sand (generally defined as being less than 5mm grain size). This works out at about 12bnt of sand produced globally per year that figure including sand mined from rivers, dry pits and manufactured sand. While no precise figures exist, best guesstimates for annual global production would be 4bnt of river sand, 6bnt of land-based sand and 2bnt of manufactured sand.

Environmental pressures on sand and gravel operations have led to crushed rock and recycled aggregates taking growing market shares. In particular, permitted natural sand is becoming increasingly scarce and restricted (especially in Europe), which has led to higher prices for natural sand and specifiers are now more prepared to accept manufactured sand (produced from crushed rock fines) and recycled aggregates (produced from sorted and treated construction and demolition materials).

3.2. Aggregates supply and demand in Viet Nam

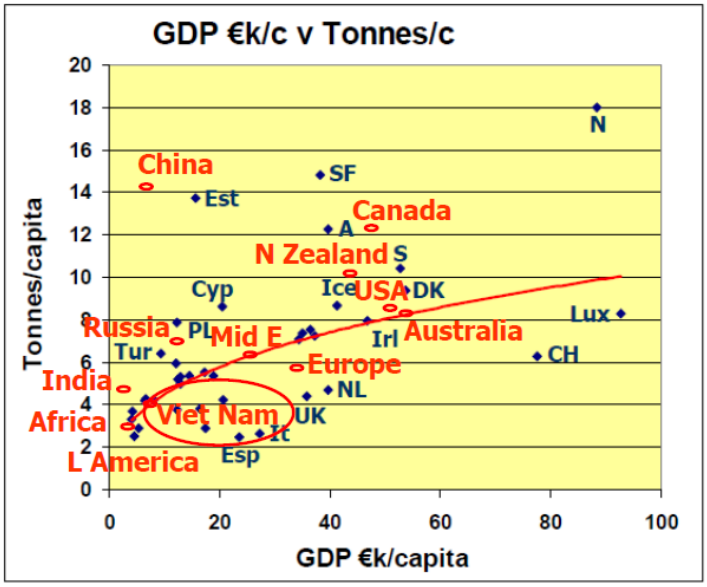


Fig 9. Diagram showing the 2019 statistical link between GDP/capita and aggregates demand in tons/capita, demonstrating that the consumption of aggregates per capita grows as an economy grows.

The data points marked in blue represent the European countries (UEPG data), while those in red are the international comparisons (GAIN data). This data also points to the Viet Nam demand being about 4 tons/capita.

Figure 9. Statistical link between GDP/capita and aggregates *demand in tons/capita*

In the absence of published data, the 2019 aggregate consumption in Viet Nam (based on its GDP of over €3k/capita) is interpolated at approximately 4t/c, including sand, gravel and crushed rock. For a population of 96m, this translates to a national aggregates demand of approaching 400mt/year. Within that figure, national sand demand is likely over 100mt/year.

As a crosscheck, pro-rating (by a factor of 8) from national cement production (excluding exports), also yields a similar estimated annual aggregates production for Viet Nam of at least 400mt/year. Put in context, the Viet Nam aggregates demand of 400mt/year is actually some 4-5 times that of the raw materials demand for its national cement industry.

Furthermore, aggregates demand in Viet Nam is likely to grow significantly during this decade, driven by economic development, urbanisation, and population growth and possibly by a need to create defences against rising sea levels.

Looking at the Mekong Delta region, covering an area of about 40,500 km^2 in 12 provinces and 1 city under the central government, is home to some 18m people, with a further 9m people living in the adjacent greater Ho Chi Minh City (HCMC). That population would indicate an aggregates demand of some 100mt/year, of which 30mt/year would be sand, mainly river sand. Accordingly, it appears that demand now greatly exceeds supply and hence the increasing damage due to over-extraction to the Delta infrastructure.

The resultant loss of riverbed geomorphological stability and lack of material causing bank erosion, channel incision and depressed water levels in the main channels which are said to have dropped by more than a meter between 1998 and 2008, allowing salt seawater to flood rice paddies, affecting riverbank stability and; impacting both rice and fishing productivity.

According to WWF data, the potential socioeconomic effects of this are huge, since about 70 per cent of the basin's population relies on agriculture for its livelihood. The Mekong Delta is one of the most productive regions in the world. It is often referred to as Viet Nam's 'rice bowl' as it produces more than 16 million tons of rice annually for domestic consumption and export.

Therefore, the over-extraction of sand from the Mekong Delta requires urgent action.

4. EXPERIENCES IN RESPONSIBLE RIVER EXTRACTION INTERNATIONALLY

During 2020, GAIN members had addressed the common aggregates industry challenge of irresponsible river sand extraction. As a tangible result, directly relevant to this assignment, ten GAIN relevant case studies have been documented in the following regions:

- In Asia: China, India and Malaysia.
- In Latin America: Colombia and Mexico.
- In North America: USA and Canada.
- In Oceania: New Zealand.
- In Europe: UK and Netherlands.

In addition, two further case studies were assessed, albeit without GAIN verification, as the rivers were mentioned in the Terms of Reference for this study:

- In Asia: Myanmar and Japan.

Below is a summary of the twelve case studies, which are fully described in the Annexes: ín each case, the good practices and pitfalls are identified, which provide constructive suggestions for improvement for the challenging situation in the VMD.

4.1. China [45-52]

4.1.1. Overview

As described in Annex 1, according to information from the China Aggregates Association (CAA), river extraction still supplies some 30% of the national aggregates demand of 20bnt/year. Driven by the national ambition towards greater sustainability, illegal/irresponsible sand mining is now being strongly curtailed in China, with an initial focus on the key rivers and provinces. This initiative is also being driven by the need to maintain the stability and navigability of its rivers and flood control.

Under the Supreme Law, the legal basis for sand mining had long been established in China, though implementation of regulations had been intermittent due to the burgeoning construction demand for aggregates. In 2017, the Hebei Provincial Quality and Technical Supervision Bureau and Hebei Provincial Water Resources Department jointly issued *"Technical Specification for the Safe Production of River Sand Mining (DB13/T 2549-2017)"*, 2017. This provides very detailed technical best practice guidelines for river extraction, now being adopted in other provinces.

In 2019, the Ministry of Water Resources issued "*The River Sand Mining Management Regulations".* In 2020, the Ministry followed with *"The Yangtze River Protection Law of the People's Republic of China",* and then *"The Management Plan for Sand Excavation in Important Sections of the Yellow River Basin (2020-2025)".* In parallel in 2020 it issued the *"Five Principles of River Sand Mining Management Regulations in Jiangxi Province".*

China still relies on importation of sand to meet the ongoing demands of its construction industry, and is now imposing requirements to demonstrate responsible sourcing.

4.1.2. The key learnings

4.1.2.1. Good practices

- Ownership: River sand and gravel resources are vested at National/Federal level.
- Guiding legislation: Both Environmental and Water Legislation are backed up by specific Sand Mining Regulations.
- Permit conditions: Permits include requirements on the time, area, volume, mining depth, operating method, mining equipment, qualifications of technical personnel and other aspects.
- Legal conditions in licensing procedures: Licenses are approved by a single central government authority.
- Individual responsibility: For each river basin, a river chief is designated, who is responsible for organizing and leading the management and protection of the corresponding rivers and lakes.
- Compliance: Video monitoring, GPS positioning and sounding systems, are reinforced with daily supervision and inspection by enforcement teams with news coverage and social media, with a public reporting system for any illegal sand mining in river channels.
- Sanctions: Legal process has been clarified for prosecuting those responsible for illegal sand mining activities with imposition of fines and prison sentences of up to seven years.
- Technical requirements:

    - *No mining operations may be carried out during thunderstorms, fog and high winds;*
    - *No-extraction areas include: River flood control works, river remediation projects: drainage and drainage work; reservoir hubs; hydrological observation facilities and culverts; railways; highways; bridges; gas pipelines; communication cables, transmission lines and their ancillary facilities;*
    - *There is prohibition of any oil discharge by equipment or sewage effluent into the waterway.*
    - *In mining, no slopes are to be >1:3, maximum mining depth to be <8m, it is required to work both sides of the river simultaneously to avoid differential impacts;*

- *There are specific constraints on selection and approval of mining equipment, with certification required for dredgers.*

- Safety: Dedicated on-site safety manager and technically safe equipment to be used.
- Other sand sources: Sand can be imported from responsible international sources to fulfill demand needs.
- There is a professional and active aggregates association for responsible operators.

4.1.2.2. Pitfalls

- Past relaxations of permitting and compliance requirements when sand shortages threatened the schedule for important construction projects; this inconsistency undermined the strength of measures and disincentives.
- Continuing relatively low criminal costs and loopholes in the sanction regime in unregulated rivers.
- Historic poor implementation of relatively good legislation.

4.2. India [53-72]

4.2.1. Overview

As described in Annex 2, India has long sought to regulate illegal sand extraction. Part of that challenge arose as sand and aggregates were deemed to be a "Minor Mineral" under the "*Mines and Minerals (Development and Regulations) Act of 1957, Section 3(e)"*, thus delegating its control from federal to state level.

In 2004, the State of Andhra Pradesh issued its *"Water, Land and Trees Rules",* which still define the key technical guidelines for sand extraction. In 2016, the Ministry of Environment, Forest and Climate Change developed the *"Sustainable Sand Mining Management Guidelines 2016"*. In 2017, the Ministry of Water Resources produced the *"Draft Policy on Sediment Management"* in the context of River Development and Ganja Rejuvenation.

There followed the "*Sand Mining Framework"* from the Ministry of Mines in 2018, which notably resulted from a consultation process involving fourteen States and therefore brought consensus on a plan of action. In 2020, the Ministry of Environment, Forest and Climate Change produced the *"Enforcement and Monitoring Guidelines for Sand Mining"*, determined to tackle the continuing high level of illegal extraction, which being controlled by mafia-type groups, resulting in exceedingly high market prices for sand.

The first real success in tackling illegal extraction came in the State of Telangana, championed by its Director of Mines and Geology, supported by the Mining Engineers' Association of India (MEAI). The various regulations were applied with determination to phase out illegal extraction, where illegal extraction is now severely punished through fines and even confiscation of loads and trucks. In parallel, the strategy was to replace natural sand by manufactured sands ("M-sand"), produced through crushing quarry fines. This initiative has been very successful, where now 45% of sand used in the State is manufactured sand. A similar program is being now adopted in other States. Thus this success in the State of Telangana represents an excellent case study.

4.2.2. The key learnings

4.2.2.1. Good practices

- Democracy: Essential to achieving success was a dialogue between States in recognizing scale of challenge and in arriving at consensus on implementation.
- Role of the leader: The State of Telangana was first to successfully regularize rigorous permitting, led by the State Director of Mines and Geology acting as project manager, cooperating with other State agencies.
- Guiding legislation: Both Environmental and Water Legislation are backed up by specific Sand Mining Regulations, with a strong focus on sediment management incorporating: (i) knowledge and management of sediments at the basin scale and (ii) a wider application of available scientific knowledge.
- Commercial impact of enforcement of legislation: The imposition of regulations resulted in supply shortages in certain States, and had resulted in very high sand prices. This provided the financial incentive/justification for investment in alternative sand solutions, such as manufactured sand using Vertical Shaft Impactor technology, supported by incentives. In turn, this alternative improved supply and market prices fell, while regulatory enforcement was facilitated through having fewer fixed point quarries to monitor.
- Auctioning blocks for extraction: Use of auctioning has multiple desirable effects: increasing the cost of extraction; ensuring only professional lessees receive permits and raising finance to fund the activities of regulators, monitoring and enforcement.
- Permit conditions: Permits include requirements on the time, area, volume, mining depth, operating method, mining equipment, qualifications of technical personnel and other aspects.

Pre-requisites for sand mining operation included regular monitoring of mined minerals and that their transportation and storage must be ensured and all information shall be captured at centralized database for easy tracking of illegal material.

- Compliance: Use of IT-enabled services and latest technologies including drones for surveillance of the sand mining together with video monitoring, using GPS positioning of vessels, reinforced with daily supervision and inspection with a public reporting system for any illegal sand mining in river channels. Illegal activities are policed by mobile squads.
- Sanctions: Legal process has been clarified for prosecuting those responsible for illegal sand mining activities with imposition of fines, confiscation and prison sentences of up to seven years.
- Technical requirements:

  - No extractive operations within 500m of any existing structure such as bridges, dams, weirs or any other cross drainage structure, or within 500m of any ground water extraction structures or where the thickness of sand is <2m.
  - Maximum extraction thickness = 2m, but only where the thickness of sand is > 8m. Extraction to be <1m where the thickness is > 3m and <8m.
  - Sand quarrying shall not be permitted within 15 meters or 1/5 of the width of the stream bed from the bank whichever is the greater.
  - The sand quarrying shall be restricted to depths above the water table recorded during monsoon and in no case affect the water table.
  - In one state, there is a total prohibition against river dredging, apart from dam areas where sand and sediment have built up.
  - The quantity of sand deposited annually is monitored by establishing observation stations along the stream course.
  - No mining operations to be carried out during the monsoon season or in periods of heavy rain.
  - No-extraction areas include: River flood control works, river remediation projects: drainage and drainage work; reservoir hubs; hydrological observation facilities and culverts; railways; highways; bridges; gas pipelines; communication cables, transmission lines and their ancillary facilities.
  - Prohibition of any oil discharge by equipment or sewage effluent into the waterway.
  - No slopes >1:3; maximum mining depth <8m; working both sides of the river simultaneously to avoid differential impacts.
  - Specific constraints on selection and approval of mining equipment, with certification required for dredgers.

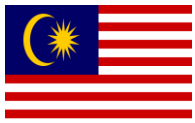
- Other sand sources: Specific measures to reduce/manage demand and supply gaps. Promotion of manufactured sand, artificial sand and alternative technologies in construction materials and processes were also required for reducing the dependence and demand on naturally occurring sand and gravel.

4.2.2.2. Pitfalls

- In legislation dating from 1957, sand was deemed to be a “Minor Mineral” and so was relegated to State rather than federal control.
- Good sand extraction guidelines stemmed from 2004, but were generally not applied. Various sand extraction guidelines were issued in 2016, 2017 and 2018 but were not successfully implemented until 2020. Mis-starts had resulted in patchy/poor historic implementation of relatively good legislation/guidelines, and these failed predominantly because of vested interests and insufficient power/resources and political will to implement these at State level
- Illegal extraction plus strong sand demand had led to very high sand prices.
- Damage to water table and scarce supplies remains an additional driver of change.
- Continuing relatively low criminal costs and loopholes in the sanction regime. Despite arrests and fines for first and second offences ranging up to Rs100k (€13k), with power to seize loads and trucks after a third offence, there were almost 5,000 offences recorded in a single State in

just one year (2018/19); this level of infringement suggesting that the penalties are too modest and an insufficient deterrent.

4.3. Malaysia [73-82]



4.3.1. Overview

As described in Annex 3, river extraction is an important source of aggregates in Malaysia. The Natural Minerals Policy dates from 2009, though aggregates in general were not deemed as minerals. In parallel, also in 2009, the Ministry of Natural Resources and Environment developed the *"River Sand Mining Management Guideline"*.

Quite uniquely, it covered in detail the calculation of sediment transport in rivers, the impacts of mining on channel stability, and went on to determine appropriate extraction methods and suitable sites. It also had detailed monitoring requirements covering sand replenishment, geomorphology and hydrology, as well as detailed advice on riparian habitats. However it appears that these good guidelines were often not applied in practice, again because of lack of political power and determination at state or regional level.

In 2020, in a move to regularize sand mining, new *"Guidelines for Mining and Processing Sungai Sand"* were developed on a cooperative basis by the Peninsular States of Kedah, Perak, Selangor, Pahang and Kelantan. Permitting is delegated to the relevant Department of Irrigation and Drainage (DID) in the District Land Office or State Director of Lands and Mines or State Economic Planning Unit.

In Selangor, in the Kuala Lumpur region, there is a particularly good example of responsible river extraction by the State-owned company, Kumpulan Semesta Sdn Bhd, which is the subject of this case study. The extraction provides positive effects on maintaining river flow and reducing flooding through providing reservoir storage. Activity of a few irresponsible operators has been curtailed through close monitoring of activity and transport vehicles using GPS tracing. This project has gained international recognition, and provides an excellent case study.

4.3.2. The key learnings

4.3.2.1. Good practices

- In response to widespread illegal extraction, detailed sand mining regulations were developed in 2009, but were then of limited effectiveness.
- In 2020, new guidelines were established by cooperative states in the peninsular region, agreeing good practice operating procedures.
- These included detailed requirements on excavation depth, placing of stockpiles back from river bank and also on dry excavation on floodplains.
- Sand budgets are required at 50m intervals, extraction by various means in middle third of river only, stockpiles at lease 20m from banks, sediment washout ponds to prevent leakage back into river, also floating barriers in case of oil leakage, with rehabilitation of work areas required post-extraction.
- This was complemented by close tracking of any illegal activity, with 200 dedicated staff, achieving a very high level of compliance.
- Recognition that river sand mining cause severe environmental degradation, but equally that sustainable extraction of sand and gravel from rivers can bring social, environmental and economic benefits.

4.3.2.2. Pitfalls

- In legislation emanating from 1994 and 2009, aggregates and sand were not defined as a mineral, hence were essentially unregulated.
- Alleged past and possibly some ongoing poor practices in river/beach sand excavation and export from more remote provinces, despite legislative curbs.

4.4. Colombia [83-84]

4.4.1. Overview

As described in Annex 4, river-dredged sand and gravel comprises 40% of the national aggregates production of 150mt/year, and up to 90% in some regions. This is because most mountain areas are designated as nature parks, making it almost impossible to open a new hard-rock quarry. Hence rivers are the key source of sand and aggregates, though past poor industry reputation also made it difficult to get river extraction permits.

Accordingly, the national aggregates association, ASOGRAVAS, is now playing a key role in ensuring that the industry extracts responsibly, through extensive liaison with regional authorities, NGOs and local family operators, all of these being important wider stakeholders. A major step forward was the preparation in 2015 of the national Technical and Environmental Guidelines for Responsible River Extraction (in Spanish, "*Instrumento Técnico-Ambiental de Procedimientos y Técnicas Necesarias para el Desarrollo Apropriado de la Extracción de Materiales de Arrastre*"). This was a cooperative exercise between UPME (the Planning Unit of the Mining Ministry) and UPTC (the Technical University of Colombia), and the subject of this case study.

A very detailed permitting process has been developed. Remote monitoring of extraction activities is being introduced, including use of drones, to support those in responsible extraction and to identify any operating irresponsibly. There has been strong support from the authorities, which benefit from taxation, and it has also enhanced the reputation of the responsible extraction industry.

In parallel, ASOGRAVAS has successfully launched a scheme to demonstrate responsible sourcing of aggregates, named *"Compra Formal, Construye Legal!" ("Buy responsibly, Construct Legally").*

4.4.2. The key learnings

4.4.2.1. Good practices

- Existence of a responsible professional aggregates association rising to the challenge of widespread irresponsible river extraction.
- It launched a unique cooperative effort towards responsible river mining between mining authorities and technical university.
- The initiative was driven by increased difficulty for responsible operators in getting permits due to environmental objections because of industry malpractice.
- Consultation was based on six key rivers, including the related municipal authorities, regional NGOs and artisanal miners.
- Very detailed guidelines were agreed based on both mining and environmental legislation, including sediment calculation, legal aspects of permitting and environmental risk evaluation.
- Guidelines included mining sensitivity indicators for river extraction in each river, including its hydrogeology, hydro-sedimentology, hydrogeology.
- These also include seasonal and climate evaluations, such as El Niño and la Niña periods, as well as risk management assessment for flood prevention and infrastructure damage.
- River reclamation and restoration are required as part of mining closure.
- The necessary strong enforcement comes from many directions, which may even include the army and police in addition to local government and federal mining and environmental authorities.
- Strong mechanisms are in place to deter any ongoing illegal operations, including use of sophisticated monitoring systems like satellite and drone imaging complemented with in site studies and evaluations.
- Strong support is received from government authorities as the regularization of extraction increasing their tax returns; safety authorities benefit similarly.

- Process was complemented by their highly successful *"buy responsibly, construct legally"* campaign, involving the construction industry, driven by their wishes to construct with higher quality aggregates.

4.4.2.2. Pitfalls

- A challenge to progress is that there are some operators of sites where extraction is permitted, but they can still operate irresponsibly.
- There is also continuing infringement of other laws, such as payment of taxes.
- Extending the campaign nationwide is a slow process, but is ongoing and is being pursued with determination.

4.5. Mexico [85-86]

4.5.1. Overview

As described in Annex 5, there has been widespread illegal extraction from rivers and beaches in the Baja California region, driven by lucrative exports into the USA. Regulation has been very weak to non-existent. The Mining Law of 1992, derived from the Constitution, effectively exempted aggregates for construction, while the 1992 Law of National Waters sought to establish a statutory basis for federal regulation of sand mining in riverbeds, this did not materialize in practice.

The illegal activity had become so aggressive that Mexican federal, state, and local officials responded sharply in 2005 and exports were temporarily halted, however that situation has now again reversed. The extraction and use of sand was defined and permitted by local authorities, rather than by federal oversight. As a consequence, discrete geographies had different rules, enforcement practices and ethics, meaning that coordinated productive discussions towards a coherent national strategy on sand extraction will require inputs from all the entities involved.

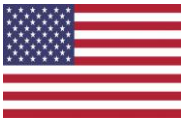
In a concerted new initiative, enforcement is now being pursued through the 2020 reform of the Law on National Waters, (*"Ley de Aguas Nacionales"*) and the 2021 reform of the General Law on Ecological Conservation and Protection of the Environment (*"Ley General del Equilibrio Ecológico y la Protección del Medioambiente"*). Environmental legislation applied from a federal level, supported by regional authorities, is now clearly being considered a more powerful approach towards compliance than through localized application of mining legislation.

4.5.2. The key learnings

4.5.2.1. Good Practices

- A coherent set of federal legislation and central permitting of extraction are required to ensure consistent application and implementation.
- The Mining Law of 1992 exempted aggregates, but were included under the Natural Waters Law of 1992. Attempts were made in 2005 to curb illegal extraction, but met with only limited success, since lost.
- The sufficient political will and a champion to now curb illegal extraction is still an unknown variable.

4.6. USA [87-94]



4.6.1. Overview

As described in Annex 6, in the USA, most sand and gravel is excavated on land, with probably less than 2% coming from larger rivers, such as the Ohio and Mississippi. Obtaining sand and gravel by dredging waters or even near water (this includes wetlands as well) requires a very lengthy and detailed permitting process that considers environmental impacts to waters, endangered species and other issues.

Like a lot of environmental issues in the US, river sand extraction is prescriptively regulated to the particular situation, rather than utilizing a general code of good practice. The US Army Corps of Engineers' (USACE) Regulatory Program covers both extraction and discharges of dredged or fill material into waters of the United States and building structures or work in navigable waters of the United States, evaluated under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

The Clean Water Act imposes very high penalties, is strongly enforced and has a very serious citizen suit aspect. Accordingly, illegal river extraction is virtually non-existent, in itself constituting a successful case study.

4.6.2. The key learnings

4.6.2.1. Good Practices:

- River aggregates mining is allowed only under very closely permitted terms, and must be justified in terms of flood controls and river navigability.
- There are no general best practice guidelines, with permit conditions being at the discretion of the USACE, acting as a central authority and operating with a comprehensive portfolio of environmental and water resources based legislation.
- Environmental legislation (including water, protected species) has consequently effectively closed off river aggregates mining in the USA, with citizens empowered to litigate for damage or pollution caused.
- An active responsible national aggregates association has had to defend the industry against excessive laws even though mining operators can provide evidence to show that river sand mining is sustainable.
- There is a longer term general industry trend away from natural sand (also from dry pits) towards producing manufactured sands in hard-rock quarries, the latter viewed by regulators as more sustainable.

4.6.2.2. Pitfalls:

- Possibly the rules are over-restrictive in some cases disallowing what could be sustainable river extraction.

4.7. Canada [95-97]

4.7.1. Overview

As described in Annex 7, river sand extraction has been traditional in Canada since the 1970s, particularly in the Province of Alberta, there providing some 40% of local aggregates demand. However, because of its increasing environmental impact, since 2010, a moratorium had been effectively imposed, through publication of the *"Alberta Surface Waterbody Aggregates Policy, Background, Context and Future Work, Government of Alberta, November 2010".*

The result is that river extraction is now only permitted with extensive hydraulic and hydro-geological surveys, and is not allowed in the active river channel, though with some debate on the definition of non-active areas. Because of that debate, a detailed *"Alberta Draft Guide for Assessing Risk for Pits in the 1:100 Year Floodplain",* November 2020, is being discussed with the Alberta Sand & Gravel Association (ASGA) in cooperation with the authorities and other stakeholders. There is recognition that well-planed river extraction can provide flood protection and support river ecology.

4.7.2. The key learnings

4.7.2.1. Good practices

- Alberta is unique in Canada, where some 40% of Provincial production is river dredged; river sand mining there is very tightly controlled.
- There is a presumption against river extraction, which is now permitted only with prior extensive hydraulic and hydro-geological surveys.
- Operators must lodge a reclamation bond to ensure responsible extraction and restoration of the permitted site.
- Extraction is not allowed in the active river channel, and there is some debate on the definition of non-active areas.
- Prohibition on surface material extraction in active channels of a surface water body.
- Allows extraction in non-active areas of a surface water body (including floodplains), where risks of the activity can be identified and mitigated.
- Establishes a decision-making framework using a risk-based approach.
- Current discussion is under what conditions dry extraction from floodplains can be allowed, though with a recognition the positive impact on flood management.
- There is a major focus on aquatic species and habitats and riparian terrestrial habitats.

4.7.2.2. Pitfalls

- Is the regime over-restrictive in ruling out what can be sustainable extraction?

4.8. New Zealand [98-100]

4.8.1. Overview

As described in Annex 8, The Aggregates and Quarrying Association (AQA) has an excellent example of responsible river extraction around Canterbury in the South Island, where river extraction represented 30-40% of the local supply. The "*Canterbury River Gravel Extraction Code of Practice 2017"* is an exemplary case study of best practice in river extraction. It sets out guidelines for managing the physical extraction of gravel from regional riverbeds. Development of the Code was a recommendation in the Canterbury Regional River Gravel Management Strategy (GMS) pursuant to the Local Government Act 2002 and adopted by the Council of Environment Canterbury in 2012.

The local quarrying industry has now also developed a voluntary "*Code of Good Practice 2019"* for all extraction activities in the Greater Christchurch region. The development of a Code of Practice provides a framework for responsible management and industry good practice with full stakeholder visibility, which is now implemented throughout the region.

4.8.2. The key learnings

4.8.2.1. Good Practices

- Existence and positive influence of a responsible national aggregates association.
- The case study achieves the overall objective for sustainable gravel extraction for flood management and erosion control purposes, while protecting and enhancing environmental, cultural, social and economic values.
- Recognition that poorly-managed river mining cause severe environmental degradation, but equally that intelligent extraction of sand and gravel from rivers can also bring social, environmental and economic benefits.
- Stems from the Local Government Act applied to regional councils, delegated regionally, with highly specific local permitting.
- Additional compliance control comes from public scrutiny and reporting of any malpractice.
- Technical requirements:

    - Vehicles and machinery are prohibited from entering flowing water;
    - Temporary structures are allowed only for short periods and may not interfere with fish spawning areas;
    - There are strict precautions against fuel leakages; fuel storage areas must be above flood levels;
    - Dust emissions have to be minimized.

- The industry has developed a voluntary code of conduct designed to create compliance certainty for communities and local authorities alike, to ensure that the agreed safe and accountable quarry practices are carried out.

4.9. UK [101-104]

4.9.1. Overview

As described in Annex 9, marine dredging of sand and gravel from the seabed (>15km offshore at depths of 20m-40m) is long established in England (as also in other European countries bordering the North Sea) to secure material used as construction aggregate, for beach nourishment and for land reclamation. The supply of aggregate from marine sources is vital for maintaining supply, particularly to markets in London and the South East of England, which now lack local land-based resources.

For this activity, the *"Good Practice Guidance, Extraction by Dredging of Aggregates from England's Seabed, 2017"* has been produced by the British Marine Aggregate Producers Association (BMAPA) and The Crown Estate (that is, the UK Government). The document covers the planning, licensing, environmental assessment, monitoring, mitigation and management methods that are employed to protect the environment and other seabed interests and to ensure the sustainability of the industry.

A marine license is issued under the *Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended in 2011)*, which is based the *EU Environmental Impact Assessment Directive*. In addition, any marine license issued will have considered the requirements of *The Conservation (Natural Habitats) Regulations 1994* and *The Conservation of Habitats and Species Regulations 2010* and the *Offshore Marine Conservation (Natural Habitats) Regulations 2007*.

The experience of the UK Mineral Products Association (MPA) is that it is very important to explain to the public the reasons for marine dredging and also demonstrably to minimize environmental impacts on biodiversity and the adjacent coastline. As a specific example, the MPA has prepared a pamphlet *"Aggregates Dredging and the Norfolk Coastline, a regional perspective of marine sand and gravel off the Norfolk coats since the Ice Age"*. It explains the low impact of offshore dredging on the Norfolk coastline.

Onshore in the UK, river extraction is no longer permitted, except in the specific case of dredging of silt to increase river flow capacity and prevent flooding (as is now generally the case throughout Europe).

4.9.2. The key learnings

4.9.2.1. Good Practices

- Marine extraction is tightly permitted under European Union (pre-Brexit) and UK legislation.
- An extensive EIA of the extractive area is required to get permits.
- There is a very detailed Code of Good Practice on marine extraction.
- All dredging areas are monitored before, during and after extraction.
- Ships are GPS-monitored to ensure compliance within designated area.
- Extraction is by suction pumps, with in-ship aggregates washing.
- There is extensive public liaison.
- There is a presumption against onshore river sand and gravel mining, except when there are other compelling reasons for extraction.
- Existence of a responsible national aggregates association.

4.10. The Netherlands

4.10.1. Overview

As described in Annex 10, the European Union (EU) has some of the world's highest environmental standards, developed over decades. EU environment policy is based on Articles 11 and 191-193 of the *Treaty on the Functioning of the European Union*. Under Article 191, combating climate change is an explicit objective of EU environmental policy. Sustainable development is an overarching objective for the EU, which is committed to a 'high level of protection and improvement of the quality of the environment' (Article 3 of the Treaty on European Union).

In Europe, river extraction has effectively been banned under the *EU Water Framework Directive*, more specifically Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. Under this Directive, for each river basin, "river basin management plans" have to be established. These river basin management plans have been developed, to protect the interests of citizens, environmental organizations, nature, water-using sectors in the economy; all need cleaner rivers and lakes, groundwater and bathing waters.
Other Directives relevant to any proposed river extraction are:

- *Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks.*
- *Directive 2006/118/EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.*
- *Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption.*
- *Directive 92/43/EEC of the Council of 21 May 1992 on the conservation of natural habitats and Birds.*

All of these Directive are focus on the conservation of natural habitats and of wild fauna and flora aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. As most European rivers are biodiversity-sensitive, any extraction from rivers will need to Environmental Impact Assessments in terms of the Habitats and Birds Directives. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas, safeguarded against potentially damaging developments.

A notable exception to good practice was the proposed sediment extraction from the Drava River near Osijek in Croatia, apparently without due assessment under the Habitats and Birds Directives and the Water Framework Directive, now a subject of legal action.

On the other hand, a positive example is the Grensmaas Project in the Netherlands, featured below, combining extraction, flood protection and nature conservation. The work extends over a 16-year period (2011-2027) over a 43-kilometer lenghth between Maastricht and Echt-Susteren. Flood protection and the new nature park are paid for with the extraction and sale of 54mt of sand and gravel, at a total project cost of €700 million. It is notable for the extensive consultation with all relevant authorities, citizen groups and NGOs.

4.10.2. The key learnings

4.10.2.1. Good practices

- Trans-national river basin management plans are now established to ensure coherent application of policy and regulation along the length and breadth of major rivers.

- In Europe, aggregates are generally excluded from mining legislation, being usually covered under regional and/or local planning regulations. There is a presumption against river sand mining, with extraction only allowed to facilitate flood control and river navigability.
- River mining in Europe is now mainly constrained by environmental, water and biodiversity directives rather than mining legislation.
- Environmental regulations give strong monitoring, reporting, enforcement and prosecution powers to both regulators and citizens.
- The Grensmaas mega-project in the Maas River in the Netherlands is justified by flood control considerations, nature conservation and economics.

4.10.2.2. Pitfalls

- A notable exception to good practice was the proposed sediment extraction from the Drava River near Osijek in Croatia, apparently without due assessment under the Habitats and Birds Directives and the Water Framework Directive, now a subject of legal action.

4.11. Myanmar [105-115]

4.11.1. Overview

As described in Annex 11, the River Ayeyarwady (Irrawaddy) is reported to be suffering from excessive sand extraction, due to a booming national construction industry. This excessive extraction is reported to be damaging the river infrastructure with negative impacts on fishing and farming of the region. The National Water Resources Committee (NWRC) in 2017 found that the present rate of sand and gravel extraction is "near or beyond the bounds of sustainability" with increasing erosion being recorded near the mouths of the distributaries. The WWF Study of 2018 *"The Ayeyarwady River and the Economy of Myanmar"* saw the Ayeyarwady Basin as the key economic value-driver of the country, if its resources could be better managed.

Sand, considered as a natural resource, is owned by the state. As such, under Article 37 of Myanmar's 2008 Constitution, the Union can enact necessary law to supervise extraction and utilization of these State-owned natural resources. Myanmar drafted its *Environmental Conservation Law* in 2012, the objective being to provide interim management guidelines for different industries. The Ministry of Natural Resources and Environmental Conservation then drafted a *National Environmental Policy* with the help of United Nations Development Program, with subsequent provisions under the *Environmental Conservation Rules (2014)* and the *EIA Procedures (2015)*. Another policy tool that supports the EIA review of projects are the *National Environmental Quality Guidelines (NEQG)*, passed in 2015.

While these laws and associated regulations appear to be well structured, many mining activities continue without EIAs and permits. Applications for mining licenses are submitted at the township level. The regional waterways department, namely the Directorate of Water Resources (DWIR), then conducts a hydrographic survey and provides recommendations on whether to issue a license. Differing licensing practices appear to occur between states and regions. In some areas it is reported that in addition to production fees and tax, township and ward administrators asked them for donations towards school or road projects. In other areas, it has been reported in media that the General Administrative Department (GAD) sells extraction licenses to the highest bidder.

The states and region-level DWIR oversee licensing compliance. Teams comprising officials from the DWIR, GAD and Myanmar Police Force patrol the river three or four times a month during the dry season. Anyone found mining without a license can be charged under the 2006 Conservation of Water Resources and Rivers Law, though this is reported to be ineffective in practice. The main problem may not be unlicensed operations, but the extraction of sand by licensed operators beyond the limits of their licenses. This is challenging to monitor, however, and enforcement tends often to be driven by community complaints.

4.11.2. The key learnings

4.11.2.1. Good practices

- Sand, under the Constitution, as a natural resource, is owned by the State.
- There is a strong Conservation of Water Resources Law, as also an Environmental Conservation Law. EIAs are required in the suite of Environmental Laws.
- The DWIR and the GAD grant the licenses.
- The legislation permits auctioning of aggregate blocks.

4.11.2.2. Pitfalls

- Regulation is ineffective when it comes to local implementation; environmental permits are often only given once an operation has been underway for many years.
- With so many Ministries and regulators, there can be reluctance in issuing permits for fear of offending a fellow regulator or of being accused of graft.

- Licensing is consequently disparate and often delayed at local township level; differing licensing practices appear to occur between states and regions. In some areas it is reported that in addition to production fees and tax, township and ward administrators asked them for donations towards school or road projects; in other areas, it has been reported in media that the GAD sells extraction licenses to the highest bidder.
- The policing of compliance is inefficient and patrol teams are ineffective, with infrequent visits by inspectors and none during the key monsoon season, when the main waterways are open.

4.12. Japan [116-117]

4.12.1. Overview

As described in Annex 12, statistics indicate that only about 5% of the current national demand for about 400mt/year of aggregates comes from river-dredged sand & gravel. Mining of Minerals in Japan was covered by the generally-ineffective *Mining Law No 289 of 1950*, though aggregates were not included within the list of Specified Minerals. This was superseded by the *Mining Law Amendment Act* introduced 61 years later in 2012, though this did not amend the list of Specified Minerals.

As in many advanced economies, sand and gravel extraction is now tightly-regulated through environmental legislation in Japan. The change from river extraction to aggregates production from hard-rock quarries in Japan was induced by less river sediment availability to due urban development, river flow modifications and dams, coupled with environmental regulations that effectively ruled out river extraction.

4.12.2. The key learnings

4.12.2.1. Good practices

- River sand mining has been virtually eliminated in Japan
- River extraction in the Shinano River, economically important in the past, is almost phased out, through a combination of river-diversion, urban development, dam-building and environmental legislation.

4.13. Lessons learnt from the case studies

These twelve case studies demonstrate that:

- River extraction remains an important source of aggregates in many countries, though uncontrolled over-exploitation can cause severe damage to river infrastructure & environment.
- River extraction can be carried out in full harmony with nature within annual sediment deposition rates (once reserves have been given time to replenish), and furthermore can provide flood control and can foster biodiversity (as particularly demonstrated in the biodiversity-positive case studies from New Zealand, UK and Netherlands).
- However, unfortunately, due to the enticement of burgeoning construction demands and lax and inconsistent permitting, monitoring and enforcement controls and low extraction costs, river extraction in some countries has become illegal and irresponsible.
- There are learnings from both successes and pitfalls of the case studies which demonstrate that, with determination of all parties involved, river extraction can be well-controlled and that illegal extraction can be phased out.
- More sustainable solutions for construction can be developed by reducing river sand supply and simultaneously creating economic incentives for moving to alternative materials.

Analyzing the twelve case studies, seven key success factors emerge, as summarized below:

4.13.1. Legislation, regulation and permitting

In all the case studies, with the exception of China, national mining legislation and regulation has been delegated to river, regional or provincial level. Implementation has in several cases has taken up to 10-15 years to implement successfully (for example in China, India, Malaysia and Colombia), but is now being achieved. As in the case of Viet Nam, challenges of implementation still exist in Mexico and Myanmar.

In developed countries, water and environmental legislation and regulation are actually more demanding on obtaining permission for river extraction than mining legislation; in fact, that is why river extraction has now been virtually phased out in developed countries, except where specifically justified for reasons of flood control or maintaining navigability.

A persistent theme from many of the case studies is that consistency of treatment, permitting and enforcement can be achieved by having a single (or very few) responsible authorities, which act as a highly-visible single permitting process and authority for the river basin, with a close collaboration between authorities along the length of the river. This is ideally accompanied by certification of responsible, financially solid operators with excellent track records, which will be the only organizations permitted to extract river sand with close control over their operations and clear, meaningful penalties for infringements of permits.

Table 2 Summary of lessons learned based on three elements in 12 case studies

Case Study	Mining legislation and regulation	Environmental legislation and regulation	Permitting authority and regime
China	There is central ownership of resources, with central control of permits, now being systematically applied to main rivers & provinces.	There is central water legislation and regulation, at least for main rivers and provinces; it remains to be seen if this is achieved in the minor rivers.	Licenses are controlled by a central government authority; permit conditions specify time, area, volume, depth, operating method and equipment.
India	Regulation is delegated to State level (eg Telangana), though it took	Phasing out of illegal river extraction is also driven by water scarcity challenges.	Licenses are issued and controlled by the State authorities, where appropriate

	many years to achieve successful implementation at State level.		delegated to township/municipality level.
Malaysia	Regulation is now being achieved at river level, though it took many years to achieve the required successful implementation.	Water and environmental regulation has long been a concern, now being successfully addressed.	Licensing became successful only when administered under a committed river authority.
Colombia	Regulation is now being successfully implemented at river level, as agreed in a cooperation with the river municipalities and associated stakeholders.	Water and environmental legislation is now at the core of permitting, there being very strict biodiversity designations.	Permitting conditions are fixed by municipalities.
Mexico	Admits lack of success in curtailing illegal extraction so far, but is determined to rectify.	Water and environmental issues are recognized, but not yet applied.	No systematic permitting regime is yet implemented.
USA	Successful implementation through national agencies (for example, US Army Corps of Engineers).	Water and environmental regulation has greatly constrained river extraction, possibly overly strict in some cases.	Permitting conditions are agreed on a case-by-case basis.
Canada	There is successful implementation at Provincial level.	Water and environmental regulation has greatly constrained river extraction.	Permitting conditions are agreed on a case-by-case basis.
New Zealand	There is successful implementation of national legislation at river/regional level.	Water and environmental regulation has greatly constrained river extraction.	Permitting conditions are agreed on a case-by-case basis.
UK	Marine extraction is regulated by the Government.	Water and environmental regulation has a strong influence on the permitting of marine extraction and has constrained river extraction.	Permitting conditions are agreed on a case-by-case basis.
Netherlands	European and Dutch legislation effectively prohibit river extraction except where justified by river flood control or navigability.	Water and environmental regulation has greatly constrained river extraction.	Permitting conditions are agreed on a case-by-case basis, particularly for the Grensmaas project.
Myanmar	National legislation is ineffectively applied at river/regional level.	Water and Environmental regulation are not yet implemented.	Permitting system is ineffective.
Japan	River extraction is phased out on environmental considerations.	Water and environmental regulation has greatly constrained river extraction.	Permitting is allowed only under specific circumstances.

4.13.2. Technical guidelines and compliance monitoring

There are a number of countries (including China, India, Malaysia, Colombia, New Zealand and UK) where detailed technical guidelines have been developed for river extraction, which could be suitably adopted for use in the case of the VMD. Several of these define in considerable detail when and where extraction can take place, with prohibitions on extraction close to various types of utility infrastructure, constraints on the location of material stockpiles, the type of extraction equipment to be used, including safety aspects.

The most successful case studies in phasing out of illegal river extraction (namely China, India, Malaysia and Colombia) are marked by determined detection of any continuing illegal activity (by GPS monitoring, use of drones, etc.), combined with a range of sanctions and penalties including progressive fines, confiscation of loads or trucks and even imprisonment of repeated offenders.

These measures are often complemented by hot-line "whistle-blowing" by local communities and NGOs in these countries. Compliance monitoring and enforcement are costly and require the necessary IT/GPS technology and the involvement of local communities to be effective.

Table 3 Summary of two elements "technical guidelines" and "compliance monitoring" in 12 case studies

Case study	River mining technical guidelines	Compliance monitoring
China	Detailed guidelines are available, covering both the extraction area constraints, the extraction process and the types of vessels used.	GPS and noise monitoring; severe penalties now for illegal activities, including imprisonment; using social media to avail of "whistleblowers".
India	Detailed guidelines are available, covering areas, process of extraction.	Special policing force employed to achieve compliance.
Malaysia	Detailed guidelines are available, very detailed on operating procedures.	Special policing force (in this case 200) employed to achieve compliance.
Colombia	Detailed guidelines are available, particularly on risk assessment aspects.	GPS and drone monitoring, supplemented by support from community groups.
Mexico	No guidelines yet exist.	Complaints by local groups hitherto not heeded.
USA	Guidelines applied are developed for each application.	Strong powers of compliant and remedy exist under EPA as well as from local communities.
Canada	Detailed guidelines for river extraction are available.	Strong powers of compliant and remedy exist under EPA as well as from local communities.
New Zealand	Detailed guidelines are for river extraction available.	Strong powers of complaint and remedy exist under environmental agency as well as from local communities.
UK	Detailed guidelines for marine extraction are available.	Strong powers of complaint and remedy exist under environmental agency as well as from local communities.
Netherlands	Guidelines are agreed on a specific project basis.	Strong powers of complaint and remedy exist under environmental agency as well as from local communities.
Myanmar	No detailed guidelines yet exist.	Complaints by local groups hitherto not heeded.
Japan	Not relevant, as river extraction has been phased out.	River extraction is virtually phased out.

4.13.3. Project leader/champion and professional associations

The case studies which demonstrate most success in phasing out illegal extraction (for example in China, India, Malaysia and Colombia) are notably characterized by a project leader or champion enforces the permitting process, liaising with all the stakeholders involved and coordinating activities. This role could be filled by the Viet Nam Construction Materials Association.

Another common success factor was the active role played by an aggregates industry or professional association in coordinating the role of the responsible aggregates supply sector. So far in Viet Nam, its aggregates sector is fragmented and disjointed, without a common voice on key issues, probably also exacerbated by the fact that the sector (like in other regions) is dominated by small players, sometimes with opaque ownership.

A professional aggregates association could be modeled on the Viet Nam Cement Association (VNCA), which encompasses both the state-owned producer (VICEM) and responsible private companies in campaigning on common issues in the national interest and for the good of the industry itself. There are many successful models of such associations in GAIN™, and a professional Viet Nam aggregates-focused association could with great benefit become a member of GAIN™. This association could also be charged with ensuring that the alternative aggregates and sands meet standards to ensure high-quality concrete, asphalt and other construction products. Additionally, the association could assist in certifying Responsible Operators and accompany the construction sector in a requirement to use only responsibly-sourced sands and aggregates, ideally backed up by certification of responsible sourcing.

Table 4 Summary of two elements "project leader" and "professional association" in 12 case studies

Case Study	Project leader/champion	Aggregates or professional association
China	River Chief is designated for each main river.	China Aggregates Association, CAA.
India	State of Telangana Director of Mines and Geology.	Mining Engineers' Association of India, MEAI.
Malaysia	Company director.	Malaysia Quarries Association, MQA.
Colombia	National aggregates association, ASOGRAVAS.	National aggregates association, ASOGRAVAS.
Mexico	None yet.	National association being formed, ASEC.
USA	National aggregates association, NSSGA.	National Stone, Sand & Gravel Association, NSSGA.
Canada	Provincial (Alberta) sand and gravel association, ASGA.	Provincial aggregates associations, that for Alberta being ASGA.
New Zealand	National aggregates association, AQA, and regional producers.	National Aggregates and Quarry Association, AQA.
UK	British Marine Aggregates Producers Association, BMAPA.	Mineral Products Association, MPA, being a member of the European Aggregates Association, UEPG.
Netherlands	Dutch Grensmaas Consortium.	Dutch aggregates association, FAÇADE, also being part of UEPG.
Myanmar	None yet.	None yet exists.
Japan	River extraction phased out.	Japan Crushed Stone Association, JCSA.

5. LEGISLATIVE SITUATION IN VIET NAM

5.1. National Mineral Law of 2010

The extraction of minerals in Viet Nam is covered under the **Mineral Law under the National Legislative Assembly, No 60/2010/QH12 of 2010**[6,37]. The Law defines minerals simply as minerals and mineral substances mined underground or over-ground, which clearly includes sands and aggregates in general.

Its Article 13 has the general requirement that master plans be prepared that respect the socio-economic effectiveness and that environmental protection must be considered in making investment decisions; and that advanced mining technologies which are suitable to the size and characteristics of each mine, as well as each kind of mineral, shall be applied in order to recover minerals to the maximum.

Its Article 64 defines minerals for use as common construction materials, first ranking amongst these are sand of all kinds (except siliceous white sand), also including sedimentary rocks, limestone, and dolomite. **However, organizations and individuals that mine minerals for use as common construction materials are not required to apply for mining licenses when mining minerals in the land area of an approved or licensed investment project to build a work and using mined products only for building such work, but should, where appropriate under Article 65, submit a mining plan in advance at the provincial level and pay a mineral fee**.

5.2. Viet Nam Construction Materials Development Strategy 2021-2030, orientation to 2050

In August 2020, the **Prime Minister published a decision (No 1266/QD-TTg[24]):** defining the ***Approval of Viet Nam Construction Materials Development Strategy 2021-2030, Orientation to 2050*.** This process is to be led by the Ministries of Construction, Natural Resources and Environment, Industry and Trade and Finance, amongst others. Notably it also advocated the development of professional associations for the various sectors and welcomed private investment in the building materials sector.

It also lays out process efficiency requirements for key sectors in its Appendices, some of which are very detailed, such as in the cases of cement and lime. In its Appendix X, the following general requirements for sand production are included:

- To develop facilities exploiting and processing natural sand, using advanced mining technology; natural sand suitable for concrete should not be used in leveling (infill) applications, nor exported; construction sand production facilities must meet technical regulations and standards on environmental protection, with rehabilitation and restoration.
- To strengthen the development of manufactured sand products to meet demand; striving to achieve the target of using crushed sand, recycled and from industrial and construction wastes to replace by 2030 at least 40% of the use of natural sand in construction.
- For the period of 2031-2050, the use of natural sand in construction should be minimized; to raise the rate of using crushed sand, recycled sand from industrial and construction waste, at least 60% of the total amount of sand used in construction.

5.3. Mining laws and regulations specific to river sand mining

5.3.1. The Government Resolution 120 of 2017

The **Government Resolution 120 of November 2017[39]** lays out a detailed strategy for the ***Sustainable and Climate-Resilient Development of the Mekong Delta of Viet Nam***, acknowledging

its superb potential for agricultural development, food industry, tourism, renewable energy, with due account being taken of the magnitude of climate change, extreme weather events and sea level rise.

In addition, risks are identified in over-exploitation of sediment, the construction of houses and infrastructure along riverbanks, which, for example, can increase the risk of land instability. Advanced technology and local indigenous knowledge are to be applied, ensuring the livelihoods of people, under the central role of the Government. The transformation process requires a long-term vision, prioritizing climate change adaptation, developing a low carbon green economy and protecting natural ecosystem.

The Ministry of Agriculture and Rural Development is to lead, coordinating with the Ministries of Planning and Investment, Finance, Natural Resources and Environment and relevant agencies, to build and submit to the Prime Minister a comprehensive program on sustainable agriculture development and climate resilience of the Mekong Delta.

In particular, the Ministry of Construction is charged to effectively implement the regional construction plan, protecting houses along riversides to minimize risk of landslides, with a requirement to research new substitutable materials for leveling and construction.

5.3.2. Other legislative instruments

In recent years, government has enacted several new legislative instruments outlining specific measures and penalties related to sand mining in waterways [16,17,18]. **These developments are welcome and may serve to increase the cost of sand mining, but they may be insufficient to effect real, meaningful and sustainable change**.

The **Prime Minister's Decision 2427/QD-TTG*: Approving Mineral Resources Strategy to 2020, with a Vision toward 2030* of December 22, 2011**[41] stipulates the general requirements that the mining and processing of minerals as common construction materials must be associated with occupational safety, protection of landscape and environment. It forbids mining of construction materials at the foot of hillsides, mountains, along the national highways in order to protect the landscape.

The **Government Decree 23/2020/ND-CP [16]: *"Management of River Bed Sand and Gravel and Protection of River Beds, Banks and Terraces"*** includes requirements on:

- "The licensing is carried out by holding a mining right auction, except for the case in which the area not reserved for mining right auction has been approved by the competent authority in accordance with regulations of the Law on Minerals.
- If the area to be covered by the license to explore and mine river bed sand and gravel borders at least 2 provinces or central-affiliated cities, before the licensing, the People's Committee of the province where the applicant is available shall seek a written opinion from the People's Committee of the bordering province.
- Before the licensing, the provincial People's Committee shall obtain the written consent from the inland waterway, natural disaster management and irrigation authority and satisfy the requirements set forth in Article 15 hereof.
- Permissible daily mining time: from 7am to 5pm, mining at night is not allowed; regulations on mining time periods during a year."

Its Article 15 lays out requirements specific to riverbed sand and gravel mining as:

a. *The mining areas must be away from the edge of the bank at a minimum distance suitable for the natural width of the river bed; topographic and geological features and river bank stability shall be decided by the competent authority specified in Clause 2 Article 21 hereof;*
b. *The slope of the bed of the mined river route must be equivalent to the natural slope of the bed of the mined river section and must not suddenly change the slope of the whole river route and the mining depth and must be suitable for the topographic and geological features of the river*

section and must not form any swirling hole or increase the risk of river bank instability, shall be decided by the competent authority specified in Clause 2 Article 21 hereof;

c. *If the river section running through a midland or mountainous region has undergone seasonal sedimentation, according to the sedimentation changes, the competent authority specified in Clause 2 Article 21 hereof shall decide to lay down specific requirements for the sand and gravel mining to ensure that the risk of river bank and terrace erosion is prevented and minimized."*

Furthermore, its Clause 2, Article 21 requires that:

a. *The authority appraising the environmental impact assessment report or considering confirming the environmental protection plan tailored for the project that is required to undergo assessment of impacts on river beds, banks and terraces shall appraise contents of assessment of impacts on river beds, banks and terraces.*

To be specific:

b. *The Ministry of Natural Resources and Environment shall approve the implementation plans with respect to the projects whose environmental impact assessment reports are appraised and approved by the Ministry of Natural Resources and Environment.*

c. *Regarding the projects that are required to undergo assessment of impacts on river beds, banks and terraces in the following cases on inter-provincial rivers, the Ministry of Natural Resources and Environment shall appraise and approve contents environmental impact assessment report and approve implementation plans, except of the cases specified in Clause 3 of this Article:*

- *Mine sand and gravel, and dredge and clear channels on inter-provincial river sections that border at least 2 provinces or on other inter-provincial river sections at a distance of no more than 5 km from the boundary between the 2 provinces to the downstream and upstream;*
- *Embank or encroach on the river on inter-provincial river sections that border at least 2 provinces; on other inter-provincial river sections at an expected length of encroachment of at least 1 km or narrow the river bed width to no more than 5%.*

d. *Every provincial People's Committee shall approve the implementation plans with respect to local projects whose environmental impact assessment reports are appraised and approved by the provincial People's Committee, except for the cases specified in Point a of this Clause;*

e. *The authority that has the power to confirm the environmental protection plan in accordance with regulations of law on environmental protection also has the power to approve the implementation plans with respect to such projects, except for the cases specified in Points a and b of this Clause."*

Decree 36/2020/ND-CP[17] (which superseded Decree 33/2017/ND-CP), ***"Penalties for Administrative Violations against Regulations on Water and Mineral Resources: Penalties and Remedial Measures against Administrative Violations"***, included statements on:

- "Principal penalties: Any organizational/individual entities that commit administrative violations against regulations on water and mineral resources shall be liable to any of the following principal penalties: a) a warning, b) a fine or c) suspend the mineral exploration license or the mineral extraction license for 1 to 12 months.
- The maximum fine for a violation against regulations on water resources incurred by an individual is VND 250 million VND; that incurred by an organization is VND 500m. The maximum fine for a violation against regulations on mineral resources incurred by an individual is VND 1bn (€36,400); that incurred by an organization is VND 2bn (€72,800);
- An entity committing administrative violation may, subject to the nature and severity of the violation, face one or several additional penalties mentioned below:

- Suspend the license to explore, extract and use water resources, the license to discharge wastewater into water bodies; the license for groundwater drilling; the mineral exploration license or the mineral extraction license for 1 – 24 months;
- Suspend the formulation and/or performance of water resources projects/schemes; suspend the exploration or extraction of water/ mineral resources for 1 – 12 months;
- Confiscate the exhibits and/or specimens which are minerals, and instrumentalities of administrative violations.
- Additional penalties shall be only applied in association with principal penalties."

5.4. Environmental legislation and regulation

In developed economies, river sand extraction is often more constrained by environmental legislation often working alongside mining legislation; hence it is appropriate to briefly review that aspect also for Viet Nam.

Since 2014 **Law on Environmental Protection, 55/2014/QH13** *(43)* has been the key reference point, but although long in detail, it appears to have fallen short in effectiveness in protecting the environment. Under its Article 7, it was forbidden to illegally extract natural resources, and its Article 35 required environmental protection during extraction of natural resources, though neither specifically mentioned sand in that context. Its Article 163 provided for compensation in case of environmental damage. Implementation rested with the State and there was no environmental protection agency as would be common in many countries. Time has shown the Law to be largely ineffective in tackling Viet Nam's increasing environmental challenges brought about by its rapid economic development.

In November 2020, the National Assembly approved the **Revised Law on Environmental Protection,** (44) to come into effect on January 1, 2022. It focuses on cleaning up of wastewater discharges and on waste recycling, and in that context; it may encourage use of recycled aggregates. Implemented by the Ministry for the Environment (MoNRE), the Revised Law will give a bigger role to communities in conservation, which may help the situation for VMD communities, though critics fear the monitoring and enforcement mechanisms will continue to be insufficient. This is unfortunate, as in many developed economies (as shown in the case studies), environmental regulation is actually more powerful than mining regulation in imposing high operating standards on river extraction.

In terms of climate change, Viet Nam's **Intended Nationally-Determined Contribution (INDC)** under the Paris Agreement sees a doubling of GHG emissions by 2030 and tripling by 2050, driven by population and economic growth. In contrast, Viet Nam is considered one of the most hazard-prone countries in the world, experiencing typhoons, floods, droughts, and landslides. The country's poorer populations are now concentrated in mostly rural areas with precarious housing and social infrastructure and low-lying roads highly susceptible to flooding, and are highly dependent on climate-sensitive livelihoods such as fishing and rain-fed agriculture. Growing industrial and service sectors have reduced the relative contribution of agriculture, forestry, and fishing to gross domestic product, but these sectors still collectively contribute a significant amount of gross domestic product and employ less than half of the country's labor force. The energy sector was responsible for more than half of greenhouse gas emissions, followed by agriculture, industrial processes, waste, and land-use change and forestry. Climate change impact projections for Vietnam include an increase in temperatures, increased intensity of extreme weather events and a rise in sea levels, obviously with particular consequence for the VMD region. On the positive side, this outlook could provide Viet Nam the opportunity of seeking international funding for climate adaptation, some of which could justifiable be spent in addressing the VMD challenges outlined in this report.

5.5. Other recent developments relating to the VMD

The Prime Minister recently established a Mekong Delta Coordinating Council for the 2020-2025 period, headed by Deputy Prime Minister. It includes the Ministry of Planning and Investment (Permanent Vice Chairman), Ministry of Natural Resources and Environment, Ministry of Agriculture

and Rural Development, Ministry of Construction, Ministry of Industry and Trade, Ministry of Science and technology, Ministry of Health, Ministry of Education and Training and Ministry of Transport, Government Office, Ministry of Finance, 12 provinces and 1 city under the central government in the Mekong Delta, Can Tho University and Vietnam Southern Food Corporation. The Council will put forwards mechanisms, policies, strategies, plans, projects, programs and tasks for the whole region in the direction of ensuring sustainable and climate-resilient development of the Mekong Delta.

5.6. Key learnings from legislation and regulation

5.6.1. Commentary

- The Mineral resources strategy to 2020, with a vision toward 2030 rightly set targets for the health and safety of those involved in sand extraction activities, also forbidding extraction that could be a visual intrusion on the landscape.
- The Government Resolution 120 of 2017 is to be lauded in its ambition to prevent over-exploitation of resources in the VMD, particularly in preventing river bank landslides and risk to properties along the river, but unfortunately fails to address the over-exploitation itself.
- Strategy for development of building materials in the 2021-2030 period with a vision towards 2050 is entirely appropriate in requiring sand extraction to be carried out using the latest technology and high standards of environmental protection; in order to reduce excessive sand extraction in the VMD, it sets laudable targets for replacing natural sand by manufactured sand and recycled materials.
- The Government Decree 23/2020 is intended to set up a system of auctioning for mining rights, though appears to make exemptions that may undermine that purpose; it also sets up a procedure for communication between local authorities where mining rights/permits cross their boundaries.
- The Government Decree 36/2020 correctly sets up a system of penalties and sanctions for non-compliance with permits, however, there is a loophole in that amounts of illegally extracted sand of less than 30m^3 receive only a small administrative penalty, potentially allowing infringing operators to “hide” behind this provision.
- The Prime Minister’s setting up of the VMD Coordinating Council for the 2020-2025 period; however, the question remains if these will have sufficient powers to guarantee successful implementation.
- The Environmental Law of 2014 and the Revised Law of 2020 are welcome in addressing environmental challenges, though unfortunately, these being national in scope, do not specifically address the VMD issues.

5.6.2. Aspects to Improve

- The delegation of powers on permitting, monitoring and supervision to local authorities was and still is imprecise and may allow adjacent Provinces to set completely different and sometimes incoherent license conditions and royalty fees. That, unfortunately, is one of the main reasons for the unsustainable current over-exploitation of the VMD; it remains to be seen whether the recently appointed VMD Coordinating Council as well as the VMD Sustainable Sand Mining Initiative might have sufficient regional powers to help achieve implementation.
- Measuring extracted volumes is reportedly close to impossible, with authorities relying on self-declaration or invoiced volumes. Since these volumes are the used for the calculation of royalty payments to the Province, there can be temptation grossly to under-declare and to sell material for cash without traceable invoicing.
- There is also reportedly little control over the quality of extraction and transportation equipment, nor over the competence of the operators.
- In the absence of current sedimentation data, it is unfortunately impossible at this time to determine by how much sand demand is exceeding supply; it is understood that such a sedimentation study is now being commissioned.

- Consideration should be given to provide more precise detailed technical guidelines on good practices in river extraction, based on lessons which can be learned from the case studies cited in this report.
- There is a role for a national aggregates association or other body to represent the responsible extraction industry (both from rivers, dry pits and hard-rock quarries), which could potentially raise technical process, product quality and environmental operating standards throughout the industry, as it do associations in other countries. This role could possibly be filled by the existing Construction Materials Association.
- The penalties proposed for non-compliance may be insufficient to deter larger operators intent on continuing illegal extraction.
- Neither is there sufficient commitment to measures to monitor and tackle non-compliance (such as via GPS tracking, video monitoring, use of drones, etc.), nor in attracting or empowering confidential "whistleblower" reporting from local communities.
- Environmental regulation could give local communities greater power to redress for river pollution, damage to property or losses of income from fishing or rice cultivation.
- Taken together, these drawbacks mean that sand is extracted from rivers by uncertified/unqualified operators with low cost technology, poorly paid employees, scant regard for Health, Safety and Responsible Extraction, little risk of fines and penalties, underpayment of royalties, evasion of taxes, so that costs are ultra-low. This, in turn, means that customers have little incentive to use more sustainable, responsibly sourced alternatives. It is recommended that legislation is implemented which internalizes the panorama of damaging externalities of river sand extraction and that results in greatly increased professionalism and costs.
- In conclusion, it is expected that the legislation could internalize the externalities of sand mining and be promoted to increase professionalism and cost in the field of river sand mining. It can be argued that the 2030/2050 targets for replacing natural sand by manufactured sand and recycled materials could be more ambitious in timing and quantity, based on the case study achievements in other countries.

As an overall summary on the Viet Nam situation, a 2019 paper, Nhi Ba Nguyen et al[15] reported on how national mineral and mining policy operate at a local level. "Findings show that, over the past decade, the Vietnamese Government has initiated substantial reforms to the regulatory frameworks governing mining, with the central objective to attract foreign direct investment (FDI). However, it has become apparent that these reforms have numerous deficiencies and loopholes that have led to a range of unintended economic, social and environmental consequences. To cope with challenges such as rent-seeking, limited capacities and capabilities of government staff, failure of institutions and neglect of local communities, policy makers will need to think differently and strategically about the mining industry and how regulations are implemented. Only by addressing these weaknesses will the path be paved for the sustainable growth of Vietnam's mining industry into the future".

6. ALTERNATIVES TO RIVER SAND

It is beyond the scope of this report to take a view on whether construction and economic development are desirable and necessary, nor whether alternative building materials to concrete (eg wood, steel etc.) are more or less environmentally sustainable than concrete. However, it is clear from experience in other jurisdictions (as in China, India, Malaysia) that restricting the supply of river sand aggregates has relatively little impact on end user demand for concrete and fill materials, primarily from the construction sector. With supply shortages, unintended consequences can result in outcomes such as surging prices (as in India), delays and increased costs for housing and construction projects, intense pressure by vested interests on political bodies, regulatory flip-flopping (as previously in China) and illegal sand extraction carried out by mafia-type cartels.

Regulatory measures should ideally take these secondary effects into account and take steps to ensure that other national objectives are not substantially impeded by river sand legislation. Internalizing externalities by using legislation and regulation to increase river sand costs and professionalism is desirable, especially as the increased costs can provide the economic incentive to invest in alternatives. The alternatives may have some environmental drawbacks, but in the overall balance may well be more sustainable. For example, the manufacture of sand extracted from hard-rock quarries involves mineral extraction, possible use of water, creation of dust and potentially greater transportation impacts. However, offsetting factors include the greater ease of regulating and policing of a relatively few point quarry sources with smaller physical footprints versus the vast area of the VMD; use of fine materials in the quarries which would otherwise be disposed of as waste; application of latest proven technology. This picture is complex and the sustainability comparison, as said, is also beyond the scope of this report.

Nevertheless, it is worth rehearsing some of the options open to end users when insufficient sedimentation, regulation and enforcement restrict dramatically the availability of construction sand.

6.1. Manufactured sand (“M-Sand”)

6.1.1. Application of M-Sand in the world

Hard rock quarries are primarily designed to produce crushed stone aggregates, often also producing fines that often remain unsold. These quarries are usually semi-permanent, multi-decade operations, with large capacity and at a fixed location, facilitating regulation and enforcement.

Fig 10. Illustrates a manufactured sand plant in the United Arab Emirates, which product is shipped globally.

As in this case, by adding fine crushing equipment to a hard rock quarry at incremental low investment, manufactured sand may be produced by further crushing by-product materials, to produce high-quality sand. This fine-crushing may be achieved by using Vertical Shaft Impactors (VSIs), as shown here, or using grinding roller technology.

Figure 10. Manufactured sand plant in the United Arab Emirates

Studies have shown that the best end product for various purposes can be achieved with high-velocity impact crushing; a vertical shaft impactor yields the soundness and shape of the material and produces a quality that is very close to natural sand. The better the grain shape of the end product, the better its

performance in concrete, asphalt and base mixtures. Air classifiers are used to remove the needed amount of fine particles and dust, or alternatively, wet classification may be used.

The advantages of manufactured over natural sand include the ability to produce with exactly the right shape and gradation, When used in concrete, there may be saving in cement usage through achieving concrete of optimum quality, strength and structural integrity. Although not without environmental impacts, it can present substantial potential sustainability benefits vs illegally extracted river sand.

If river-based sand prices surge (due to interdiction and/or regulation, as in India), there can be strong financial incentives to invest in manufactured sand equipment with the result it can be more cost effective than natural sand, subject to a robust regulatory and enforcement regime. Manufactured sand is free of silt and clay particles, and has denser particle packing than natural sand. It also offers higher flexural strength, better abrasion resistance, higher unit weight and lower permeability. After initial familiarization, contractors prefer manufactured over natural sand, allowing them to produce higher grade concretes at lower costs, especially due to reduced cement demand for a specific concrete performance. For example, ready mixed concrete producers in Yangon, Myanmar, prefer to use manufactured sand to that supplied by barge from riverbed mining in the Irrawaddy for any high specification structural concrete or for demanding international contractors, despite higher prices for manufactured sand.

An outstanding example of moving from natural to manufactured sand is in Hyderabad, the capital city of the State of Telangana, India's technology industry hub, where rapid growth puts great pressure on regional infrastructure development. The city had long been struggling to get river sand, but governmental policies banned the use of river sand, citing that the depletion of the natural resource and the ill-effects of dredging and indiscriminate quarrying of river beds posed a great threat to the environment. There is now a rapid transition taking place from natural sand to manufactured sand, a win-win situation for all concerned.

Fig 11. Natural sand Prices in 2018 in various Indian States. This has been partially facilitated by economic effects. Indian sand prices in recent years have fluctuated widely throughout the sub-continent due to material availability and permitting restrictions.
When river sand mining was banned in many Indian cities in 2017, delivered prices spiked (see figure at left showing prices in 2018) varying by a factor of over 7x from $38/t in Mumbai to $5.40/t in Andhra Pradesh.

Figure 11. Natural sand Prices in 2018

As described above, in the high-priced markets, hard rock quarry operators reacted by investing in vertical shaft impactor crushers to manufacture sand, so that now no shortages exist and delivered prices in Mumbai have stabilized at $9.50/t. There are similar good experiences in other countries (such as in China and Malaysia), and there is indeed an increasing global transition from natural to manufactured sands.

6.1.2. Application of M-Sand in Viet Nam

An industry source has confirmed that some hard-rock deposits exist within the VMD region and are capable of development; however, licensing conditions need to be stricter with longer permit durations (>30 years) to justify the capital investment in opening new larger-scale quarries.

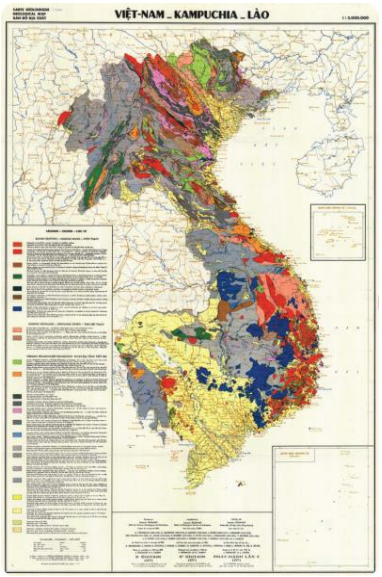


Figure 12. Geological map

Figure 13. Global cement directory

Fig 12. In searching for a suitable hard-rock source for producing manufactured sands, the geological map shows that the Delta region, as expected, is covered principally by alluvial deposits.

On the other hand **Fig 13.**, the Global Cement Directory map shows cement plants located in the Mekong Region, implying hard-rock resources potentially suitable for the production of manufactured sands.

The hard-rock quarry operators, encouraged by the authorities, have rapidly invested in this new business, and the construction industry is welcoming the higher quality, lower price, better reputation and performance of manufactured sand. Because of this rapid investment by the quarry operators, and consequent better supply of sand, the high “black-market” prices created by illegal operators have now disappeared, to the benefit of all concerned. In the VMD region, there are not many hard rock quarries, although in An Giang and Kien Giang province- crushed sand production is available.

Equally, responsible suppliers need to be encouraged to develop new hard-rock quarries in southern Viet Nam and cost-effective sustainable logistics routes from hard rock quarries in central and northern Viet Nam which should supply the necessary aggregates volumes for a rapidly-developing economy; there is also a real new and exciting opportunity for them to start producing manufactured sand. Viet Nam has the advantage of being a coastal country, while the VMD has a wide system of rivers and channels which would allow the economic delivery of aggregates and manufactured sand by barge or ship to all parts of the country from central or northern Viet Nam where more hard-rock deposits exist.

6.2. Recycled aggregates

6.2.1. Application of recycled aggregates in the world

Recycled Aggregates (RCAs) are typically crushed concrete (or asphalt pavement) derived from sorted construction and demolition waste that is then reused in other building projects.

Figure 14. Crushing and screening plant

Fig 14. A large crushing and screening plant for recycling of construction and demolition materials in the Netherlands. This activity is an important source of aggregates in economies with high landfill taxation or bans and is of increasing importance worworldwide. RCAs can be used for road base, fill, graded aggregates and as a (partial) component in both structural and non-structural concrete and in asphalt. Recycled fines may also be used to replace natural/river sand.

RCAs reduce both primary mineral extraction and landfilling and can (depending on location of the recycling unit) be a means to reduce costs of construction while also boosting “green” label points. For example, the US LEED® certification system recognizes recycled concrete in its point system.

As an example, Construction and Demolition (C&D) waste is the largest waste stream in the EU, often representing around one third of total arisings. Orders of magnitude of C&D waste in 2009 were 510mt in the EU, 325mt in the USA and 77mt in Japan. The EU Waste Framework Directive 2008/98/EC established a target of 70% of C&D Waste to be recycled by 2020. However, with the exception of a few Member States, only about 60% of C&D total waste is typically being recycled. Some EU Member States have already developed and implemented a framework which leads to a recycling rate of up to 90% of available waste, equivalent to 25% substitution for primary aggregates.

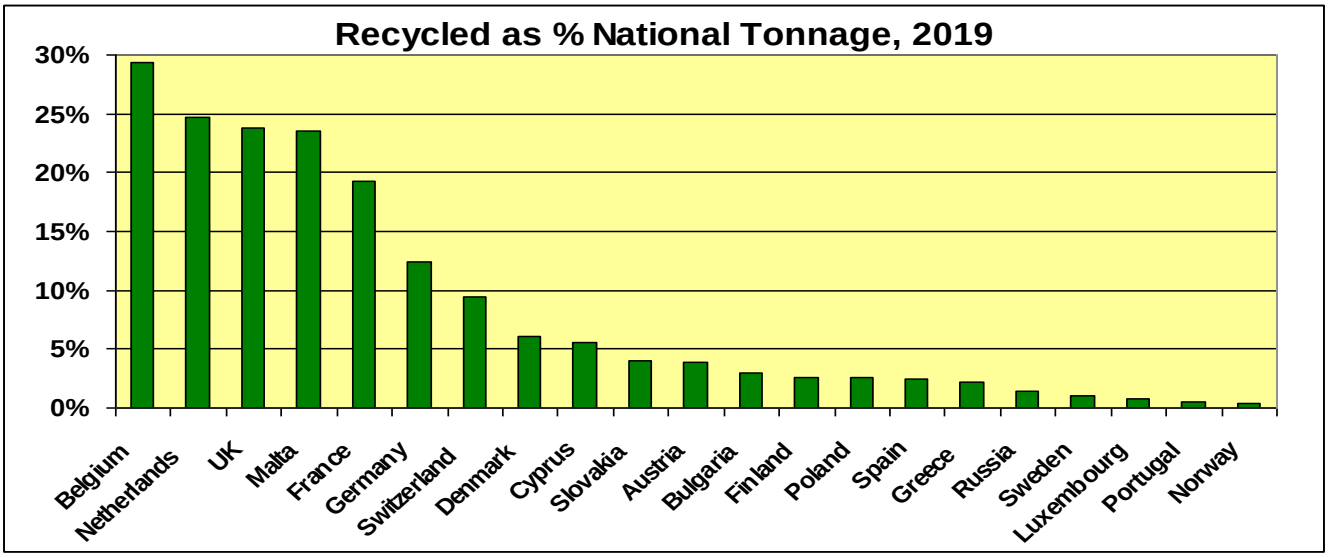


Figure 15. UEPG 2019 recycling data

Fig 15. UEPG 2019 recycling data showing the percentages of substitution of RCA (as a % of total demand) in various European countries. For Belgium, Netherlands, UK and Malta, more than 20% of total demand is filled by RCA, but it is less than 5% in many other countries. The average across Europe is 11%.

This is achieved through policy objectives, fiscal incentives (eg landfill taxes and aggregate taxes) and even bans on certain waste categories, to drive consumers and industry towards lower landfill rates. Landfill rates of waste are indirectly proportional to the level of landfill taxes and/or where landfill bans are in place or planned.

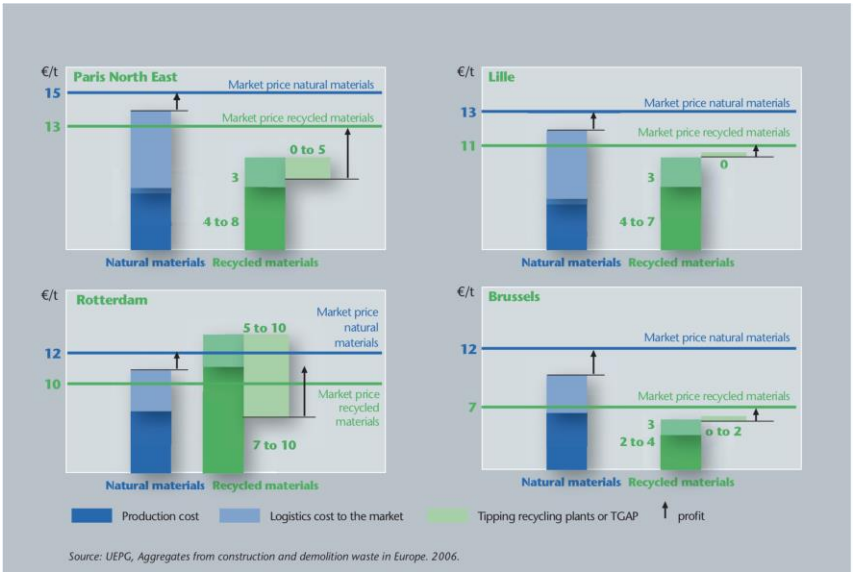


Fig 16. Typically, RCAs realize a price which is approximately 60-85% that of natural aggregates. An RCA producer in the EU however will often benefit from receiving raw sorted construction waste at a negative price reflecting part of the saving that the demolition contractor makes by not paying the landfill gate fee. A recent study(23) in France estimates that the price ex demolition site of sorted construction waste is around -€5/t, with a cost for sorting, crushing, screening of ~€8.7/t.

Figure 16. RCAs prices

Some of the common hurdles to recycling and re-using C&D waste is the lack of confidence in the quality of C&D recycled materials, increased water demand in concrete (with consequent strength reduction) and concerns of contamination which could affect performance (eg in concrete) or lead to leaching of environmental pollutants. In addition, recycling challenges can also be exacerbated by lack of regulation of end-of-waste criteria. The amount of RCA that can be used to replace natural aggregates in structural concrete varies but can often be restricted by specifiers to 20-30%.

6.2.2. Application of recycled aggregates in Viet Nam

A 2013 paper on recycling construction demolition waste in the world and in Vietnam[35] indicated that 100% of Construction and Demolition waste was disposed of in “landfills” in Viet Nam. A 2018 paper on the current status of construction and demolition waste management In Vietnam; challenges and opportunities[36] confirmed that such waste amounted to 60kt/day (or 18mt/year) and accounted for 10-12% of all waste, and that provision for some incentives to users of the recycled products was necessary to promote recycling. The Law on Construction (2014) stipulates that construction contractors are responsible for Construction and Demolition Waste (CDW) management. The Law on Environmental Protection (2014) stipulates that CDW shall be collected and treated in an adequate way, and the Decree on Management of Investment Projects on the Construction of Works (2009) stipulates that construction contractors shall transport and dispose of CDW and take it to designated places.

In the past two decades, the Vietnam Government has put in place a sound legal framework for environmental protection that addresses guidelines for the management and disposal of all waste streams. This framework is supported by many national strategies and directives that apply to solid waste management. Typical strategies are:

- Strategy for the Management of Solid Waste in Vietnam Cities and Industrial Parks (1999).
- National Strategy on Environmental Protection up to the year 2010 and Vision to 2020. (2003).
- Directive No. 23/2005/CT-TTg on Enhancing the Management of Solid Wastes in Urban Centres and Industrial Parks (2005).
- National Strategy for Integrated Management of Solid Waste up to 2025 and Vision towards 2050 (2009).
- National Strategy on Environmental Protection up to the Year 2020 and Vision to 2030 (2012).

The 2018 paper concluded that none these regulations had been successful, due to a multiplicity of problems, and appropriately suggested a more holistic approach addressing all technical, social, institutional, and economic issues is vital to achieving a sustainable solution. The paper also mentioned

a cooperation with Japan in the JST-JICA SATREPS Project through transfer of Japanese technology in recycling to Viet Nam.

In 2010, the Vietnam Green Building Council (VGBC) introduced LOTUS, the first green building rating system that considered Vietnam's building regulations, climate conditions and construction practices. The Dodge Data & Analytics *World Green Building Trends 2018 Survey* indicated that only 13% of respondents from Viet Nam were currently doing the majority of their projects green, but 61% expected to do new green commercial construction in the next three years. Market and client demands were the main driver for green building, while the lack of policy support, lack of trained green building professionals and higher first costs seemed to be the main barriers to green building adoption in the country.

The development of green buildings in Viet Nam is still in its infancy, with approximately 40 building certifications, the majority of which are in the industrial sector. Due to a lack of enforcement of regulations, global corporate guidelines have been the only real drivers. In addition there was no need hitherto to reduce operating expenses due to low energy prices. However, green building practices are slowly emerging as an important facet in the construction sector.

Most production of RCA takes place in urban areas (like HCMC) associated with building demolition activity, low availability of landfill and high aggregates prices.

All these factors point to a significant opportunity to promote use of recycled aggregates for use in "green" construction in the coming years.

6.3. Low grade materials for land raising

Use of low grade, but inert materials (for example, coal mine overburden, coal washings, steel slag) can be used for land raising applications, provided there are no impacts due to leaching (for example of heavy metal trace contents). However, some of these may better be beneficiated by cement producers, and may thereby attract a greater commercial value. Coal slag (or fly-ash) would arguably better be used by the local cement producers as alternative materials to clinker.

In 2019, a new Viet Nam standard called TCVN 12660:2019 on ash from coal-fired power plants was published(21): This standard sets out the technical, construction and acceptance requirements for its use in construction of highway embankments. The standard identified certain risks which might limit the ability to apply this resource in the VMD and limited its use to the construction of embankments, but not in areas prone to flooding or at groundwater level.

Sea sand, if not washed, is generally less suitable for use in structural concrete because of reinforcing steel corrosion and efflorescence concerns; also near-shore extraction of sea sand may only exacerbate coastal erosion (as seems to be the case in Kien Giang and Tra Vinh in the VMD). It may be that additional consideration could be given to extraction of marine sand or aggregates several kilometers offshore (as in the UK case study), if suitable marine resources exist at modest depths, though that would require specialist dredging vessels and rigorous controls.

In Europe, the chloride limit is placed on the concrete producers, and the supplier of sea sand or marine aggregates has to declare a maximum chloride value which will not be exceeded. For use in reinforced concrete, the sand has to be washed in clean (non-saline) water, while seawater washing is acceptable for producing unreinforced concrete. The National Standard TCVN 9205:2012[22] for crushed sand in concrete and mortar, Table 2, sets limits for acid-soluble chloride content of <0.01% by weight when used in pre-stressed concrete and <0.05% when used in reinforced concrete and other concretes and mortars, though either may be exceeded if the total chloride ion content in 1m3 of concrete is <0.6kg. Other international research[33] confirms acceptability of use of washed sea sand in concretes under controlled circumstances.

6.4. Encouraging sand sustainability through economic levers

6.4.1. Application experience in the world

Without external action in the sand market, the costs of river sand for construction and land leveling will be equal to costs of extraction (which can be very typically less than $1/tonne) plus handling and transport to the customer site plus the operator profit margin. The capital entry barriers to entry are also very low, sometimes reportedly with low quality “home-made” equipment being used. The result is that an irresponsible operator can rapidly exploit an area and enjoy considerable profits, despite the very high externalities involved in uncontrolled river sand extraction.

Intervention by the state can change this by effecting and enforcing legislation that internalizes those externalities and uses economic levers to achieve more sustainable development outcomes using technically acceptable alternatives to river sand.

Cost internalization can be achieved by a range of policy options including:

- Restricting supply: The banning of river sand extraction in parts of India led to prices for sand spiking at up to $38/t (see above). In turn, this led to rapid investment by hard rock quarries and conversion of the local construction sectors to M-sand.
- River sand royalty or aggregate tax: Where river sand sub-surface mineral ownership lies with the Indian States, it is possible to impose a royalty on river sand. In India, typical royalties imposed vary, with a range up to $1/t. As an alternative, a state can opt to charge an aggregate tax, such as is applied in the UK, where the current level of taxation is $2.77/t. This approach works where alternatives to river sand do not attract a royalty or tax payment, so that the final cost differential benefits users of alternatives.
- Auctioning blocks of river sand: With a central permitting authority, it is possible that only those blocks identified by that authority can be exploited and that the rights to do so can be secured by certified responsible operators by winning a transparent auction.
- Tender and operating bonds: Further costs can be imposed on river sand by requiring operators to pay tender bonds and operating bonds. This has the added benefit of restricting potential operators to those capable financially of extracting and restoring the blocks professionally.
- Landfill tax: Financial incentives can also be extended to increasing the costs of landfilling, through both a landfill tax and exacting engineering requirements for landfills. This, in turn, will have the secondary effect of incentivizing recycling Construction and Demolition wastes as aggregates and fill. Landfill taxation Europe can exceed €100/t.
- Norms and green labels: Adjustment to norms to give preference to alternatives and to restrict the technical usage of river sand can lead to a commercial preference for M-sand and recycled aggregates. Equally, green labels such as LEED are finding increasing global application, where construction project owners can specify that construction contractors have to achieve a certain level of points achieved in part by using sustainable sources of construction materials.

An increasingly common component of the solution is a phased change from natural to manufactured sand. This can require both user-friendly promotional communications and PR, successful case studies (for example, on overall cost per cubic meter of concrete from using M-sand), as well as financial incentives along the construction value chain to specify/use responsibly sourced sand.

It is proven that such actions towards responsible extraction benefit most stakeholders and can be for the general good of local society. Accordingly, in parallel, a “responsibly sourced” certificate for legally extracted sand and aggregates could be introduced as an auditable requirement for project developers, with failure to demonstrate that sand and aggregates have been responsibly sourced leading to fines and penalties.

Hence, a key recommendation of this study is to make this decision a reality with proper financial incentives to fund the change and its monitoring and enforcement. What is missing to date is the

economic lever to align interests along the construction value chain, so that stakeholders can all benefit from not using river-based sand. This should include the communities along the rivers.

The legislation can facilitate auctions to take place. This opens a potential route to drive up extraction costs as well as provide funds to finance a greatly increased regulatory, permitting, monitoring and enforcement effort.

Refinements to auctions could include some or all of the following:

- Use of bonds to ensure that bidders have the financial and technical resources to perform satisfactorily and responsibly.
- These may include:

    - Tender bonds lodged in advance of auctions (refundable in the event that a bid is unsuccessful). The level of such a bond could be set at the level of, say, €1-2/m^3 and would be retained by the permitting authority in the event of a successful bid.
    - Performance (or rehabilitation) bonds lodged by successful bidders to guarantee technical performance conditions, including site restoration on completion, returnable on certified completion of an extraction block.

- Bidding beyond the tender bond should have a minimum reserve price (or royalty) per m^3, in order to drive up extraction costs and fund the responsible authority's costs.

6.4.1. Application ability in Viet Nam

While banning river-based sand and gravel extraction (or tightly restricting it with extraction being limited to within annual regeneration) are desirable ultimate goals, the unintended consequences of imposing policies in isolation can include supply shortages affecting economic development and delaying construction programs, rising "black market" prices for sand and even potential for criminalization of extraction (described by UNEP as the "sand mafias").

Hence, the solutions for addressing the impacts of river-based sand and gravel extraction should therefore ideally consider the wider implications for overall sustainable development, putting in place practical solutions which can assure a managed transition to the ultimate goal with a portfolio of measures which fulfil overall national sustainable development objectives, balancing environmental, social and economic outcomes. For the Mekong Delta, specific lessons can be learnt to adopt policies which can satisfy the various interest groups in the economic landscape.

Given the gravity of the current situation in the VMD, the starting point for permitting should be that extraction is permitted only in specific, highly defined blocks of material with precise Cartesian co-ordinates and when the maximum volume of material to be extracted can be delineated by the permitting authority. With sufficient professional resources and equipment, individual blocks can be identified for auctioning to accredited operators.

As confirmation of the advisability of such a strategy, a 2017 report by the Institute of Transport Science and Technology suggested to the HCMC Department of Transport indicated that artificial sand could be made for up to 15% more cheaply than mining natural sand and that it makes better quality concrete. The shortage has apparently been partly created by a government crackdown on illegal sand dredging. The effectiveness of this campaign led to a 200% rise in prices, and this in turn has put pressure on infrastructure projects with large concrete requirements. Maybe the transition to alternatives to river sand is already taking place, driven by market forces.

In private discussions with a senior member of the Viet Nam construction materials industry, the Consultants were advised that typical maritime transport costs of dry bulk materials from central Viet Nam to the VMD is of the order of \$5-8/m^3 for a distance of 500km. If the cash costs of M-sand production (including capital) is of the order of \$4-7/m^3, it means that sand prices in the MKD would

need to be over $12-16/m3 to provide a strong commercial incentive to switch to M-sand from central Vietnam. With sand prices in the VMD now reported to be up to $10/$m^3$ in the wet season and up to $16/m3 in the dry busy construction season (driven by a huge demand in highway construction), this means that the market conditions are now emerging that will incentivise the investment in the production of M-sand and its transportation to the buoyant VMD market.

Optionally, until such quarries can be developed, aggregates and/or manufactured could be imported from responsible international suppliers. Importation has advantage of quickly acting to reduce the current over-extraction in the Mekong Delta until the indigenous hard-rock quarries in Viet Nam can fill the demand gap.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The impacts of excessive sand extraction in the Mekong Delta have been documented in many reports, driven primarily by the burgeoning sand demand in the high-growth national and regional construction sector. The reducing availability of sediments is exacerbated by the building of hydroelectric dams, and may also be worsened by the impacts of climate change. There is a resulting significant loss to fishing and rice cultivation in the Delta region, compounded with riverbank erosion and saltwater intrusion. The latest estimates indicate a threefold reduction in sediment transport over the last three decades, and a similar reduction in the sand component to possibly only 3-5mt/year now. Thus the over-extraction of sand requires urgent remedial measures.

The demand of aggregates in Viet Nam is estimated at about 4 tons/capita, which translates to 400mt/year nationally, of which 100mt/year of aggregates are used in the combined VMD and HCMC region, with its population of 27m people. While the sand component of this might be 30mt/year, the indications are that total sand demand significantly outstrips river supply, though there may be unquantified supplies also from non-river sources. This again implies measures to better regulate river sand extraction within sedimentation budget, and to develop supplies of alternatives such as manufactured sand and recycled and other waste materials.

Section 4 looks to successes and failures of legislation and regulation concerning river extraction in twelve countries, namely China, India, Malaysia, Colombia, Mexico, USA, Canada, New Zealand, UK, Netherlands, Myanmar and Japan, predominantly based on experiences of GAIN members. In each case, best practices and pitfalls are identified. This section also assesses for each case study the wider issues of permitting procedures, sedimentation estimation, technical best practice operating guidelines, including compliance monitoring and associated penalties. Some case studies (such as Mexico and Myanmar) admit lack of success that is mainly because of not meeting the requirements of the four elements: legislation and regulation, permission for river sand extraction and compliance monitoring. In addition, economic drivers and the needs of infrastructure development impact on the effectiveness of enforcement and enactment of legislation and regulation. Particularly, in Mexico, the illegally extracted sand and gravel are exported and sold to US construction companies at vast profits; in Myanmar, a construction boom has fueled a sharp increase in the extraction of sand. Case studies in India and Malaysia have just been partially successful. However, India has implemented the strategy that replacing natural sand by manufactured sands (“M-sand”), produced through crushing quarry fines, is being now adopted in other states. This program can be considered as a good practice to reduce pressure on river sand demand. In some countries like Canada, the UK and the Netherlands, river sand extraction only allowed to facilitate flood control, enhance river flow and river navigability. Besides, river dredging activities are regulated specific exploited areas and rigorous monitored. In developed countries (specific cases such as USA, New Zealand and Japan) river sand mining has been virtually eliminated, supply instead being from hard-rock quarries.

Section 4 also presents a combined overview of all of these case study experiences under the seven key headings for success which emerge, namely, mining and environmental legislation/regulation, permitting procedures, technical guidelines, compliance monitoring, the needs for regional project leadership and professional associations. These seven key success factors lead to corresponding recommendations as below.

Section 5 reviews the state of development of mining legislation and its regulation in Viet Nam. While the key laws exist, these are not implemented sufficiently in the context of sand mining.

Section 6 reviews some technical options for alleviating pressure on sand extraction in the VMD, through the supply of alternatives. These can include manufactured sands (assuming these are sustainably produced), recycled aggregates from construction and demolition materials and other waste materials. International experiences of these options are covered, which can accrue the triple

benefits of replacing scarce natural sand while beneficiating by-product or “waste” materials, thus moving towards a circular economy.

7.2. Recommendations

The recommendations are arranged in hierarchy of priority based on favorable implement conditions in Viet Nam

7.2.1. Over-extraction of river sand in the VMD

Sedimentation quantities in the VMD should be re-assessed, a project (outside the scope of this report) understood to be currently underway. This is necessary in order to introduce a permitting regime within the river sedimentation budget and to better assess and promote alternative sand supply options.

7.2.2. Mining and environmental legislation and regulation in Viet Nam

The Consultants suggest that the **National Mining Law of 2010** could include specifics like:

- Vesting river sand mineral ownership (or at least permitting rights) of river aggregates in the State at central level (if not already done) and to remove any permitted development rights for river sand.
- Introduction of a single Lower Mekong Delta-wide process where the central permitting authority identifies clearly designated blocks (with 3-D spatial specifications and requirements such as timing, extraction methodology, restoration, management systems, reporting etc) with each block auctioned by a transparent process but only for certified “responsible operators”, who would have to be certified following a rigorous qualification process and lodging of tendering and operational bonds (the former repayable if not successful or on completion of the extraction and restoration of the river sand block). The certification scheme could potentially be created and run with the assistance of a professional aggregates association.
- A presumption against excessive river sand extraction with allowance for the central licensing body or Ministry to authorize extraction with strict limits on VMD extraction in a particular zone to not to be greater than the recharged volumes in each year and higher royalties throughout the delta.
- Where the authority decides to permit specific blocks of river sand for extraction, only certified “Responsible Operators” (see below) would be allowed to bid in a transparent online auction, access to which would require both a non-refundable tender bond and a commitment to depositing of a rehabilitation bond if the bid is successful.
- A significantly reinforced and rigorously implemented criminal sanction scheme for illegal mining activity with much higher financial penalties, confiscation of equipment and imprisonment for offenders and under-reporting of volumes and evasion of royalties and other taxes.
- Introduction of a “Responsible Operator” certification scheme for companies to allow them to bid for river sand permits. Only such Responsible Operators would be allowed to conduct extraction operations using equipment which would also have to approved by the authority.
- Enforcement of accurate extracted volume reports and payment of a centrally-stipulated standard royalty for every ton extracted, which adequately internalizes externalities (with exemptions for manufactured sand, recycled aggregates and wastes used for land raising).
- Introduction of a “Responsible Sourcing” certification scheme for construction aggregates and land raising materials. These would have to accompany any supply of such materials, failure by construction project developers to be able to produce certificates for materials used would be punishable by fines.
- Royalties, fines and the proceeds of auctions could be paid to the regulatory authority to internalize the externalities of sand mining and be hypothecated for use in Lower Mekong Delta protection activities (including funding of: (1) the personnel and operating costs of the authority, (2) monitoring and enforcement activities, (3) the costs of the LMD Sand Project, Leader (see later), as well as (4) financial incentives to communities who actively work against illegal extraction – maybe as some form of monitoring grant per km for communities on each side of

the rivers). Crucially, these additional costs would also aim deliberately to drive up the price of river sand (thereby making alternatives more economically attractive).

- For discussion, the target additional costs should result in the price of river sand delivered to construction sites in the MKD to be at least equal to that of M-sand transported (probably by sea and waterway) from rigorously permitted and monitored fixed point hard rock quarries located in the middle and north of the country. The latest data on rising VMD sand prices indicates that that such alternative sourcing of sand could now become commercially attractive.

While Article 82 of the 2010 Law defines the Ministry of Natural Resources and Environment as the competent overall authority, provincial-level people's committees may currently grant mineral exploration licenses and licenses for mining of minerals for use as common construction materials. The consultants suggest that there should be only one single regulatory and permitting authority. This should be **a supra-provincial level, for example, MoNRE or MARD** or a new river basin authority – which could also include control (or at least co-ordinate the activities of relevant ministries and government organizations) over other activities, such as fish farming, dams, tourism, riverbank development etc. to circumvent regulatory and monitoring avoidance and other unintended edge effects where provincial boundaries run along watercourses.

The consultants agree with the **Government Resolution 120 of 2017**, but would suggest the need to draw on experience in other river basins. *Firstly,* coordinating all actions under one regional or national authority. A first step to which has now been taken with the creation of a Mekong Coordination Council[20] to regulate sand mining extraction regulatory activities. *Secondly,* with an additional focus being provided by a high-level, respected project leader who could ensure informed and constructive alignment, unblock impediments at high level, champion changes to legislation, regulation, norms and standards, co-ordinate effective communication strategies to promote the usage of alternatives to river sand and lead interactions with other upstream nation states, whose activities can also affect the VMD environment and sand recharge situation. The high level champion would need access to the highest levels of Government capable of resolving issues and cutting through red tape to champion benign changes in legislation etc. and to lead interactions with upstream Governments.

As regards the **Government Decree 36/2020**, the consultants see that penalties defined in legislation is a positive step. However, the level of fines and penalties are modest and do not represent significant disincentives to irresponsible or illegal behavior. For example, the maximum fine for an organization is stipulated at €72,800. As a maximum, this is a relatively inconsequential sum and may be viewed as a "cost of doing business" by an irresponsible operator. It is suggested that more draconian measures are contemplated to provide a real and meaningful deterrent to illegal and/or irresponsible behavior. Such measures could include:

- Immediate Cease and desist Order for the affected site and operator.
- Withdrawal (or suspension) of the Responsible Operator certificate.
- Confiscation of the extractive, treatment and transportation equipment of the operator.
- Fines to have both a minimum and maximum absolute amount (but at much higher levels, say a minimum of VND10bn and a maximum of VND100bn).

Greater certainty that operations will be carried out legally, responsibly, in line with permit conditions can be achieved by a central certification of **Responsible Operators** using specific and measurable criteria for qualification, which alone would be permitted to bid for mining blocks. Responsible Operator status would allow an organization to have access to profitable, but strongly regulated and controlled, river extraction activities. Withdrawal of such a certificate would have profound commercial and financial implications for a company.

7.2.3. Learning from International Best Practice in River Extraction

A persistent theme from the case studies (as outlined previously) is that **consistency of permitting and enforcement** needs to be achieved by having a single responsible authority, which acts as a highly-visible single permitting process and authority for the river basin, with a close collaboration between authorities along the length of the river. This is ideally accompanied by certification of

responsible, financially solid operators with excellent track records, which will be the only organizations permitted to extract river sand with close control over their operations and clear, meaningful penalties for infringements of permits.

The current situation in the VMD is that provincial authorities (sometimes with boundaries along river channels) seem to be responsible for permitting and enforcement. Given the urgency of the situation in the Mekong Delta, it is recommended that mineral ownership, permitting, monitoring/policing and enforcement are all explicitly vested at the national level, with the potential for the Viet Nam Government to delegate the permitting, monitoring and enforcement elements to one single Mekong River Authority with a directorate composed of competent civil servants, with political oversight.

There are a number of countries (including China, India, Malaysia, Colombia, New Zealand and UK) where detailed **technical guidelines** have been developed for river extraction, which could be suitably adopted for use in the case of the VMD. Several of these define in considerable detail when and where extraction can take place, with prohibitions on extraction close to various types of utility infrastructure, constraints on the location of material stockpiles, the type of extraction equipment to be used, including safety aspects. The basic technical guidelines included under Decree 23/2020 should be expanded into a detailed code of good practice by the regional permitting authority, ideally to be developed in consultation with the mining operators in the VMD.

The most successful case studies in phasing out of illegal river extraction (namely China, India, Malaysia and Colombia) are marked by determined detection of any continuing illegal activity (by GPS monitoring, use of drones, etc.), combined with a range of sanctions and penalties including progressive fines, confiscation of loads or trucks and even imprisonment of repeated offenders.

Experiences from GAIN member show that, to be successful, there has to be very strong action by the relevant authorities, not just in regulation, but also in implementation and monitoring. GAIN experiences from other jurisdictions show that it is necessary not only to specifically permit river/delta extraction areas and quantities, but to also introduce GPS tracking of operating vessels and of all delivery trucks, to ensure compliance. It is also highly desirable that the concrete industry suppliers and construction contractors cooperate through purchasing of aggregates certified to be responsibly-sourced.

In **compliance monitoring**, enforcement of permits and legislation in the VMD over an area of 40,500km^2 is a big task, yet can be achieved with an empowered regional authority equipped with sufficient policing resources. Local communities need to be enlisted through hotlines, social media etc to report infringements and will need to be reinforced with satellite imagery and drone monitoring. Key penalties need to include greatly increased fines, confiscation of plant or even imprisonment for serious and repeated violations; other disincentives can be withdrawal (or suspension) of the Responsible Operator Certificate, thereby cutting off the operator from his/her source of value creation.

The appointment of high-profile, respected **project leader or champion** to drive and enforce change, co-ordinate action between different Ministries and the permitting authority and to communicate forcefully on economically beneficial alternatives to river sand both locally and in upstream countries.

In Viet Nam, with so many parties potentially involved in regulation, permitting, monitoring and enforcement, there can be potential for delays in achieving alignment and implementing desirable strategies and regulations. To overcome this, Viet Nam may wish to consider the approach (as deployed, for example, in China, India, Malaysia and Colombia), where a single high-profile, respected and influential individual is appointed as Project Leader for the VMD with a term, say, of three years and a brief, which would ensure delivery of overall Government objectives in reducing/elimination river sand extraction and allow direct intervention in order to deal with bureaucratic blockages, to champion the rapid passage of new legislation, regulations, guidelines, norms and standards and to lead interactions with upstream countries.

Creation of a **professional aggregates and/or a construction industry association** is highly desirable to provide an effective interlocutor for regulatory authorities, to assist the permitting authority

in the certification of responsible operators and a focus for continuous industrial improvement as well as leading on green labels (which for example would require certificates of source for sand and aggregates and penalize the use of river sand) and on revised sand, aggregate, norms, applying also to manufactured and recycled sand and aggregates. It would appear that the Ministry of Construction could put these into effect.

7.2.4. Developing alternatives to river sand

Promote the production of high quality **manufactured sand** from hard-rock quarries (if not within the VMD, in central or northern Viet Nam) a measure that is being deployed with significant success in case study several regions. Indications are that there are some hard-rock resources within the VMD, but the licensing/permitting regime hitherto does not sufficiently encourage development.

Promote the sorting and **recycling of construction and demolition waste** to produce both concreting aggregates as well as lower-grade leveling fill, with the potential additional benefits in reduced landfilling and aggregates transport. Also promote optimal beneficiation of low grade, but inert wastes for land raising applications.

Suggested introduction of a **responsible sourcing certification** scheme for construction aggregates and land raising materials. These would have to accompany any supply of such materials, failure by construction project developers to be able to produce certificates for materials used could be punishable by fines.

Royalties, fines and the proceeds of auctions could be paid to the regulatory authority to **internalize the externalities of sand mining** and be hypothecated for use in Lower Mekong Delta protection activities (including funding of: (1) the personnel and operating costs of the authority, (2) monitoring and enforcement activities, (3) the costs of the LMD Sand Project, Leader (see later), as well as (4) financial incentives to communities who actively work against illegal extraction – maybe as some form of monitoring grant per km for communities on each side of the rivers). Crucially, these additional costs would also aim deliberately to drive up the price of river sand (thereby making alternatives more economically attractive).

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