Working togther toward sustainable sand mining and management.

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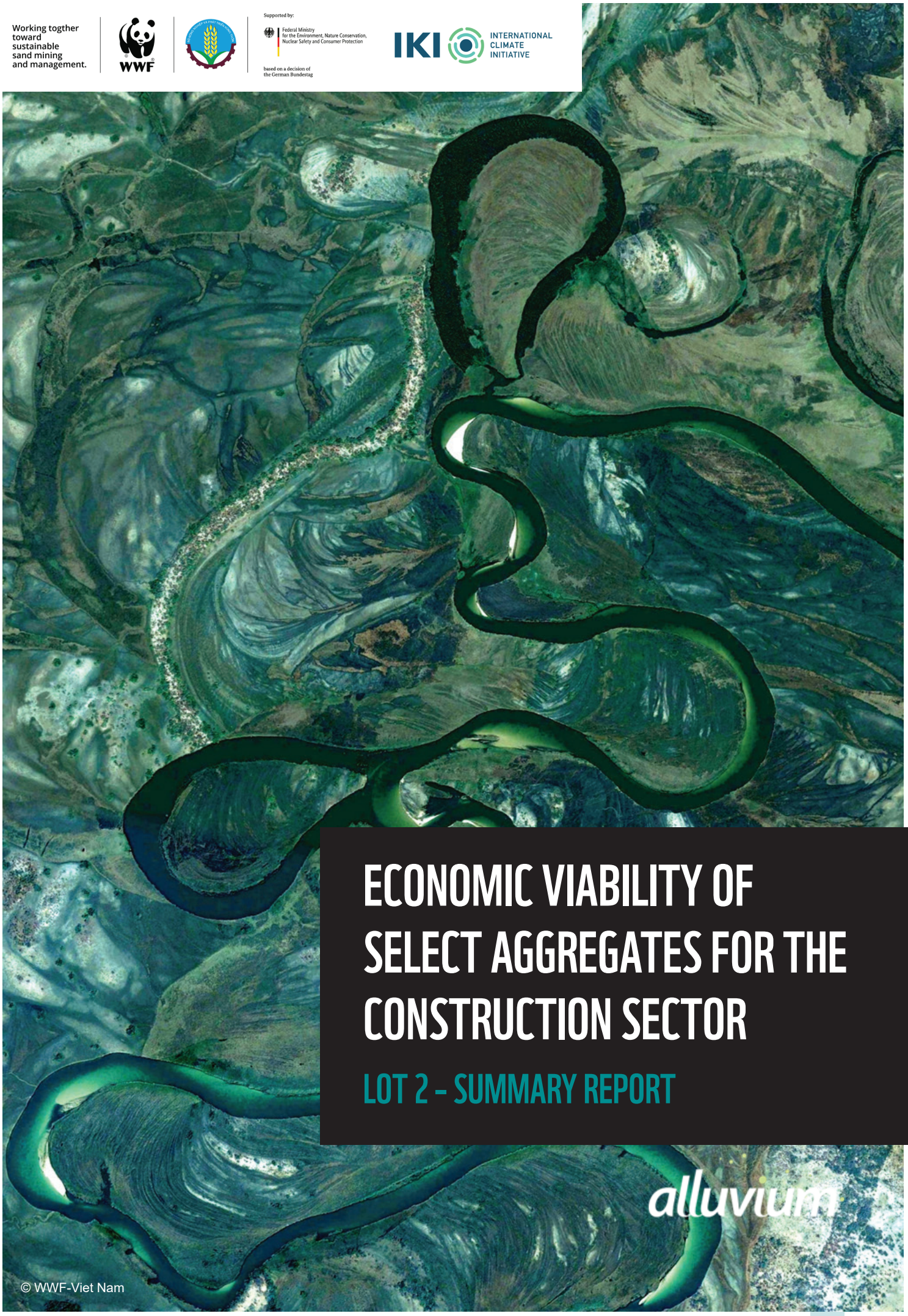

ECONOMIC VIABILITY OF SELECT AGGREGATES FOR THE CONSTRUCTION SECTOR

LOT 2 – SUMMARY REPORT

alluvium

Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

Artwork by Melissa Barton. This piece was commissioned by Alluvium and tells our story of caring for Country, through different forms of waterbodies, from creeklines to coastlines. The artwork depicts people linked by journey lines, sharing stories, understanding and learning to care for Country and the waterways within.

This report has been prepared by Alluvium International for World Wide Fund for Nature – Viet Nam (WWF-Viet Nam)] under the contract titled 'Consultancy service involving an assessment of the economic viability (profitability calculation) of select aggregates for the construction sector'.

This report is conducted by the Alluvium International and reflects the results of Alluvium International's research activities within the scope of the Project Drifting Sands: Mitigating the impacts of climate change in the Mekong Delta through public and private sector engagement in the sand industry" (IKI SMP), and Alluvium International's knowledge and expertise. The IKI SMP is managed by the Viet Nam Disaster and Dyke Management Authority, Ministry of Agriculture and Rural Development (VNDDMA) and the World Wide Fund for Nature in Viet Nam (WWF-Viet Nam) with the generous support of the International Climate Initiative (IKI), Germany. The contents of this report do not necessarily reflect the views of VNDDMA, IKI or WWF-Viet Nam. The degree of reliance placed upon the projections in this report is a matter for that reader's own judgement. The VNDDMA, IKI, WWF-Viet Nam and Alluvium International accept no responsibility whatsoever for any loss or conflicts occasioned by any person or organisation acting or refraining from action as a result of reliance on the study.

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Cover image: abstract river image, Shutterstock

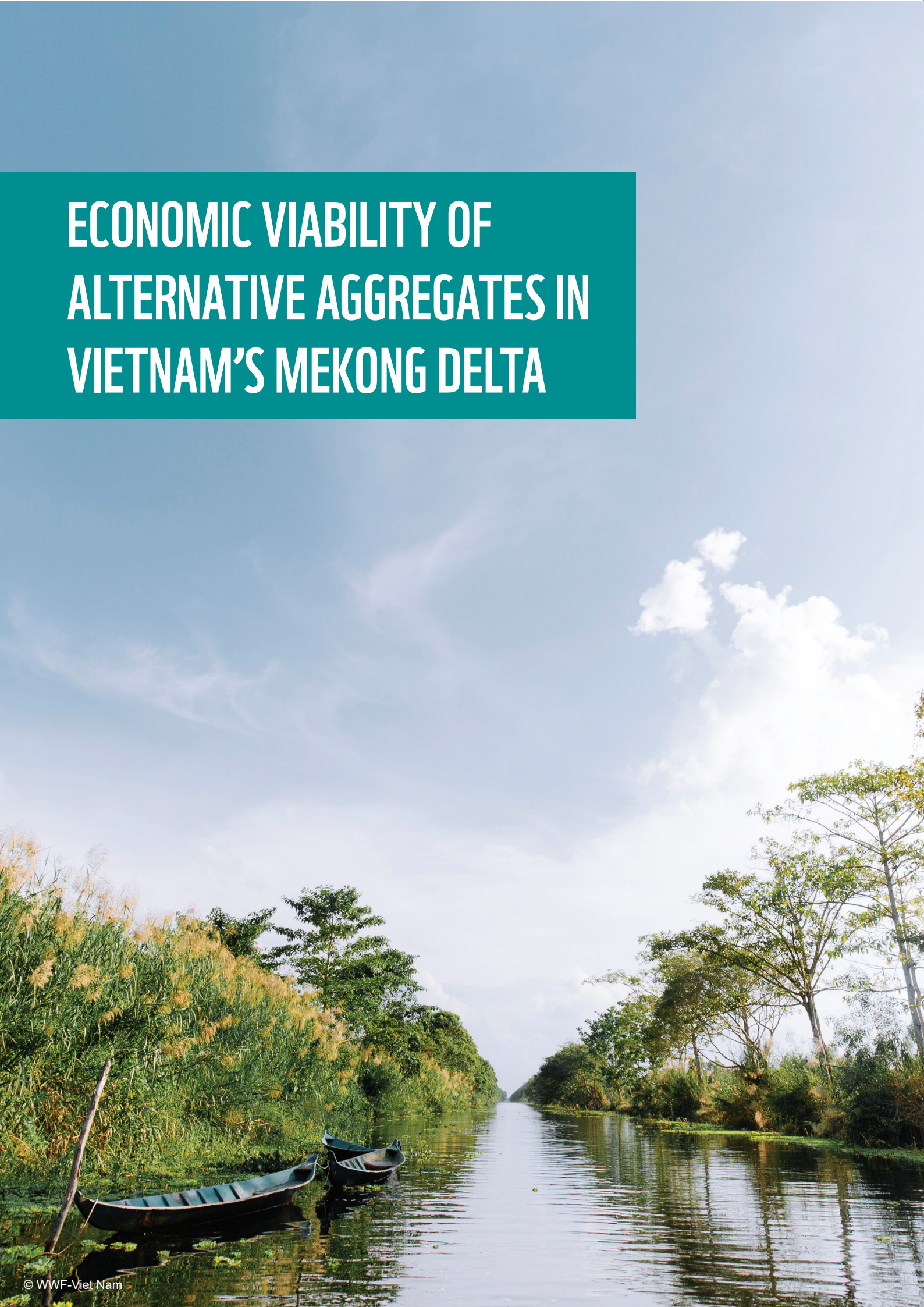
This document presents high-level policy guidance which communicates key findings and presents recommendations from the study commissioned by WWF-Viet Nam: **Ref 10.22- IKI SMP- Lot 2: Consultancy service involving an assessment of the economic viability (profitability calculation).** This is not intended to be an exhaustive list of options, but rather a brief consideration of some viable strategies to reduce the reliance on river sand. This document was written for brevity and any additional information can be found in the main report.

For this high-level study, simplifying assumptions were made by the project team to complete the project within the resource and budgetary constraints of the project. This process involved a rapid desktop review of available information shared by the WWF-Viet Nam project team as well as a web search of reputable sources (e.g., government reports, published research papers).

This study culminated in a cost-benefit analysis that found that for every USD 1 invested USD 1 invested, there are beneficial returns of USD 1.27. The total net present value of this is USD -0.08 B to USD 0.70 B While the **economic benefits of shifting to alternative aggregates appear modest** based on the scope of benefits quantified, the **environmental benefits could be substantial**. In effect, these results are conservative and underestimate the true economic benefits of using alternative aggregates.

Further research is needed to refine cost estimates and explore long-term viability of recycled concrete as a viable alternative.

ECONOMIC VIABILITY OF ALTERNATIVE AGGREGATES IN VIETNAM'S MEKONG DELTA



1.1. PURPOSE

The purpose of the study was to investigate the economic viability of using alternative aggregates to replace river sand extraction in Vietnam's Mekong Delta (VMD). The need for this investigation arises from the significant environmental threats posed by excessive sand mining in the region, including erosion, land subsidence, and saltwater intrusion. As sand mining resources are expected to diminish over time, the need for sustainable substitutes such as alternative aggregates become increasingly urgent.

1.2. MODEL OVERVIEW

Alternative aggregates

The economic viability of alternative aggregates considered in this study were:

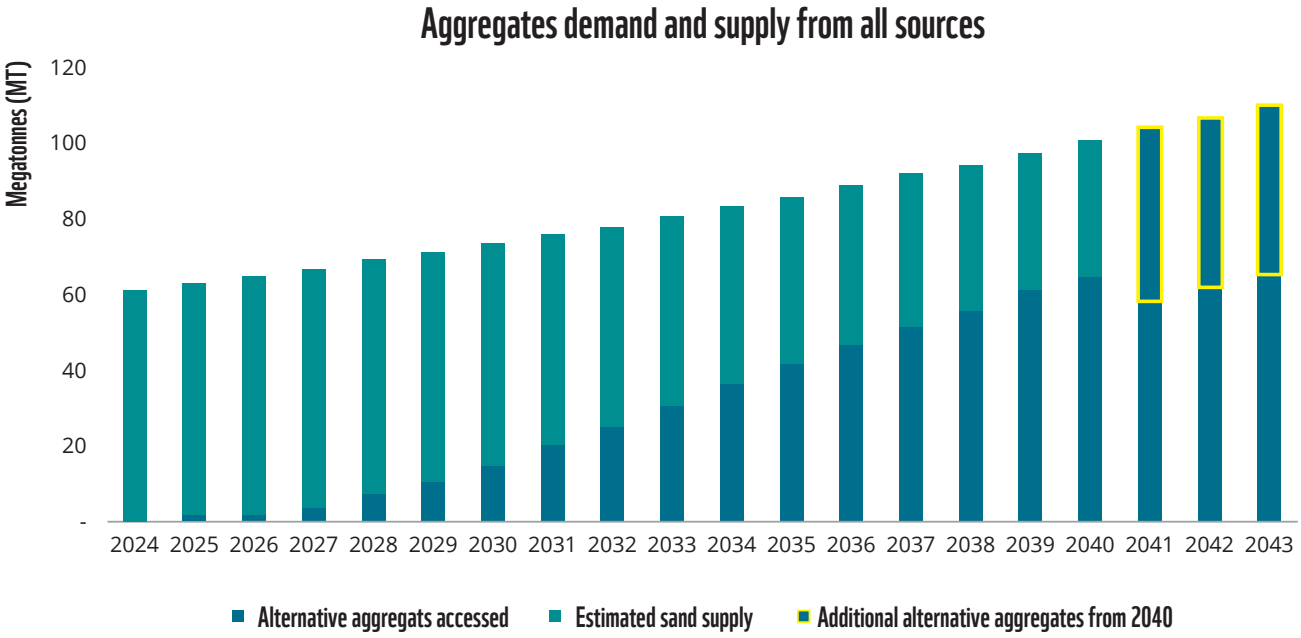
1. M-Sand,
2. Rice-husk ash,
3. Sugarcane bagasse ash,
4. Recycled concrete,
5. Glass waste,
6. Blast furnace slag,
7. Rubber waste (waste tyres); and,
8. Coal bottom ash

The availability of 8 alternative aggregates were investigated in the preceding project. Of these alternatives, manufactured sand **(M-Sand)** was the most promising alternative. **Recycled concrete** had some potential, but there was limited evidence that it could provide sufficient volume in the short term to lift the pressure on sand excavation in the Delta. New facilities may need to be built to expand production of M-Sand. There was insufficient data to suggest that the 6 alternatives were viable substitutes for river sand.

Forecasted growth

The diagram additionally illustrates the breakdown of annual supply between river and and alternative aggregates. The proportion of alternative aggregates compared to river sand supply grows gradually over time, as this reflects the declining availability of river sand and the increasing volume of alternative aggregates. **From 2040 onwards where river sand is depleted based on current extraction rates,** this supply will have to come entirely from alternative aggregate supply or from imports. It is projected that by 2043, the demand for aggregates will increase by 83% compared to the present day. Demand by 2043 based on this method is estimated at 158 M tonnes for the Viet Nam Delta.

The forecasting approach adopted in this study considers population growth as the main driver of aggregate demand. This implicitly considers a variety of different drivers such as urban development, large infrastructure projects, and other civil uses as contributing to the increase in the demand for aggregates.



Model approach

A cost-benefit analysis (CBA) approach was used in this study. A cost-benefit analysis (CBA) helps compare the pros and cons of different options. It considers both the upfront costs and the long-term benefits of a project or policy. This approach assesses the net benefits of a new project or option, where the net benefits are assessed and estimated – all compared to a base case (sometimes called a do nothing differently case). A 20-year evaluation period was used for this analysis.

The steps to the CBA are presented in the diagram below:

Identify benefits and costs for the different options

- Identify all costs and benefits to society
- Determine data and resources required to value the identified costs and benefits

Quantify impacts

- Quantify physical impacts options over a specified timeframe
- Use valuation techniques, appropriate default values. Monetise the costs and benefits

Discount benefits and costs back to present values

- Use the appropriate real discount rate as per the Department of Treasury and Finance guidlines
- Ensure only real prices are used to maintain consistency with the use of a real discount
- Determine the appropriate appraisal period

Aggregate benefits and costs

- Calculate Net Present Value (NPV) and benefit cost ratio (BCR) for each option
- Use NPV and BCR to help rankd the options

Assess risk and uncertainty

- Indentify risk and uncertainty with the options analysed using scenario anaysis incuding Monte Carlo analysis
- Analyse and discuss how the above assessment may affect the feasibility and ranking of the options

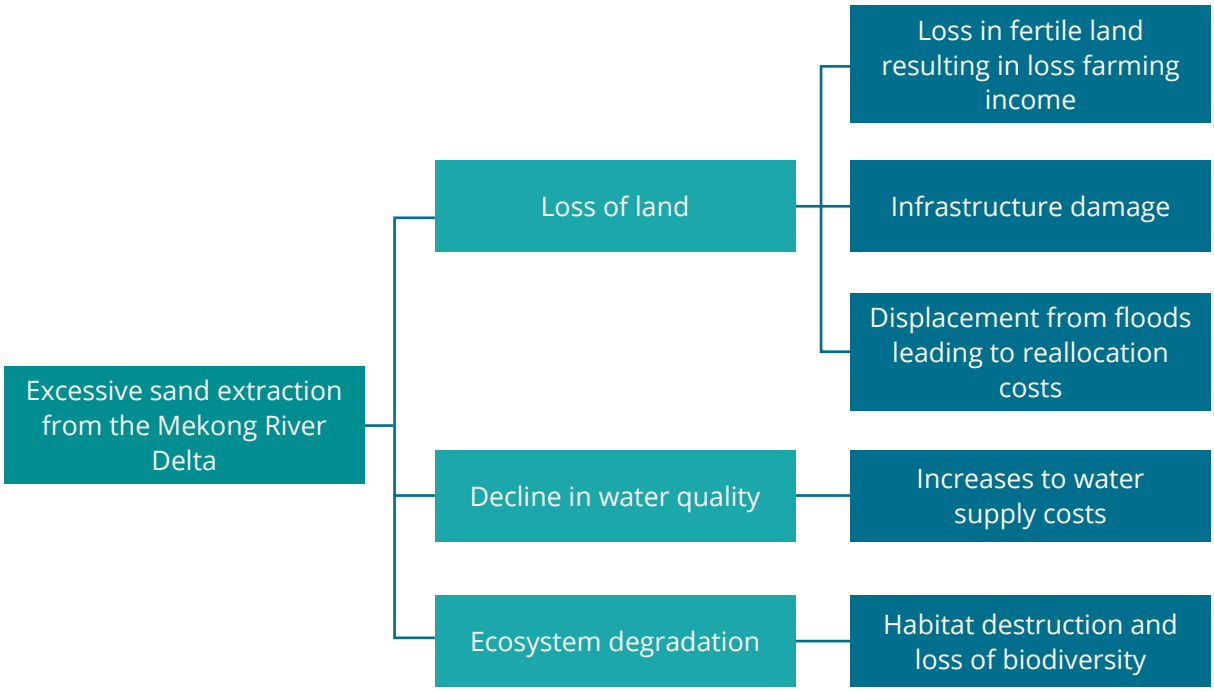
Assess distributional impacts

- Identify the impacts on different groups in society that are likely to be affected by the different options

Assess result and determine a preferred option

- Analyse overall results including the NPV and BCR, distributional impacts, scenario analysis
- Recomment the final preferred option(s)
- Present findings and a recommentdations

Tóm tắt các tác động được mô hình hóa của việc khai thác cát sỏi quá mức dựa trên phương án cơ sở (hoặc hiện trạng) được trình bày ở sơ đồ dưới đây.



Scope of assessment

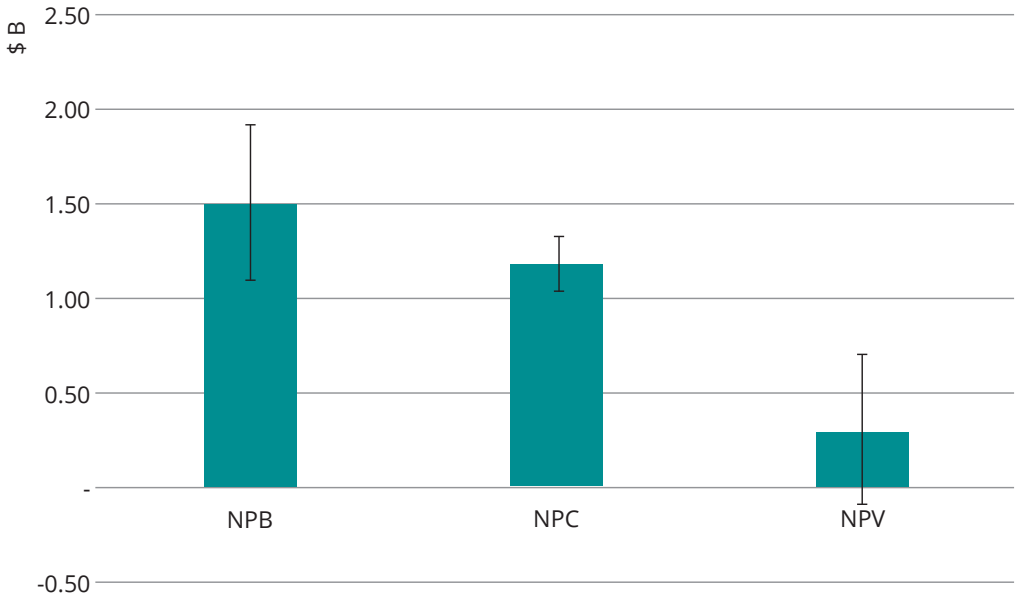
There are several impacts that are considered in the CBA. However, not all impacts can be valued in monetary terms and included in the quantitative analysis/CBA modelling due to data and information limitations. The table below outlines the key impacts assessed and how they are treated in the CBA – both in terms of their inclusion in the base case, and their inclusion in the manufactured aggregates case.

Inclusion and section of this report	Description
Riverbank Erosion/Collapse (Section 2.2)	Sand mining and riverbed erosion are making the Mekong Delta lose its coastline. This is causing saltier water to move inland, threatening the Delta. Studies show that sand mining contributes between 5% and 20% of the problem. Hard infrastructure options will need to be constructed to stabilise the streambank to avoid riverbank collapse.
Impacts on agricultural productivity (Section 2.3)	Climate change and human activities like dams are reducing freshwater flow in Vietnam's Mekong Delta. This saltier water is harming rice crops, a major source of income for the region and a significant area of farmland have already been affected by saltwater intrusion. Farmers may be able to switch to salt-tolerant rice varieties, but the impact of adaption is not considered in this study.
Impacts of use of manufactured aggregates on commercial operations (Section 2.4)	From the construction industry's viewpoint, the benefit of using alternative aggregates are the lower unit costs (USD 8.12 for M-Sand) relative to river sand (USD 13.54 per tonne). Previous reports have suggested that they stand to benefit from a price differential of USD 5.42 per tonne as M-Sand will be cheaper than river sand. As recycled concrete represents a growth opportunity, it is assumed in this study that a new concrete and demolition waste recycling facility will need to be built to supplement the generation of alternative aggregates. The costs of transport and logistics are also considered in this study. Only the marginal costs of transporting M-sand relative to river sand is considered in this analysis.

Treatment in base case	Manufactured aggregates case	Comments
Riverbank erosion (a cost).	Avoided expenditure on riverbank stabilisation infrastructure (a benefit)	Included in quantitative CBA modelling. Significant quantitative sensitivity conducted. This is primarily a direct impact on affected landholders and an indirect impact on the broader community.
Lost agricultural productivity due to salt intrusion (a cost).	Reduced losses in agricultural productivity due to salt intrusion (a benefit).	Included in quantitative CBA modelling. Significant quantitative sensitivity conducted. This is primarily a direct impact on affected landholders and an indirect impact on the broader community.
No change to current practice.	For the potential volume of manufactured aggregates produced, change in net costs of production and transportation to end users. This includes full costs of manufacture and change sin logistics/ transport costs (savings are a benefit)	Included in quantitative CBA modelling. Significant quantitative sensitivity conducted. This is primarily a direct impact on producers and users of aggregates.

1.3. RESULTS

The analysis, presented in a 20-year timeframe, yielded a modest benefit-cost ratio (BCR) of 1.27, with variations between 0.94 and 1.60. While this suggests potential economic benefit, the significant variation in net present costs compared to net present benefits indicates a possibility of outweighing downsides. The uncertainty highlighted by the sensitivity analysis around the BCR implies the need for additional financial or legislative tools, such as subsidies or taxes, to incentivize a wider adoption of alternative aggregates.



1.4. POLICY STATEMENT

The central aim of the policies recommended in this report is to advocate for the transition from river sand extraction to the use of economically viable alternative aggregates in the VMD region. This transition should be guided by a comprehensive understanding of the availability, cost-effectiveness, and environmental impact of alternative aggregates.

The policy recommendations discussed in this paper cover a range of different approaches.

Policy suggestion 1 – Regulation and enforcement

Some potential options under this include enhancing regulatory standards and enforcement measures for aggregate extraction, such as bans in sensitive environmental zones, stricter licensing, and controls, and cracking down on illegal extraction.

Amendments to procurement policies by the Government of Viet Nam can encourage sustainable practices and incentivize the production and use of manufactured aggregates. Considerations for altering the allocation process, including access fees or competitive tenders, could be explored to better manage and regulate aggregate extraction.

Implementing enhanced regulatory standards and enforcement measures for aggregate extraction can be time intensive due to legislative processes and stakeholder consultations. Challenges include potential resistance from industry stakeholders, balancing environmental protection with economic considerations, and ensuring effective enforcement mechanisms to prevent illegal extraction despite stricter regulations.

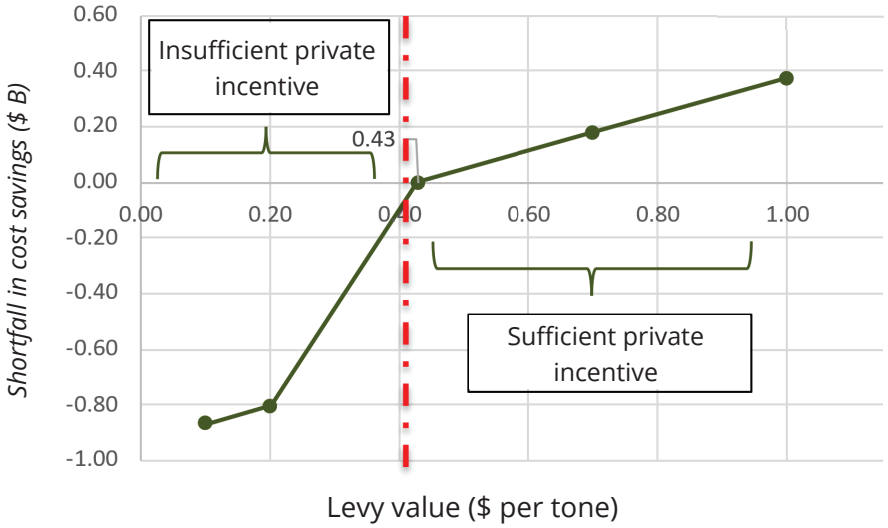
Policy suggestion 2 – Levy on river sand mining

The policy aims to address the negative impacts of aggregate extraction, particularly sand mining, by implementing a tax structure that reflects the true social and environmental costs associated with this activity.

Considering the dominance of river sand in the construction industry and the lack of incentives for alternatives, a levy on sand mining companies is proposed to increase prices and encourage the adoption of alternative aggregates.

Determining the appropriate tax and understanding the implications of levy imposition at different points in the supply chain require additional research and analysis.

Potential impact of a levy on sand mining



Developing and implementing a tax or levy structure to address the negative impacts of sand mining may take several months to a year. Challenges include potential resistance from sand mining companies and the construction industry due to cost increases, determining an appropriate levy amount, and addressing evasion or loopholes in the levy system.

A high-level estimate of the appropriate tax amount to charge is displayed in the figure. The diagram shows the how the difference between the private benefits of sand mining less the total costs of adopting alternative aggregates change as a levy on sand mining increases. An increase in the levy value will make alternative aggregates relatively more attractive relative to river sand.

Based on the current data, it is estimated that a levy value of USD 0.41 per tonne of sand mining would be required to ensure users of sand aggregates are indifferent between extracted and manufactured aggregates (i.e. the cost to end users is the same). Levy values to the left of this are insufficient to incentivise behaviour change, as there is still a shortfall in the cost savings. Levy values after this point may be sufficient to drive behaviour change as it is now economical for private actors to switch to M-Sand and recycled concrete materials.

Policy suggestion 3 – Subsidies on alternative aggregates

Offering tax incentives or grants for companies investing in recycling infrastructure like crushers and sorting facilities can encourage the use of recycled concrete aggregates in construction projects.

Government investments in dedicated crushing and sorting facilities for concrete and demolition waste recycling can further increase the supply of high-quality recycled aggregates.

Subsidies can also incentivize alternative aggregate use, with varying effectiveness based on design. Volume-based subsidies may encourage greater adoption compared to flat-rate subsidies, although they can be costly to implement.

Designing and implementing subsidy programs to encourage the use of alternative aggregates requires financial planning, policy development, and administrative setup, which can be time intensive. Challenges include structuring subsidies effectively, allocating sufficient budgetary resources, and monitoring their impact to ensure effectiveness.

Policy suggestion 4 – Building codes and standards

It's essential to tackle regulatory barriers hindering the widespread adoption of M-Sand. This includes streamlining environmental permits and approvals for M-Sand plants to facilitate quicker establishment of production facilities.

Incentivizing collaboration among government agencies, research institutions, and industry stakeholders can promote knowledge-sharing and technology transfer, fostering innovations in M-Sand production processes and increasing uptake of alternative aggregates.

Integrating recycled concrete aggregates into building codes and procurement policies creates market demand, driving investment in recycling technologies. Public awareness campaigns can also promote the environmental and economic benefits of recycled materials, fostering sustainability in the construction industry.

Engaging the building industry in updating codes and policies is crucial to overcome perceived risks and promote the adoption of recycled concrete aggregates in construction projects.

Challenges to updating building codes and standards include overcoming industry resistance to new standards, ensuring practicality and enforceability, and educating stakeholders on the benefits and requirements of updated codes related to sustainable practices.

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