Newcastle University

Open Research Case Study

Shedding light on the murky world of sand mining in SE Asia

Chris Hackney

Newcastle University Academic Track Fellow, School of Geography, Politics and Sociology,

Introduction, providing a brief description of the case study:

More than 50 Bn tonnes of sand is extracted every year and forms the foundation for modern society. Yet, there is a paucity of reliable, global data relating to the levels and the location of this extraction. This limits global efforts to manage this resource and the resulting environmental and social impacts of its extraction. A recent UN report highlighted the need for open mapping and monitoring of sand resources (UNEP, 2022). In response to this I have developed a machine learning approach to detect sand mining vessels from high resolution satellite imagery and made this, and the resulting datasets, publically available. These are the first publically available datasets detailing the location of sand extraction activities through the Lower Mekong River in Cambodia and Vietnam. This work is currently informing regional level debates in the Mekong River Commission and the development of new laws within Vietnam to regulate sand extraction in the Mekong delta. It has also led to new scientific understanding of the impacts of sand mining on the Mekong river systems in Cambodia, its impacts on river bank erosion and environmental degradation..

Description of the research context in which the open practices were employed:

This research was undertaken as part of my ongoing NUAcT fellowship and a UKRI GCRF research grant (EP/V036394/1). These projects involve close collaborations with partners in Cambodia (Institute of Technology of Cambodia) and Vietnam (National Centre for Water Resources Planning and Investigation and the Southern Institute for Water Resources Research) who were integral to the design of the research and whom necessitated the use of open, freely available methodologies to ensure the methodology and approach could be operationalised as a routine monitoring tool for project partners beyond the duration of the project.

What open practices were used and why:

Open source machine learning techniques (Faster R-CNN) in widely used and freely available coding languages (R and Python) were developed. The analysis was conducted using publically available cloud processing software (Google Collab). This enabled partner institutions and organisations in Vietnam to co-develop and run the analysis, as well as operationalise the process beyond the duration of the initial project. Furthermore, two academic articles based on the research were published in open access journals (Hackney et al., 2021; Smigaj et al., 2023) and all code and datasets in these publications is freely accessible from online repositories. Thus, for the first time, spatial datasets of the location and rates of sand extraction in a global mega river are publically available.

What barriers or challenges were encountered, and how these were handled:

Barriers encountered included appropriate knowledge of coding and the methodologies deployed with regional partners. To overcome this a series of online workshops were held to upskill and train personnel in Cambodia and Vietnam in the use of coding and analysis. The sensitive nature of the sand mining industry in the region (which is a constant barrier to the publication of information on rates and locations of extraction practices globally) raised concerns with local partners regarding making the data publically available.

However through careful discussion with partners, national institutions and through due ethical considerations, the datasets and outputs were generated in an acceptable, spatially aggregated way.

What benefits were realised, and for whom, as a result of using the open practices:

The work has enabled local partners to begin environmental impact assessments in areas of high extraction, allowing them to target their resources at the most impacted regions. This will feed down to local communities who will benefit from more sustainable development and more secure livelihoods. Furthermore, the methodology developed here is widely transferable other regions, globally. This work is currently informing ongoing programmes by the World Bank, WWF, UNEP and national governments in Cambodia and Vietnam.

What lessons have been learnt from the experience?:

This work has highlighted the need for close collaboration and constant communication with key local partners. It has also highlighted the need for open practices to ensure that local partners and key stakeholders can continue the use of monitoring tools and realise the benefit beyond the duration of the initial project.

Conclusion, summarising the main take-away message:

Open research and data generation, combined by close collaboration with local and regional partners, has enabled the first datasets on the location and rates of sand extraction to be generated from high resolution satellite imagery.