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Editorial: The mangroves of Southeast Asia in the United Nation's decade on ecosystem restoration

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Editorial on the Research Topic
The mangroves of Southeast Asia in the United Nation's decade on ecosystem restoration

Introduction

Mangroves are recognized for several important ecological and socio-economic services they perform. The delivery of these services are directly linked to the livelihood and well-being of the societies that rely on mangrove forests, particularly on the provision of food and income and in protecting coastal human populations against the impacts of natural disasters (Sannigrahi et al., 2020). The largest and most diverse mangroves in the world are located in Southeast Asia (SE Asia), an area also considered to be a biodiversity hotspot (Bhowmik et al., 2022). Although global trends indicate mangrove gains in the last twenty years, mangrove losses are still reported in the region (Bryan-Brown et al., 2020). The causes of mangroves losses are not necessarily attributable to aquaculture ponds anymore (as was the case from 1970s to 1990s) but because of tremendous pressures for coastal reclamation/development, conversion to oil palm plantations, and to natural disasters (primarily typhoons and rising sea level (Hamilton and Friess, 2018). The region already has national-/internationally-awarded successful mangrove conservation and restoration programs as early as 1900s (Gerona-Daga & Salmo). However, the successes (or failures) of these programs are largely unreported and undocumented (Gatt et al., 2022; Lovelock et al., 2022). If only these previous programs have been properly documented, then the current and future restoration may have incorporated the lessons and avoided common causes of failures (Salmo, 2021).

The implementation of the United Nation's Decade on Ecosystem Restoration (2021-2030) provides an opportunity [but also a challenge (Waltham et al., 2020; da Rosa and Marques, 2022)] to reflect on previous lessons in order to advance mangrove restoration in SE Asia. For example, the 20 x 30 and 30 x 30 visions provide hopes to

deliver conservation and restoration targets by year 2030. In this Research Topic, seven articles present the status and lessons, and provide perspectives for a "better" mangrove restoration strategies to help achieve the UN's targets/strategies on ecosystem restoration.

Restoration index and "bio-shields"

Juanico developed a "restoration index" to estimate the potential success of mangrove restoration programs in the Philippines. The index is a prospective tool that can assess the progress and success of restoration programs in terms of "bio-shielding" effect (especially in terms of coastal protection against catastrophic typhoons). The study further proposed that future restoration efforts should be moved further inland to have substantial forest. Restoring mangroves inland will be politically and socio-economically challenging as these are the same sites that are currently occupied by coastal residents and also targeted for future coastal development/reclamation programs. A substantial financial investment to restore the inland areas is needed.

Tracking undetected "historical mangrove losses" as indicator for selecting restoration areas

Baltezar et al. used a combination of several remote sensing approaches in tracking the "undetected" historical mangrove losses in Myanmar, Thailand, and Cambodia. The study showed specific pre-1990s mangrove maps gains and losses which the authors linked to the socio-political conditions and uncertainties in the three countries. This study not only established a new baseline that would better inform current understandings of mangrove change pre-1990s, but also helped in understanding the different needs that the people and their governments were trying to meet.

Valuing ecosystem services in conserved and restored mangroves

The systematic review of Lee et al on valuation of ecosystem services revealed the limited studies not just in Malaysia but is most likely the case for the entire region. Because of limited dissemination, the results of valuation studies lacks integration (and influence) in policies and governance. The authors recommended that future valuation studies in SE Asia should engage policy makers and incorporate a clear dissemination strategy (i.e., policy briefs on science-policy nexus).

Integrating "social capital", finance and policy in mangrove restoration

The lack or absence of restorable areas is one of the primary reasons why massive mangrove planting projects are conducted in sub-optimal areas (e.g., seagrass, mudflats, etc.). Shusheng et al. proposed "ecological bank" as an integrative restoration approach to attract more social investments and develop streamlined policies for mangrove restoration plans. The authors suggested that income that will be generated from industries using or located near mangroves will be used to support restoration projects and provide subsidies to pond owners and social investors.

Systematic assessment and monitoring of recovery of mangrove cover

Tinh et al. used a combination of satellite imagery analyses and field surveys in the assessment and monitoring of mangrove restoration projects over time. The authors clearly showed net gains and rates of increases (as hectare per year) at "commune level" in Mekong delta as well as in other provinces. Despite the perceived success, the authors raised concerns on: (1) narrow mangrove strips which could be vulnerable to rising sea level and coastal squeeze, and (2) conversion of mangroves to other land uses.

The eDNA as an adaptive biodiversity assessment tool

The stability and recovery of biodiversity are expected as one of the key outputs of mangrove restoration programs. It serves as evidence of recovery of ecosystem services especially when done in chronosequence and in comparison, with a reference and disturbed systems. But conventional biodiversity assessment and monitoring methods (e.g., plot/transect, field surveys, etc.) are very expensive and time-consuming. The eDNA technique has recently gained prominence in biodiversity assessment for most aquatic ecosystems but surprisingly is not widely adapted in mangrove yet. Wee et al. reviewed key technical and practical limitations but also provided several essential and practical guides to scientists, policymakers, conservation practitioners and mangrove forest managers in implementing eDNA metabarcoding as a biomonitoring tool in mangrove restoration programs.

Status, trends, and directions of mangrove restoration studies

Most of the mangrove restoration studies in the region were conducted in response to problems associated with conversion to aquaculture, coastal erosion, and natural disasters. Different countries have different foci based on national problems and priorities (Gerona-Daga and Salmo). A systematic assessment of impacts of restoration programs are rarely reported. Out of the available reports, the most commonly reported impacts are ecosystem functions that are directly related to the recovery of ecosystem services primarily "awareness" and "livelihood", but not

the other equally important ecosystem functions. Research topics suggested in this study provide a path forward to improve mangrove restoration, and aid in the development of national and international restoration and conservation strategies. The authors further suggested that an international network among SE Asian scientists through the Association of Southeast Asian Nations (ASEAN) should be facilitated to come up with a more strategic mangrove research and management program.

Synthesis and recommendations: The Southeast Asian mangroves in 2030

The seven articles in this Research Topic provided an overview of different mangrove restoration approaches and programs in SE Asia (Figure 1). Most restoration programs were implemented to increase mangrove cover and as supplement to current conservation/protection programs. But considering that mangrove losses are still apparent and with threats from coastal reclamations and from natural disasters, mangrove restoration should no longer be considered as "supplement" rather should be a necessity that needs to be expedited (Beeston et al., 2023).

The United Nations' Decade on Ecosystem Restoration provides an excellent opportunity to highlight the importance of restoration in SE Asian mangroves. The estimated restorable areas [ca 334,000 ha sequestering ca. 8700 Mt CO_2e; cf (Worthington and Spalding, 2018)] including previously unaccounted damaged areas (Baltezar et al.) if successfully restored will put SE Asia as a model that will demonstrate the recoveries of ecosystem services. The challenge lies in providing empirical evidence that the restoration programs are successful based on "restoration indicators" (Gatt et al., 2022) including effectively restored areas, economic valuation, policy integration, etc. Hence the need for a more systematic and consistent monitoring and reporting following monitoring standards (Lovelock et al., 2022) to at least demonstrate that the biodiversity and restoration targets will be achieved in 2030.

Restoration programs will need to be moved more inland to ensure higher survival and reduce the threats of submergence from sea-level rise. Investments from each individual country will be needed to finance restoration projects but most SE Asian countries may not be able to afford. The global interest from companies and investors to finance mangrove conservation and restoration can be explored for funding support (Friess et al., 2022). The ASEAN can be tapped to facilitate the technical, policy and financial needs for the restoration programs in the region. Another opportunity is the presence of international institutions which have been providing technical and financial supports. The individual country's programs together with the facilitation of the ASEAN and with international institutions will need to be aligned to achieve the restoration targets in the region by 2030 (Figure 1).

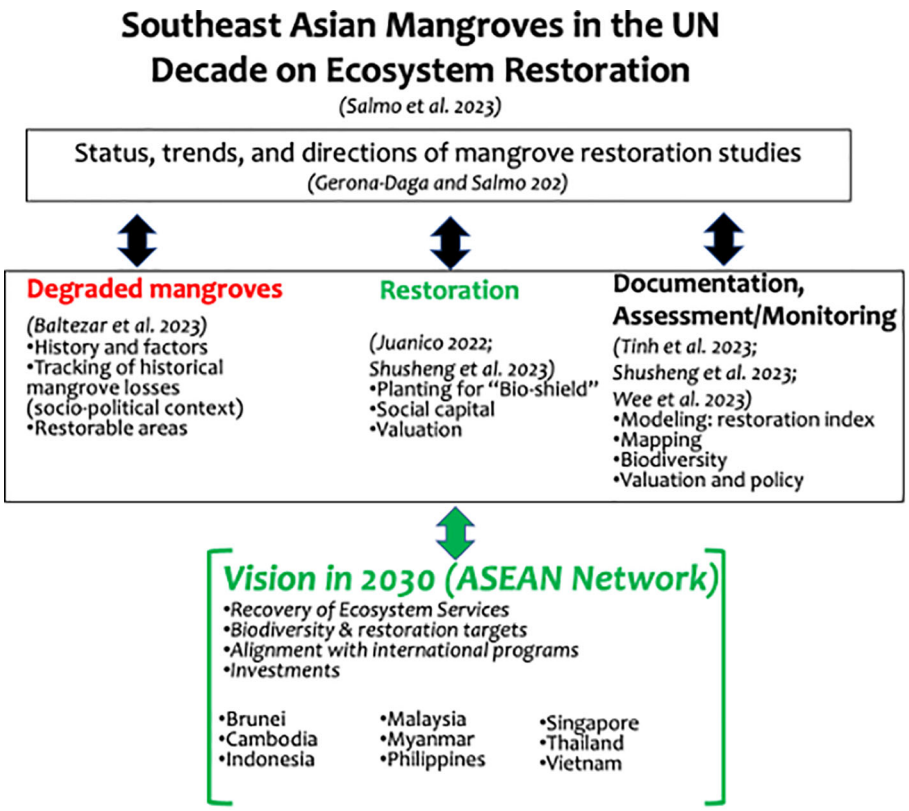

FIGURE 1
Summary of the seven manuscripts showing the status, trends, and recommendations to help achieve the mangrove restoration targets in 2030.

Author contributions

SS: Conceptualization, Formal analysis, Supervision, Writing – original draft, Writing – review & editing. RM: Writing – review & editing. KA: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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