Nature-Based Solutions for climate adaptation in Myanmar

A practice compendium and MCAN recommendations

MYANMAR CLIMATE ACTION NETWORK

Grounded learning from Myanmar's coastal, delta and urban settings to support credible, fair and maintainable nature-based adaptation.

May 2026

iied

DOH EAIN renewing places

WWF

MERA

UN-HABITAT

FOR: **Practitioners, community organisations, funders/programme designers and policy actors working on climate adaptation in Myanmar**

CONTACT: **Myanmar Climate Action Network (MCAN)**

EMAIL: **mcan@getvfairs.io**

WEBSITE: **https://myanmar-can.com**

SUGGESTED CITATION

Myanmar Climate Action Network (MCAN) (2026) Nature-Based Solutions for Climate Adaptation in Myanmar: A Practice Compendium and MCAN Recommendations. Myanmar: MCAN.

DISCLAIMER

This compendium reflects the collective learning and recommendations of MCAN and contributing partners. It is intended as practical guidance and does not necessarily represent the views of any government agency or funder. Any errors remain the responsibility of the authors.

ACKNOWLEDGMENTS

This compendium was prepared by MCAN, with contributions from its member organisations and partners, and with technical support from the International Institute for Environment and Development (IIED, www.iied.org).

We gratefully acknowledge the leadership of Doh Eain, as well as the contributions of partners including MERA-Myanmar (Mangrove and Environment Rehabilitation-conservation Association), WWF (WWF-Myanmar and WWF UK), UN-Habitat Myanmar, GEDA (Green Environmental Development Association), ZSL (Zoological Society of London), HEVN (Human Elephant Voices Network) / EcoExist, and members of the Neighbourhood Networks (NN), including Sharing Myanmar and an anonymous CSO.

We also thank all local organisations, community groups and contributors who supported the development of this compendium.

COVER IMAGE: **Mangrove / WWF**

Foreword: A practitioner compendium from the Myanmar Climate Action Network

Myanmar is facing rising climate risks alongside deep constraints on formal delivery capacity. In many places, the work of adaptation is happening through civil society, community groups, youth networks and locally-rooted organisations that continue to act even when institutions are stretched or fragmented.

This compendium responds to that reality. It brings together practical, experience-based learning on nature-based solutions (NbS) and related approaches that reduce climate risk while supporting livelihoods, ecosystems and everyday wellbeing.

The Myanmar Climate Action Network (MCAN) is a coalition of organisations and practitioners working to strengthen climate action in Myanmar. This compendium is presented as MCAN's collective recommendations, drawing on what members and partners are already doing across the country, what has been shown to work in comparable contexts and what needs to change to make NbS more effective, fair and durable.

The cases that follow are not "success stories" in a marketing sense. They are practice accounts: what problem was being tackled, how the work was organised, what enabling conditions mattered, what trade-offs appeared and what it would take to replicate or scale this work responsibly. Across very different geographies and sectors — from dense informal settlements to delta ecosystems — the compendium highlights a consistent message: NbS outcomes depend as much on long-term care, governance and maintenance as on technical design.

This document is intended for practitioners, policymakers and donors shaping climate programmes in Myanmar. MCAN's aim is to make it easier to fund, implement and evaluate NbS in ways that are locally workable, socially legitimate and robust over time — especially under conditions of uncertainty. We hope it supports better project design, more realistic expectations about what it takes to sustain results and stronger alignment between community priorities, programme delivery and national policy goals.

Signed,

Alejandro Barcena (senior researcher, IIED),
on behalf of the Myanmar Climate Action Network (MCAN)

May 2026

Mangrove-friendly aquaculture

Contents

Introduction: Nature-based Solutions as durable climate adaptation practice

Why NbS and why this compendium now?

Climate risk is already shaping daily life and development choices across Myanmar. Flooding, cyclone impacts, coastal erosion, heat and water stress interact with rapid social and economic change and with uneven access to services, secure livelihoods and safe land. These risks are not only 'natural' hazards; they are produced through the way land is used, wetlands and forests are managed, settlements grow and institutions coordinate (or fail to coordinate) across levels. The climate adaptation challenge is therefore as much about how decisions are made and maintained over time as it is about what is built or planted.[1]

NbS have become a prominent part of the global adaptation conversation because they offer something that conventional infrastructure often struggles to provide on its own: risk reduction that also strengthens ecosystems and livelihoods and that can be shaped and maintained locally when conditions are right.[2,3] Coastal ecosystems can reduce waves and storm surge impacts; mangroves, marshes, reefs and dunes can protect shorelines; green and blue spaces can store water and reduce urban heat; agroforestry and landscape restoration can reduce erosion, buffer rainfall variability and support incomes.[4,5,6] In dense urban and peri-urban settings, NbS are often delivered through smaller, hybrid 'grey–green' packages — improving drainage function, stabilising access routes, restoring local water assets and increasing shade and infiltration — so that neighbourhood systems remain functional during heavy rainfall and extreme heat.

But there is a problem with how NbS are often presented. In policy documents and fundraising pitches, they are sometimes treated as 'win-wins' that automatically deliver multiple benefits with few trade-offs. The research record is clearer: NbS can be powerful, but their success is not automatic, and their outcomes depend on design quality, local ecology, social conditions,

1 IPCC (2023) Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. doi:10.1017/9781009325844

2 Seddon, N, Chausson, A, Berry, P, Girardin, CAJ, Smith, A, and Turner, B (2020) Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society B: Biological Sciences, 375(1794), 20190120. doi:10.1098/rstb.2019.0120

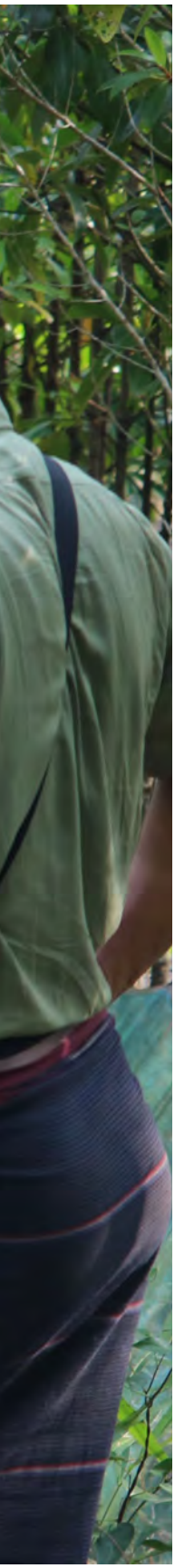
3 Turner, B, Devisscher, T, Chabaneix, N, Woroniecki, S, Messier, C, and Seddon, N (2022) The Role of Nature-Based Solutions in Supporting Social-Ecological Resilience for Climate Change Adaptation. Annual Review of Environment and Resources, 47(1), 123–148. doi:10.1146/annurev-environ-012220-010017

4 Temmerman, S, Meire, P, Bouma, TJ, Herman, PMJ, Ysebaert, T, and De Vriend, HJ (2013) Ecosystem-based coastal defence in the face of global change. Nature, 504(7478), 79–83. doi:10.1038/nature12859

5 Narayan, S, Beck, MW, Reguero, BG, Losada, IJ, Van Wesenbeeck, B, Pontee, N, Sanchirico, JN, Ingram, JC, Lange, G-M, and Burks-Copes, KA (2016) The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. PLOS ONE, 11(5), e0154735. doi:10.1371/journal.pone.0154735

6 Kabisch, N, Frantzeskaki, N, and Hansen, R (2022) Principles for urban nature-based solutions. Ambio, 51(6), 1388–1401. doi:10.1007/s13280-021-01685-w

Mangrove / WWF



rights, governance and long-term care.[7,8,9] Over-claiming undermines trust, and weak implementation can produce poor results or even harm.[10,11]

This is the practical purpose of this compendium. It brings together grounded implementation knowledge — what worked, what was hard, what was learnt — from a set of Myanmar cases. The cases include (among others) community-based mangrove restoration linked to livelihood strategies such as mangrove-friendly aquaculture; ecological mangrove restoration inside a protected area; local circular approaches that reduce input costs and waste burdens; approaches to scaling that focus on institutions and finance (Case 4), not just replicating a project; and a case addressing human–wildlife conflict through nature-based livelihood pathways (Case 5). In addition, the compendium includes three urban and peri-urban cases that show what NbS look like when the core challenge is maintaining liveable neighbourhood systems under monsoon flooding and extreme heat: (i) community-led drainage restoration and access upgrading in an informal settlement; (ii) flood prevention through waste interception, pond restoration and trench-to-green-space transformation; and (iii) alley and pocket-space upgrading supported by neighbourhood network coordination to sustain repeatable care routines around water, waste, shade and shared public space (Case 7, 8 and 9).

In short: this Introduction aims to (i) set the global context and debates on NbS in adaptation; (ii) clarify what 'good NbS' require in practice; and (iii) explain why the Myanmar case studies add value to a field that still has important gaps.

What NbS mean in practice: a concept that travels across disciplines

The term 'nature-based solutions' is best understood as an umbrella term rather than a single method. Across disciplines, NbS cover actions that protect, restore or sustainably manage ecosystems to address societal challenges, while also supporting biodiversity and human wellbeing.[12,13] Over time, the concept has expanded and sometimes blurred. Reviews that map the concept show that NbS draw from — and overlap with — older traditions such as ecosystem-based adaptation, ecological restoration, green infrastructure and ecosystem services, while also trying to speak directly to decision makers by emphasising solutions and

7 See note 2

8 Seddon, N, Smith, A, Smith, P, Key, I, Chausson, A, Girardin, C, House, J, Srivastava, S, and Turner, B (2021) Getting the message right on nature-based solutions to climate change. Global Change Biology, 27(8), 1518–1546. doi:10.1111/gcb.15513

9 IUCN (2020) IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS: first edition. IUCN, International Union for Conservation of Nature, Gland. doi:10.2305/IUCN.CH.2020.08.en

10 See note 8

11 Anguelovski, I, and Corbera, E (2023) Integrating justice in Nature-Based Solutions to avoid nature-enabled dispossession. Ambio, 52(1), 45–53 doi:10.1007/s13280-022-01771-7

12 European Commission (2015) Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities: Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities. Luxembourg: Publications Office of the European Union.

13 Cohen-Shacham, E, Walters, G, Janzen, C, and Maginnis, S (eds) (2016) Nature-based solutions to address global societal challenges. IUCN International Union for Conservation of Nature, Gland. doi:10.2305/IUCN.CH.2016.13.en

problem-solving.[14,15,16] In practice, especially in cities, NbS often involve combining ecological actions with basic service and infrastructure functions (for example, restoring drainage performance while stabilising soils, protecting trees and increasing shade).

That breadth is a strength: it lets practitioners combine ecological and social approaches and tailor interventions to place. But it is also a risk: if NbS becomes a label for almost anything green, it can hide trade-offs, allow low standards and make results difficult to compare.[17] That is why guidance documents and standards have become important in the past decade, especially as NbS moved from ideas into major investments.

Two anchor references are especially useful for practice:

- The European Commission's early framing emphasised NbS as part of a research and innovation agenda that links biodiversity to urban and societal challenges and positioned NbS as a way to re-think how cities are 'made and remade'.[18]
- The IUCN Global Standard later provided a practical framework for verifying and improving NbS design, including clear expectations on societal benefit, biodiversity integrity, economic feasibility, inclusive governance and adaptive management.[19]

The message from this compendium is straightforward: NbS are not 'planting trees' as an end in themselves. They involve using ecosystems — working with living systems — to reduce climate risk and strengthen livelihoods, in ways that are ecologically credible and socially fair.[20, 21] They also include protecting and upgrading the everyday micro-infrastructure of resilience — small water assets, shaded public spaces and functional drainage pathways — when these are essential to reduce climate risk for low-income urban communities.

What global evidence says about effectiveness for adaptation

A key reason NbS have gained prominence in adaptation policy is that ecosystems can reduce risk through physical mechanisms that grey infrastructure often tries to replace: friction that reduces waves, storage that slows and retains floodwater, shade and evapotranspiration that cools cities, root systems that stabilise soils and slopes and landscape processes that regulate water and sediment.[22, 23, 24]

14 Dorst, H, Van Der Jagt, A, Raven, R, and Runhaar, H (2019) Urban greening through nature-based solutions – Key characteristics of an emerging concept. Sustainable Cities and Society, 49, 101620. doi:10.1016/j.scs.2019.101620

15 Fang, X, Li, J, and Ma, Q (2023) Integrating green infrastructure, ecosystem services and nature-based solutions for urban sustainability: A comprehensive literature review. Sustainable Cities and Society, 98, 104843 doi:10.1016/j.scs.2023.104843

16 Sowińska-Świerkosz, B, and García, J (2022) What are Nature-based solutions (NBS)? Setting core ideas for concept clarification. Nature-Based Solutions, 2, 100009. doi:10.1016/j.nbsj.2022.100009

17 See note 16

18 See note 12

19 See note 9

20 See note 9

21 See note 16

22 See note 4

23 See note 5

24 Kabisch, N, Frantzeskaki, N, Pauleit, S, Naumann, S, Davis, M, Artmann, M, Haase, D, Knapp, S, Korn, H, Stadler, J, Zaunberger, K, and Bonn, A (2016) Nature-based solutions to climate change mitigation and adaptation in urban areas: Perspectives on indicators, knowledge gaps, barriers, and opportunities for action. Ecology and Society, 21(2), art39. doi:10.5751/ES-08373-210239

At the same time, a key message from the research literature is not 'NbS work everywhere.' It is 'NbS can work — under specific conditions — and often deliver multiple outcomes.' Evidence mapping for climate adaptation shows positive results across many NbS types but also highlights uneven data: a strong concentration across some regions, ecosystems and hazards and much weaker evidence for long-term durability and distributional outcomes.[25] A broad resilience-focused review likewise emphasises that NbS can support social-ecological resilience, but that results depend heavily on governance capacity, institutional fit and the ability to learn and adjust over time.[26]

For readers using this compendium in practice, three implications follow.

First, effectiveness is tied to local ecology and hazard dynamics.
Coastal NbS, for example, depend on habitat type, width, water depth, wave regime and maintenance of ecological function — meaning what works must be calibrated to place.[27] Ecosystem-based coastal defence is most promising where there is physical space, the ecosystem can develop and institutions can protect it against incremental degradation.[28]

Second, co-benefits are real but not guaranteed.
Urban NbS can reduce heat and manage stormwater while improving wellbeing, but co-benefits depend on access, safety and distribution — who benefits and who bears the cost of change.[29,30] NbS for flood risk management can also have unintended consequences for vulnerable groups if 'ecological measures' are designed narrowly for hazard reduction without attention to social impacts and governance.[31] Urban and peri-urban interventions also show that 'nature-based' gains often depend on basic maintenance of drains, paths and water assets, meaning social organisation and upkeep routines can be as important as the green component itself.

Third, the evidence base is still catching up with practice.
Systematic reviews and taxonomies show rapid growth in NbS research, but also highlight persistent gaps: long-term monitoring, comparable indicators, maintenance dynamics and equity outcomes.[32,33] This is precisely where well-documented case studies add value — especially when they report not only activities and outputs, but where available, governance arrangements, maintenance routines and changes over time.[34,35]

25 Chausson, A, Turner, B, Seddon, D, Chabaneix, N, Girardin, CAJ, Kapos, V, Key, I, Roe, D, Smith, A, Woroniecki, S, and Seddon, N (2020) Mapping the effectiveness of nature-based solutions for climate change adaptation. Global Change Biology, 26(11), 6134–6155. doi:10.1111/gcb.15310

26 See note 3

27 See note 5

28 See note 4

29 See note 24

30 Zhou, K, Kong, F, Yin, H, Destouni, G, Meadows, ME, Andersson, E, Chen, L, Chen, B, Li, Z and Su, J (2024) Urban flood risk management needs nature-based solutions: A coupled social-ecological system perspective. Npj Urban Sustainability, 25(4). doi:10.1038/s42949-024-00162-z

31 See note 30

32 See note 24

33 Aghaloo, K, Sharifi, A, Habibzadeh, N, Ali, T, and Chiu, Y-R (2024) How nature-based solutions can enhance urban resilience to flooding and climate change and provide other co-benefits: A systematic review and taxonomy. Urban Forestry & Urban Greening, 95, 128320 doi:10.1016/j.ufug.2024.128320

34 See note 25

35 See note 3

The main debates: ‘win-wins’, messaging and the politics behind NbS

As NbS enter mainstream climate finance and city planning, a set of debates has become unavoidable. These debates matter because they shape what gets funded, what gets measured and whose needs are prioritised.

Debate 1: Are NbS genuinely new or a rebranding of older approaches?

A critique that appears across the literature is that NbS sometimes repackage existing ideas (green infrastructure, ecosystem services, ecosystem-based adaptation) without always adding clarity on governance, standards and accountability. A Europe-focused evaluation argues that in many cases the concept has been used inconsistently and that the ‘newness’ is often about policy framing rather than practice innovation.[36] A separate review of the concept’s key characteristics finds that NbS can unite fragmented knowledge fields, but only if they become more performance-oriented and more explicit about what counts as ‘nature-based’.[37] Work aimed at concept clarification likewise warns against copy-and-paste implementation and top-down governance models that treat NbS as static assets rather than living systems requiring adaptive care.[38]

Debate 2: How NbS is framed shapes who supports it and how it is implemented.

The ‘nature-based’ label carries strong political appeal. But critical framing research shows that calling something ‘natural’ often implies it is cheaper, fairer, more democratic and less risky than ‘artificial’ alternatives — claims that may or may not hold in practice.[39] A major communication-focused paper argues for getting the message right: NbS should not be sold as a substitute for rapid emissions reductions, and claims about benefits should be specific about where, when and under what conditions outcomes are expected.[40] As NbS become part of national climate commitments and corporate claims, recent expert review work has also stressed the need for scientific integrity and transparent accounting, because weak claims can undermine both climate action and public trust.[41]

Debate 3: NbS can create harm if justice is not built in from the start.

Perhaps the most consequential debate is about social justice: who gains, who loses and how power shapes outcomes. Justice-oriented critique argues that NbS are sometimes embedded in speculative or elite development pathways, producing what the authors call ‘nature-enabled dispossession’, where greening becomes a route to exclusion, land capture or livelihood loss.[42] Urban greening scholarship has long pointed to similar

36 O’Sullivan, F, Mell, I, and Clement, S (2020) Novel Solutions or Rebranded Approaches: Evaluating the Use of Nature-Based Solutions (NBS) in Europe. Frontiers in Sustainable Cities, 2, 572527. doi:10.3389/frsc.2020.572527

37 See note 14

38 See note 16

39 Osaka, S, Bellamy, R, and Castree, N (2021) Framing “nature-based” solutions to climate change. WIREs Climate Change, 12(5), e729. doi:10.1002/wcc.729

40 See note 8

41 Buma, B, Gordon, DR, Kleisner, KM, Bartuska, A, Bidlack, A, DeFries, R, Ellis, P, Friedlingstein, P, Metzger, S, Morgan, G, Novick, K, Sanchirico, JN, Collins, JR, Eagle, AJ, Fujita, R, Holst, E, Lavallee, JM, Lubowski, RN, Melikov, C, et al. (2024) Expert review of the science underlying nature-based climate solutions. Nature Climate Change, 14(4), 402–406. doi:10.1038/s41558-024-01960-0

42 See note 11

paradoxes: green space can improve health and wellbeing but also drive gentrification and displacement if social protections are weak.[43] Political-economy-oriented studies show how NbS can be used as a discursive tool in urban 'green' agendas — sometimes enabling neo-liberalisation of nature, sometimes opening space for contestation and more democratic claims, depending on governance arrangements.[44]

The practical implication for this compendium — and for NbS assessment more broadly — is simple: NbS must be evaluated not only by ecological outputs, but by who benefits, who is included, whose rights are protected and how livelihoods are affected over time.[45,46]

Principles that matter for real-world implementation

Across the literature, there is substantial convergence on what 'good' NbS require, especially once the conversation moves from ideals to delivery. Four implementation principles are especially relevant here:

1. **Start with the risk problem, then choose the nature pathway.**
   NbS should be designed around a clear risk logic (for example, wave reduction, drainage, cooling, erosion control) and the ecological intervention must match that mechanism.[47,48] This is one reason coastal NbS have a strong evidence base: they often link measurable biophysical mechanisms to specific hazard pathways.[49]

2. **Treat NbS as a living system with thresholds, not a one-off project.**
   Many NbS benefits depend on ecosystem health and continuity. That means design should anticipate climate extremes and slow degradation pressures, invasive species and the cumulative impacts of small changes over time.[50,51] NbS are not automatically low-maintenance; they are often maintenance-dependent, but in different ways than concrete or steel.

3. **Build inclusive governance that is real, not symbolic.**
   Citizen participation is often invoked, but research shows it can range from meaningful shared decision making to tokenistic consultation. A dedicated governance review argues that participation needs resources, clear roles, accountability and attention to unequal power — otherwise it can shift burdens onto communities without increasing communities' influence over decisions.[52] The IUCN Standard operationalises this by treating inclusive governance and feedback mechanisms as essential, not optional.[53]

43 Wolch, JR, Byrne, J, and Newell, JP (2014) Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. Landscape and Urban Planning, 125, 234–244. doi:10.1016/j.landurbplan.2014.01.017

44 Kotsila, P, Anguelovski, I, Baró, F, Langemeyer, J, Sekulova, F, and Jt Connolly, J (2021) Nature-based solutions as discursive tools and contested practices in urban nature's neoliberalisation processes. Environment and Planning E: Nature and Space, 4(2), 252–274 doi:10.1177/2514848620901437

45 See note 9

46 See note 11

47 See note 4

48 See note 5

49 See note 5

50 See note 2

51 See note 3

52 Kiss, B, Sekulova, F, Hörschelmann, K, Salk, CF, Takahashi, W, and Wamsler, C (2022) Citizen participation in the governance of nature-based solutions. Environmental Policy and Governance, 32(3), 247–272. doi:10.1002/eet.1987

53 See note 9

4. **Put justice safeguards at the centre, especially around land and livelihoods.** Justice-oriented critique stresses that NbS can be used in ways that marginalise vulnerable groups, particularly when linked to property markets, elite projects or restrictive conservation without livelihood pathways.[54,55] This compendium therefore treats safeguards — rights, access, benefit-sharing, grievance mechanisms — as part of how the intervention works, not an add-on.[56]

5. **Plan for monitoring and adaptive management from day one.** A recurring observation across NbS reviews is that monitoring is often weakest where it matters most: long-term performance, distributional outcomes and ecological integrity.[57,58] Where institutions have limited capacity, monitoring needs to be simple, credible and locally maintainable and should feed into decisions rather than be a reporting exercise.[59]

6. **Communicate honestly: avoid over-claiming and vague 'win-win' language.** NbS messaging research argues that credibility depends on making claims conditional: what benefit, where, for whom, over what timeframe and with what uncertainty.[60,61] This is particularly important when NbS become a basis for finance, because vague claims can encourage weak design and disappointment.

7. **Treat urban nature-based solutions as hybrid systems of services and care.** In dense settlements, NbS outcomes often depend on the functioning of basic infrastructure: drains must flow, access routes must remain usable, dumping must be controlled and water assets must be protected. Effective practice, therefore, combines grey–green design with repeatable care routines and locally workable governance.[62,63]

These principles are not abstract. They show up repeatedly in practice, including in the Myanmar cases — especially around site selection, governance arrangements, livelihood incentives and the routines that sustain interventions after the initial project period (Case 7, 8).

From projects to portfolios: what scaling really requires

Many NbS discussions end with a call to scale up. But the research suggests scaling is often misunderstood. Scaling is rarely achieved by copying a project design into a new place. More often, scaling happens by building enabling conditions: stable roles, standards, finance, skills and institutional routines that enable multiple projects to succeed over time.

54 See note 11
55 See note 43
56 See note 9
57 See note 24
58 See note 25
59 See note 9
60 See note 8
61 See note 39
62 See note 24
63 See note 30

A study of metropolitan greening shows that scaling NbS is complex because it requires coordination across ecological, institutional and socio-cultural challenges. It often depends on intermediaries that can convene actors, align goals and maintain momentum across jurisdictions and timeframes.[64] Research has shown that NbS uptake is constrained by deeper regimes: knowledge systems, policy paradigms, procurement rules, professional norms, rather than by lack of interest alone.[65]

In this compendium, we use 'scaling' in at least three ways:

1. **Scaling out:** replication and adaptation across sites (which requires local fit)
2. **Scaling up:** policy, standards and finance that make NbS investible and routine
3. **Scaling deep:** long-term change in norms, capabilities and relationships that sustain maintenance and stewardship.

This is why one of the Myanmar cases focuses explicitly on a scaling pathway rather than a single intervention site (Case 4). It reflects a global lesson: NbS become durable when implementation capability and governance conditions become repeatable, not when a project is replicated.

The urban cases also reinforce a fourth, complementary scaling pathway: scaling through networks of practice. When neighbourhood groups share methods, coordinate small resources and build routines together, distributed micro-interventions can accumulate into citywide resilience gains even when formal systems are constrained (Cases 7, 8 and 9).

What the Myanmar cases contribute to the global discussion

Global NbS debates are increasingly sophisticated, but many remain dominated by contexts in which governance capacity, data systems and finance are relatively stable. Myanmar's reality adds value to the field precisely because it highlights what is often under-discussed: how NbS are designed and sustained when institutions are constrained, when livelihoods are precarious and when long-term care must be built through locally workable routines.

The case studies in this compendium contribute to the global discussions on NbS.

1. **They connect risk reduction to livelihood viability.**
   Several cases explicitly tie mangrove stewardship to livelihood strategies (including aquaculture), recognising that ecosystem protection is unlikely to persist if households cannot meet daily needs. This aligns with global evidence that durable NbS often depend on linking ecological outcomes to incentive structures and local economic realities,[66,67]

64 Fastenrath, S, Bush, J, and Coenen, L (2020) Scaling-up nature-based solutions. Lessons from the Living Melbourne strategy. Geoforum, 116, 63–72 doi:10.1016/j.geoforum.2020.07.011

65 Dorst, H, Van Der Jagt, A, Runhaar, H, and Raven, R (2021) Structural conditions for the wider uptake of urban nature-based solutions – A conceptual framework. Cities, 116, 103283. doi:10.1016/j.cities.2021.103283

66 See note 2

67 See note 9

but the Myanmar cases make those trade-offs and design choices visible in practical terms (Cases 1,2,3,4,6).

2. **They show governance and rights questions as implementation questions.** Research warns that NbS can cause harm when land rights, access or benefits are captured by powerful actors.[68] The Myanmar cases highlight governance arrangements — community rules, stewardship responsibilities, benefit-sharing and accountability — as part of how the interventions function (Case 1 and 2). This is also consistent with participation research that cautions against shifting responsibility onto communities without ensuring that they have real influence or support.[69]

3. **They treat maintenance as central, not secondary.** Across NbS research, maintenance is repeatedly identified as an under-funded and under-measured determinant of success.[70,71] The Myanmar cases include practical attention to monitoring and upkeep: what is feasible, who does it and how routines are sustained (Case 2). This matters because the effectiveness of NbS is not only about installation; it is about continuity.

Before intervention / MERA

68 See note 11
69 See note 52
70 See note 24
71 See note 3

4. **They broaden the NbS landscape beyond one sector.**
The cases include coastal and delta ecosystems, protected area restoration, circular input strategies (for example, waste-to-feed approaches) and nature-based responses to human–wildlife conflict through agroforestry-linked livelihoods (Case 5). This diversity reflects global arguments that NbS is an umbrella concept spanning sectors, while the Myanmar cases show how that broad concept is implemented through concrete, place-specific pathways.[72,73]

The compendium also demonstrates that urban NbS are often built through small, repeated actions that protect drainage pathways, improve shade, reclaim degraded micro-spaces and reduce waste burdens — while strengthening the community coordination needed to sustain these gains over time (Case 7, 8 and 9).[74,75]

How to read the case studies that follow

The case studies are designed to be usable. They are not written as academic papers; they are written as implementation learning. Readers can use them in three ways:

- **As design support**: to shape risk logic, ecological fit, participation design and safeguards,[76,77]
- **As implementation guidance**: to anticipate operational constraints, maintenance needs and monitoring options,[78,79] and
- **As policy and finance learning**: to identify what enabling conditions are needed to make NbS repeatable and investible, rather than one-off projects.[80,81]

A final note: this compendium does not claim that NbS are always better than grey infrastructure. Many contexts require hybrid approaches. The point is to make NbS credible and durable where they are used — ecologically, socially and institutionally — so that they reduce risk without creating new injustices or fragile ‘paper success’.[82,83,84]

In the urban cases included here, this often means combining basic engineering (drainage restoration, access upgrading, waste interception) with nature-based elements (shade, infiltration, soil stabilisation, restoration of local water assets) and — crucially — supporting the repeatable care routines that keep these systems functional through monsoon cycles and extreme heat (Case 7,8).

72 See note 14
73 See note 16
74 See note 24
75 See note 30
76 See note 9
77 Kabisch, N, Frantzeskaki, N, and Hansen, R (2022) Principles for urban nature-based solutions. Ambio, 51(6), 1388–1401. doi:10.1007/s13280-021-01685-w
78 World Bank (2017) Implementing Nature Based Flood Protection. World Bank, Washington, D.C. doi:10.1596/28837
79 See note 24
80 See note 64
81 See note 65
82 See note 8
83 See note 11
84 See note 9

How to use this compendium

This document is intended to be used, not only read. It is presented as MCAN's practice-informed recommendations for strengthening NbS for climate adaptation in Myanmar — based on what members and partners have implemented, learnt and refined across diverse settings.

What this compendium contains

The compendium has three connected parts:

1. **Introduction:** Explains what NbS can and cannot do for climate adaptation, what makes outcomes reliable and why governance, safeguards and long-term care matter for success.
2. **Case studies:** Each case documents an intervention in Myanmar, describing the problem, the approach taken and the practical conditions that enabled or constrained results.
3. **MCAN cross-case recommendations:** The closing section draws lessons across the full set of cases and states MCAN's recommendations for practitioners, funders and policy actors: what to prioritise, what to avoid and what enabling conditions are needed for scaling.

The case studies are designed so you can either:

- Read end-to-end to understand the full range of NbS practice in Myanmar, or
- Dip in selectively according to your role and the decisions you need to make.

To support selective reading, each case follows a common logic (even if the details differ). This makes it easier to compare cases and draw practical lessons.

What you will find in each case

Each case is organised around questions that are central to credible NbS practice and are consistent with widely used NbS standards and implementation guidance:[85]

- **Risk and context**: What climate risk is being addressed (for example, flooding, erosion, heat, livelihood stress) and what local conditions shape that risk?
- **Intervention approach**: What was done in practice – the full package, not just the green component (including ecology, infrastructure links, livelihoods and coordination)?
- **Who is involved and how decisions are made**: Who and what are the key actors, roles, participation options, and how were responsibilities negotiated?
- **Rights, safeguards and fairness**: How does the work avoid exclusion, dispossession, unequal burdens or harm to vulnerable groups; how are benefits distributed?
- **Maintenance and continuity**: What does it take to keep the intervention functioning after the initial project phase: who maintains it, how and with what resources?

85 See note 9

- **What is tracked and learnt**: What evidence exists so far, what is still uncertain and what the case suggests should be monitored over time?
- **Replication and scaling notes**: What must be in place for similar work to succeed elsewhere (conditions, capabilities and policy/finance needs)?

How different readers can use this compendium

Practitioners and community organisations can use the cases to:

- strengthen project design (problem definition, ecological fit, safeguards and maintenance planning)
- anticipate operational challenges and plan for continuity, and
- identify monitoring signals that are realistic and meaningful.

Funders and programme designers can use the cases to:

- assess whether proposed NbS investments include the governance and maintenance conditions required for durable outcomes
- identify where small additional investments (coordination, monitoring, local capacity, stewardship finance) can prevent failure later, and
- recognise and manage social risks (land, access, burdens) early.

Policy and public agencies can use the cases to:

- see what enabling conditions matter most for reliably delivering NbS
- identify where standards, roles or funding arrangements need strengthening, and
- support replication through clear mandates and long-term stewardship.

How MCAN intends this compendium to be applied

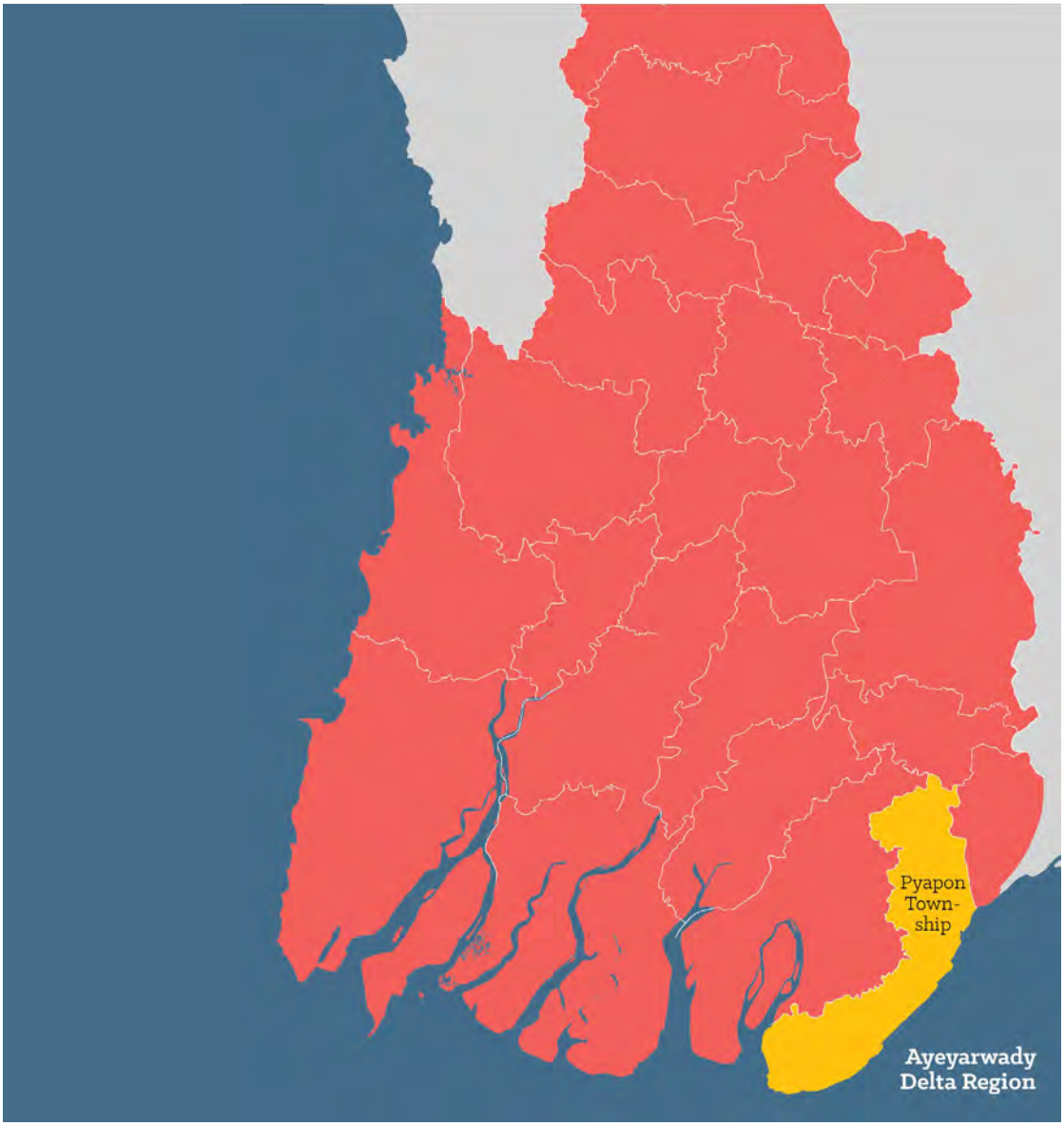
MCAN's aim is to help expand NbS in Myanmar from isolated projects to reliable pathways for climate adaptation in Myanmar. The case studies provide grounded examples; the cross-case section translates them into recommendations. Readers are encouraged to treat the cases as implementation learning — including what was difficult and what required negotiation — not as perfect templates.

A note on evidence and claims

NbS outcomes are often influenced by time, climate variability and social conditions. Some cases will have strong evidence on impacts; others will be earlier-stage or have partial monitoring. Where evidence is still emerging, the case studies focus on what can be stated responsibly, what remains uncertain and what should be tracked next. The goal is credible learning, not over-claiming.

Case 1 — Strengthening community-based mangrove restoration and promoting mangrove-friendly aquaculture

LOCATION:	**Pyapon Township, Ayeyarwady Region, Myanmar**
ORGANISATION(S):	**Mangrove and Environment Rehabilitation-conservation Association (MERA)**
PERIOD:	**June 2022 – December 2025**
AUTHORS:	**MERA (Ohn Lwin, Aung Thant Zin, Than Soe Oo, Tun Tun Zaw, Nay Myo Shwe)**



Context and climate risks

The Ayeyarwady Delta holds Myanmar's largest mangrove system — estimated at around 46% of the country's mangrove area — but it has experienced major decline due to land-use conversion (notably to agriculture and aquaculture ponds) alongside sustained resource pressures. This loss weakens natural protection against cyclones, storm surge and flooding and undermines fisheries and other resources that sustain local livelihoods and food security.

This case focuses on Pyapon Township, where mangrove areas are managed as certified Community Forests by Community Forest User Groups (CFUGs) under 30-year, renewable tenure arrangements, creating stronger incentives for long-term stewardship. Within this framework, mangrove-friendly aquaculture (MFA) activities currently reach approximately 224 households across 15 villages, with a further 310 households across 21 villages practising mangrove-friendly aquaculture through complementary FAO- and WWF-supported initiatives implemented by MERA.

Building on these governance conditions and the delta's intertidal ecology, MERA supports community-based mangrove restoration and protection while strengthening livelihoods through MFA (mud crab fattening), backed by capacity support and a revolving fund mechanism that reinvests repayments/profits into mangrove stewardship. This case should be read as the implementation package within the broader scaling pathway described in Case 4

Mangrove-Friendly Aquaculture / MERA

Intervention design and delivery

MERA supports CFUGs to co-design and operate MFA sites that maintain mangrove cover while generating income from small-scale mud crab farming. MFA is explicitly designed to integrate aquaculture into existing mangrove systems rather than replace them, with safeguards embedded in community forestry management plans agreed with the Forest Department under the Ministry of Forest and Environmental Conservation.

Step 1 — Site screening (with CFUGs)

CFUGs and MERA jointly screen candidate areas to confirm basic suitability for MFA: tidal accessibility, salinity (10–25 parts per thousand), pH (7.5–9), soils that allow burrowing and an existing mangrove canopy that provides shade while allowing around 30% sunlight penetration (managed through selective thinning and/or enrichment planting). Typical site sizes range from ~0.1 ha up to 1.2-1.6 ha per CFUG.

Step 2 — Select the model and layout

Based on micro-topography, hydrology and mangrove condition, CFUGs select one of two models and agree the physical layout and management rules needed to maintain mangrove function:

- **Model A:** Pen/enclosure culture in naturally semi-submerged intertidal areas. Pens use mesh fencing (often inward-slanted for containment) and screened inlet/outlet sections to allow tidal exchange and natural recruitment of plankton/larvae while keeping crabs contained.
- **Model B:** Ditch-and-dyke (pond) culture where perimeter ditches are excavated and dykes formed (for example, ~0.76m high), typically with separate water-control structures to manage inflow/outflow while retaining mangrove cover within/around the system (a common principle in silvo-aquaculture designs).

Step 3 — Construction and set-up

CFUGs construct pens/dykes and install inlet/outlet screening, ensuring structures can handle tidal cycles and reduce escapes/predation. Where needed, CFUGs implement selective thinning or enrichment planting to keep the canopy/light balance agreed in Step 1.

Step 4 — Stocking and husbandry (aligned to tidal cycles)

Crab seed is stocked at roughly 5,000-15,000 juveniles per hectare, and management is organised around tidal rhythms; feeding is typically scheduled in the evenings. (Operational practices also include basic water management, shelter/structure inside pens/ponds and measures to reduce stress and losses through handling.)

Step 5 — Harvesting and market integration (plus adaptive management)

Harvesting plans are agreed with CFUGs and linked to market channels. MERA supports the enabling ecosystem around production — collectors, traders, feed suppliers and transport — so that small producers can sell reliably and reduce post-harvest losses.

Governance and safeguards (running throughout Steps 1–5)

Governance measures include: CFUG selection criteria, operating rules explicitly linked to mangrove stewardship obligations, field coaching and (where applicable) revolving fund arrangements that reinforce compliance and reinvestment in stewardship. By linking the revolving fund directly to stewardship, the mechanism ensures that a portion of the aquaculture profits is specifically channelled back into forest protection activities, such as community patrols and nursery maintenance, as defined in the CFUG management plans.

Forest communities apply a dual protection system

The Ministry of Forests sets the general rules (permitted activities, harvesting quotas), while each CFUG defines its own management, profit-sharing and member engagement procedures.

Monitoring combines self-assessment by communities and regular checks by the Ministry through reports and audits. These systems, which are still recent, are gradually being refined, particularly for environmental monitoring and water quality.

Mangrove-Friendly Aquaculture / MERA

Outcomes and impacts

MFA has strengthened livelihood resilience by diversifying income and reducing households' reliance on mangrove cutting for fuelwood/charcoal and cash. Where sites were well-selected and management was consistent, CFUGs report annual production costs of ~3.5 million MMK per acre (approximately US$1,667 - source: Central Bank of Myanmar, February 2026) and profits of ~3.5–4.0 million MMK per year (approximately US$1,667–1,904, including household labour). Additional benefits accrue through by-catch (fish/shrimp entering with tidal flows) and through regulated harvesting of selected mangrove products (for example, poles, fruits) under CFUG rules.

At the local economy level, crab farming supports a wider set of actors — collectors, traders, feed suppliers and transport services — within a live-crab market that is already well established in the Ayeyarwady Delta and linked to regional export channels. In terms of environmental impacts, communities report a marked reduction in mangrove harvesting in project villages; maintaining canopy cover while managing light levels supports natural regeneration and helps retain mangroves' habitat functions for aquatic species and birds. Evidence from wider Myanmar experience suggests mud crab culture can be ecologically compatible with mangroves when it does not replace them and relies on low-cost, locally appropriate structures.

Overall resilience gains are expected through the combined effect of: (i) improved mangrove condition, where the preserved forest acts as a living buffer to attenuate wave energy and control erosion, surpassing the limited protection offered by the aquaculture structures themselves while providing carbon benefits; and (ii) more stable household incomes and livelihood options that are less dependent on extractive use of mangroves. This site-level programme also underpins the scaling pathway in Case 4 by providing the practical design parameters and operational lessons needed to replicate MFA responsibly across CFUG sites.

Note: Data collection against these indicators is ongoing. Household and village numbers for indicator 2 are currently available; quantified results for the remaining indicators will be reported as monitoring progresses.

- **Area of mangrove under CFUG stewardship:** Managed under formal 30-year extendable agreements with the Forest Department.
- **Number of households practising MFA:** 224 households across 15 villages, with a further 310 households across 21 villages across Pyapon Township.
- **Livelihood performance from MFA activities:** Reported production costs and net income at CFUG level.
- **Repayment performance of revolving fund mechanisms:** Tracking return of initial investments for reinvestment in MFA and mangrove stewardship.
- **Compliance with mangrove protection rules:** Including monitoring of illegal cutting incidents through CFUG enforcement and Forest Department oversight.
- **Participation in decision-making and benefit-sharing:** Governed through CFUG constitutions and by-laws.

Challenges and lessons

- **Site selection is decisive:** MFA performs best on low-lying intertidal sites with reliable tidal exchange; avoid elevated ground and confirm tidal access early.
- **Budget monitoring from Day One:** use simple permanent plots for canopy/regeneration, plus basic water checks (for example, salinity, pH and dissolved oxygen (DO)) with clear CFUG roles and reporting routines.
- **Manage contamination and input quality:** agree buffer zones and input controls (feed sourcing; pesticide/herbicide runoff protocols) and define an incident response plan to reduce stock losses.
- **Tenure and governance matter:** weak rights or opaque benefit-sharing undermine stewardship; use transparent CFUG rules, audits and grievance mechanisms.
- **Prevent objective drift:** make aquaculture permissions conditional on mangrove stewardship obligations and canopy safeguards.
- **Finance and markets are fragile:** high start-up costs and grading/price volatility can reduce profitability and discourage participation; use revolving funds, basic grading/handling standards and diversify buyers/market channels.

Mangrove-Friendly Aquaculture / MERA

Enabling conditions and scalability

The approach is enabled by Myanmar's Forest Policy (1995) and the Forest Law (2018), alongside the updated Community Forestry Instructions (issued as a revised framework under the 2018 Forest Law). Together, these provide the legal basis for CFUGs to manage mangrove areas under longer-term permits and agreed stewardship rules. MFA contributes to SDGs 1, 8, 13, 14 and 15 by supporting livelihoods and decent work while strengthening ecosystem-based adaptation and coastal biodiversity.

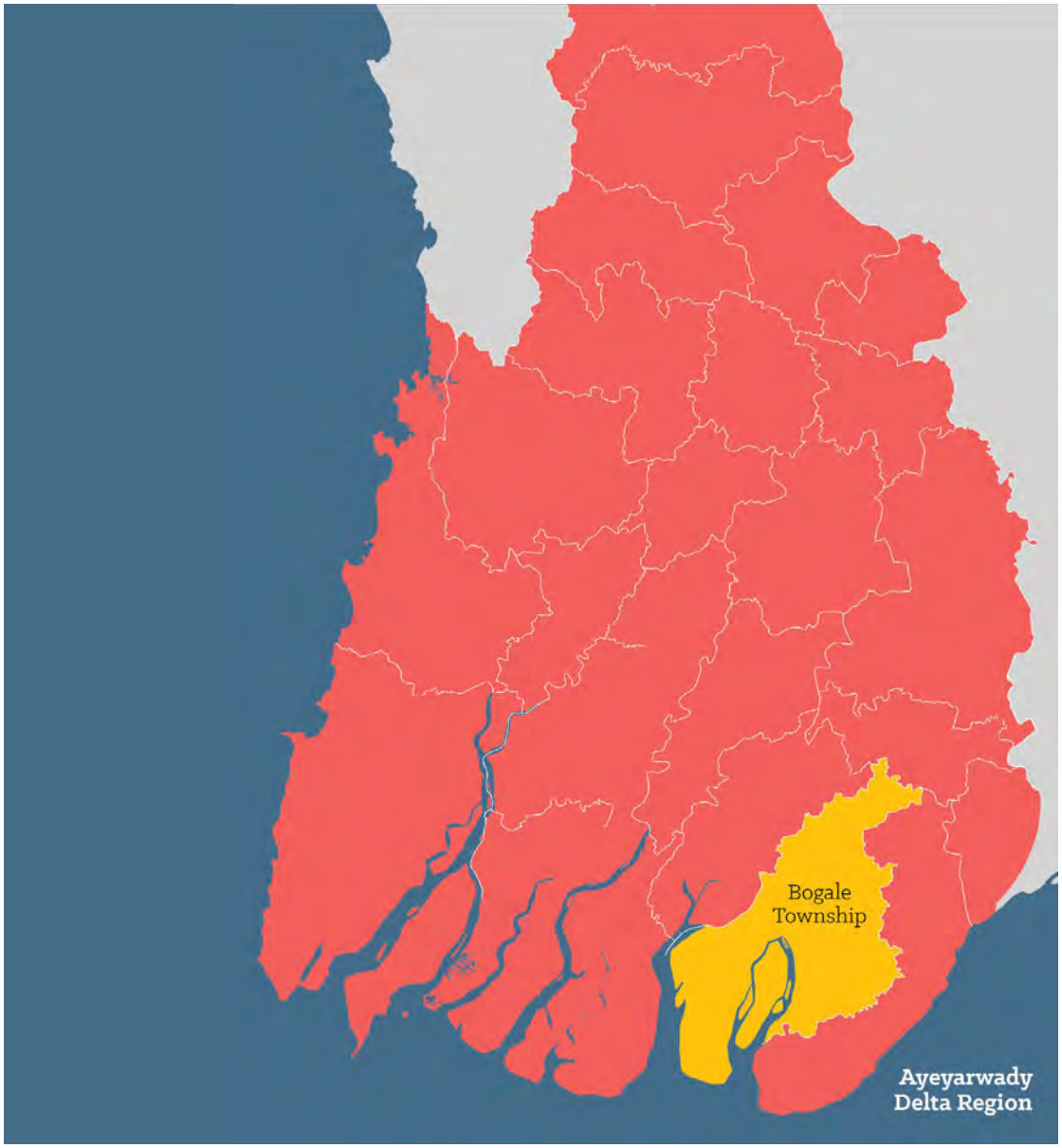
Scaling is most feasible where three conditions align: (i) secure community forest tenure, (ii) reliable tidal exchange that sustains mangrove health and aquaculture performance and (iii) access to buyers and services (seed, feed, transport, grading) within the crab value chain.

Priority areas where similar programmes could be introduced could include other coastal areas such as Tanintharyi and Rakhine. New programmes would use a phased model: establish pilot sites, facilitate peer learning between CFUGs/villages and disseminate practical standards on site selection, canopy safeguards, basic water-quality management and crab grading/handling.

The programme-level scaling architecture, enabling finance and suitability logic are described in Case 4.

Case 2 — Ecological mangrove restoration in Meinmahla Kyun Wildlife Sanctuary

LOCATION:	**Meinmahla Kyun Wildlife Sanctuary (MKWS), Bogale Township, Ayeyarwady Region, Myanmar**
ORGANISATION:	**Mangrove and Environment Rehabilitation-conservation Association (MERA)**
PERIOD:	**November 2022 – December 2023**
AUTHORS:	**MERA (Ohn Lwin, Aung Thant Zin, Than Soe Oo,Tun Tun Zaw, Nay Myo Shwe)**



Context and climate risks

Meinmahla Kyun Island in the Ayeyarwady Delta is Myanmar's flagship mangrove protected area: it was declared the Meinmahla Kyun Wildlife Sanctuary (MKWS) in 1993, recognised as an ASEAN Heritage Park in 2003 and designated as a Ramsar site in 2017. The sanctuary's mangroves and adjacent mudflats are an internationally important habitat for resident and migratory species, and they also function as a breeding/nursery area for fish and prawns, underpinning surrounding fisheries-based livelihoods.

In the southern part of the island, peak monsoon tides inundate a low-lying basin, but drainage is insufficient, and water becomes trapped. This creates prolonged waterlogging and stagnant conditions across ~20ha, preventing natural mangrove recruitment; the area remains dominated by grasses and other non-mangrove vegetation. Previous plantation efforts at this site have not succeeded, indicating that restoring tidal exchange (and flushing) is the prerequisite for recovery. Re-establishing more natural hydrology is therefore critical to rebuild the mangrove cover that strengthens coastal protection (storm surge and flood attenuation) and restores connected habitat for aquatic biodiversity.

The Meinmahla Kyun MKWS faces a series of major climate challenges: cyclones, sea flooding, river and coastal flooding, saltwater intrusion and coastal erosion. These phenomena threaten not only local ecosystems, but also the fishing activities on which coastal communities depend. However, the most pressing problem addressed by the project was hydrological: during the monsoon season, persistent flooding, exacerbated by a faulty drainage system, had transformed nearly 20ha into areas of stagnant, oxygen-depleted water, blocking any natural regeneration of mangroves.

The impact addressed was primarily ecological, with expected indirect socio-economic gains for nearby communities following hydrological restoration. The MKWS is a strictly protected area (under the Conservation of Biodiversity and Protected Areas Law) with no resident villages. Therefore, there was no direct displacement or immediate livelihood loss for communities within the project site.

However, the degradation of this 20ha area had indirect negative effects:

- **Ecological impact:** The waterlogged, anoxic 'gap' represented a loss of functional mangrove habitat, reducing the sanctuary's overall biodiversity, nursery function for fisheries and carbon sequestration capacity.
- **Indirect community impact:** Communities in surrounding areas (Bogalay township, including 24 villages around Meinmahla Kyun) depend on the ecological health of the broader delta system. A degraded area within a key sanctuary undermines fish and crustacean populations in adjacent legally-fishable waters, ultimately affecting long-term food security and fishing yields.

The ecological mangrove restoration intervention's success thus delivers indirect community benefits by restoring a core ecological asset that supports local fishery productivity and coastal resilience.

Intervention design and delivery

MERA piloted ecological mangrove restoration (EMR) at Meinmahla Kyun with support from the ASEAN Centre for Biodiversity Small Grants Programme, using a core NbS strategy of 'hydrology first' approach: re-establish tidal exchange so that mangroves can recover largely through natural recruitment, with planting used only to complement gaps where natural seed sources (mangrove propagules) are limited. Preparatory work (October-November 2022) combined rapid ecological and hydrological assessment: mapping nearby mangrove species and fruiting periods, checking micro-elevation and tidal access, identifying blockages and agreeing channel alignments with sanctuary management and relevant stakeholders.

Implementation began in January 2023 with excavation of more than 2,000m of tidal channels to reconnect the inundated basin to daily tidal flushing. To mimic natural drainage patterns and maximise hydraulic efficiency, channel inlets were sized wider and deeper (approximately 1.8m x 0.9m) to allow maximum inflow, then tapered inland (approximately 0.9m x 0.45m) to reduce bottlenecks and maintain flow velocity. By prioritising these physical site conditions over traditional planting, the EMR approach leverages the ocean's energy to facilitate restoration, making it a more cost-effective and self-sustaining solution than conventional monoculture plantations. To keep the system functioning through the monsoon season, four rounds of maintenance clearing removed debris and logs deposited by peak tides.

Because nearby 'mother trees' (mature seed-producing mangroves) were limited, MERA also supported assisted dispersal aligned with species phenology: *Bruguiera* propagules were released in July 2023 and *Avicennia* seeds in October 2023, timed to high tides to support natural redistribution and establishment.

The project was operated through a clear, collaborative partnership model:

- **Nature and Wildlife Conservation Division (NWCD), National Forest Department:** As the legally mandated management authority for MKWS, NWCD staff were the key enabling partner and institutional project owner. Their roles included granting formal permission, providing site-specific ecological knowledge, co-designing the intervention, ensuring compliance with protected area regulations and integrating project outcomes into their long-term management plan. In addition, the Forest Department retains responsibility for ongoing oversight and long-term monitoring, ensuring continuity beyond the project period and alignment with the sanctuary's management objectives.
- **Mangrove and Environment Rehabilitation-conservation Association (MERA):** Acted as the **technical facilitator and implementing agency.** MERA's responsibilities included: project design and hydrological diagnosis; community consultation; sourcing propagules; supervising strategic canal excavation and assisted dispersal; conducting biophysical monitoring and documenting outcomes.
- **Local communities (from adjacent villages):** Engaged as **consultants and temporary labourers.** Their roles included sharing historical and ecological knowledge of the site

during design, providing paid labour for canal excavation and maintenance and assisting in propagule collection from donor mangrove forests. Their involvement was crucial for local buy-in and knowledge integration.

- **ASEAN Centre for Biodiversity:** Provided **financial and technical support**, endorsing the EMR methodology as a regional best practice.

Structured community consultation was integral to the project's design phase, acknowledging that local ecological knowledge is invaluable, even for a protected area.

- **Inception workshops:** Two formal workshops were held. The first, in Bogalay town, engaged government stakeholders such as the **NWCD** under the Forestry Department, General Administration Department (GAD), Ministry of Agriculture, Livestock and Irrigation, Myanmar Navy (naval branch of the armed forces of Myanmar), etc. The second, in Chaung-Bye-Gyi village, was specifically for **community consultation** to gather local knowledge on historical site conditions, tidal patterns and wildlife and mangrove species composition.
- **Participatory design:** Community insights into natural drainage patterns were explicitly integrated into the final canal network design, moving beyond a purely top-down technical plan.
- **Planned completion workshop:** A final workshop to share results with communities is planned, closing the feedback loop and demonstrating the restored area's value to their wider ecosystem.

Monitoring has captured clear positive ecological indicators:

- Given the pilot nature of the intervention, monitoring focused on practical indicators of ecological recovery and system functioning rather than comprehensive baseline datasets, with clearer quantitative baselines recommended for future replications.
- **Mangrove recruitment (quantitative):** Systematic monitoring of 25 permanent sample plots shows successful natural and assisted regeneration.
- **Observational biological indicators:** Post-intervention, field teams have documented the **visible return of fish and crustaceans** to the newly flushed canals, indicating reactivation of the aquatic food web.
- **Water quality improvement:** While formal chemical parameters were not recorded pre-implementation, **visual and olfactory indicators** are stark: the replacement of stagnant, foul-smelling water with clear, tidally flushed water signifies a return to healthy aerobic conditions conducive to aquatic life.
- **Suggestion for the future:** To strengthen evidence, baseline and follow-up data on key water parameters (salinity, dissolved oxygen, pH) and structured aquatic biodiversity surveys are recommended for future projects.

Outcomes and impacts

EMR reactivated natural regeneration by restoring tidal exchange and flushing stagnant water, re-establishing the basic hydrological conditions mangroves need to recruit and survive. This 'hydrology first' logic is central to EMR: once water levels and tidal connectivity are corrected, mangroves can often return through natural volunteer propagule recruitment, with planting used only as a supplement where seed sources are limited. Seedlings established quickly along the channel banks and by September 2025, *Avicennia* reached ~1.5m-1.8m while *Bruguiera* exceeded ~0.9m, indicating strong early growth. Observations of additional propagules floating in from surrounding stands suggest the system is becoming increasingly self-sustaining, consistent with EMR expectations once connectivity is restored.

Beyond vegetation recovery, improved flushing can enhance local water conditions and support the return of aquatic species, while adjacent mangroves may show early health improvements as waterlogging stress is reduced. Restoring mangroves also strengthens nursery habitat and broader ecosystem functions that underpin fisheries-based livelihoods. Because MKWS is a strictly protected wildlife sanctuary with no resident population, the project delivers a dual-benefit model: it directly restores 20ha of functional habitat, while indirectly securing the 'nursery engine' of the delta. By improving the sanctuary's function as a breeding ground, the project secures the fish and crustacean stocks that the 24 fishing villages of Bogale Township depend on for long-term food security.

Compared with conventional plantations, EMR can reduce costs by avoiding nursery establishment, site clearing, mass planting and repeated weeding, and it tends to support multi-species recovery rather than monocultures; evidence from a global meta-analysis suggests hydrological rehabilitation can perform at least as well as (and in some respects better than) planting-based restoration. This cost-efficiency is further enhanced by engaging local villagers from adjacent communities through cash-for-work arrangements, providing immediate economic relief while utilising local knowledge of tidal patterns. Over time, recovered mangroves also contribute to adaptation (coastal buffering, erosion control) and mitigation through high carbon storage in biomass and sediments, though site-specific carbon outcomes require longer-term measurement.

Mangrove recruitment (quantitative):

- Sample Plot 2: *Heritiera fomes* increased from 47 to 100 individuals.
- Sample Plot 13: 95 new saplings of *Avicennia officinalis* recorded.
- Sample Plot 20: 59 new saplings of *Bruguiera gymnorhiza* recorded.

Ecological indicators:

- Documented return of fish and crustaceans to newly flushed canals.
- Improved aerobic water conditions indicated by visual and olfactory changes.

Limitations noted by MERA:

- No formal baseline water quality data collected pre-intervention.
- Future EMR projects should include baseline and follow-up measurements of key water parameters and aquatic biodiversity.

Ecological Mangrove Restoration Trench / MERA

Challenges and lessons

- **Survey precision matters.** Relying on GIS-only alignment can miss micro-elevation changes that determine whether water actually moves. Before excavation, combine desktop mapping with ground-truthing and basic levelling/topographic checks to confirm flow paths and avoid creating local ponding or unintended scouring.
- **Protected-area logistics require early planning.** Because settlement is not permitted inside the sanctuary, implementation needs an agreed logistics plan with sanctuary management covering boat access, equipment transport, temporary camps (if allowed), working hours and freshwater supply, plus clear protocols for waste removal and safety.

Seed Broadcasting / MERA

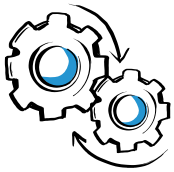
- **Propagule scarcity can delay recovery.** Where ‘mother trees’ are limited, natural recruitment may be too slow at first. Secure collection and transport permits early and plan sourcing to match species phenology and legal requirements.
- **Measuring success needs more than simple seedling counts.** Natural dispersal is patchy, so establish permanent sample plots and monitor at least every six months, tracking seedling density, survival and growth and (where feasible) canopy cover and basic water conditions.
- **Maintenance is a real operational burden.** Long channels can collapse or become blocked by debris, and channel mouths connected to main rivers can erode. Prioritise shorter channels linked to existing internal creeks and plan routine debris clearing and periodic reshaping where needed to keep tidal connectivity functioning.

The most critical challenges were technical and logistical, stemming from the remote, protected nature of the site:

- **Hydrological design limitations:** The lack of precise ground-truthing equipment (such as laser levels) led to suboptimal channel alignment in some sections. Relying on remote sensing and visual assessment was insufficient for perfect hydraulic engineering.
- **Baseline data gap:** The absence of pre-intervention baseline data on water quality and aquatic species limits the ability to quantitatively measure full impact, though qualitative changes are evident.
- **Propagule supply chain:** The need to source 312,000 propagules from distant community forests highlighted the site’s severe ecological disconnect and added logistical complexity.
- **Remote site logistics:** The site’s protected status complicated worker accommodation and necessitated the daily boat transport of all supplies, including fresh water, increasing cost and effort.

In future, we would adopt a more precision-based and adaptive management approach:

- **Invest in foundational surveys:** Conduct a detailed topographic and hydrological survey using basic levelling instruments (for example, dumpy level) to inform canal design accurately.
- **Optimise canal architecture:** Design shorter, meandering ‘fish-bone’ channel networks that follow natural depressions, rather than long straight channels. This promotes wider propagule dispersal, reduces erosion and mimics natural creek systems.
- **Establish robust baselines:** Prioritise collecting baseline data on water quality and aquatic species before any intervention.
- **Develop a local propagule supply:** Establish community-based nurseries or identified donor zones in the project preparation phase to secure a local, sustainable seed source.



Enabling conditions and scalability

EMR is well aligned with Myanmar's enabling policy and legal framework for forest and biodiversity conservation, including the Myanmar Forest Policy (1995), the Forest Law (2018) and the Conservation of Biodiversity and Protected Areas Law (2018). It also directly contributes to SDGs 13–15 by restoring coastal ecosystems, strengthening biodiversity and sustaining the regulating services that reduce climate and disaster risk in delta environments. In addition, the approach supports Myanmar's national biodiversity priorities under the Convention on Biological Diversity (CBD) and its National Biodiversity Strategy and Action Plan (NBSAP), particularly around habitat conservation, reducing pressures on ecosystems (including pollution impacts) and improving ecosystem resilience under climate change.

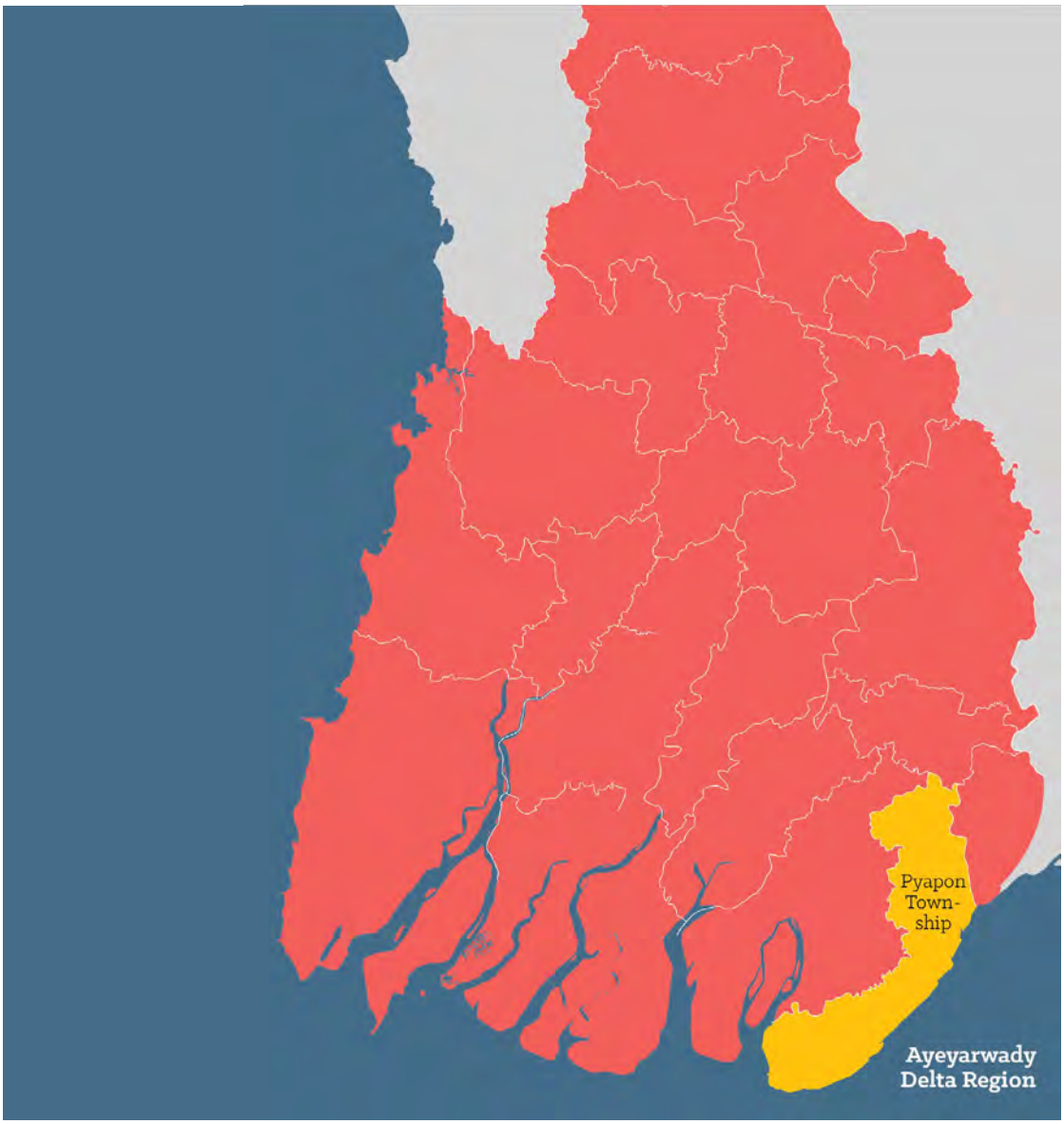
Scaling potential is strongest in degraded mangrove landscapes where hydrology has been disrupted (for example, blocked creeks, trapped monsoon water, restricted tidal exchange) but can be reconnected through low-regret earthworks that are technically simple, socially acceptable and maintainable over time. Replication should be guided by upfront site diagnostics, including micro-elevation and tidal prism (the volume of water that can move in/out with each tide), sediment dynamics and erosion risk at channel mouths, as well as locally appropriate species phenology to time any assisted dispersal where propagule supply is limited.

Future projects could prioritise other suitable deltaic and coastal settings beyond the Ayeyarwady Delta where similar hydrological constraints are present, including parts of Tanintharyi and Rakhine. Scaling would most likely be led by the NWCD of the Forest Department, in partnership with MERA and other NGO actors.

Experience from this pilot suggests that cost-effectiveness and sustainability at scale depend on upfront investment in basic topographic and hydrological surveys to guide channel alignment, optimisation of channel design to reduce erosion and maintenance needs and early planning for local propagule supply (for example, via community-based nurseries) to avoid high transport costs from distant donor sites. Indicative unit costs were not calculated for this pilot, but these factors are expected to be key drivers of cost and performance in future replications.

Case 3 — Black soldier fly larvae as local feed to strengthen mangrove-friendly crab aquaculture

LOCATION:	**Pyapon Township, Ayeyarwady Region, Myanmar**
ORGANISATION:	**Mangrove and Environment Rehabilitation-conservation Association (MERA)**
PERIOD:	**March 2024 – March 2027**
AUTHORS:	**MERA (Ohn Lwin, Aung Thant Zin, Than Soe Oo,Tun Tun Zaw, Nay Myo Shwe)**



Context and climate risks

In Pyapon Township in the Ayeyarwady Delta, MFA, especially small-scale mud crab farming, offers a practical way to strengthen livelihoods while keeping mangrove cover intact. A persistent constraint, however, is the reliability and quality of crab feed supply. Farmer consultations highlighted recurring problems with late delivery, limited availability and poor freshness of purchased feed — issues that are particularly disruptive in a delta context where flooding and cyclone impacts can interrupt transport and local market functioning.

More broadly, the Ayeyarwady Delta is highly exposed to cyclones, storm surges, coastal erosion, saline intrusion and compound riverine-coastal flooding, risks that are intensified where mangrove ecosystems are degraded.

To address this bottleneck and improve the viability of MFA as a mangrove-compatible livelihood, MERA is piloting the production of black soldier fly (BSF) larvae across 13 villages where community forestry groups are already established. BSF farming converts locally available organic waste into a high-protein, on-site feed source that can reduce costs and dependence on external supply chains, while creating a locally manageable, 'circular' input system (with frass also usable as a soil amendment where appropriate). Evidence from aquaculture research also indicates that BSF-based ingredients can substitute a portion of conventional feeds in crab diets without compromising performance, supporting the technical rationale for this pathway.

The underlying theory of change is that a more reliable and lower-cost local feed source stabilises MFA incomes and reduces households' incentives to engage in destructive mangrove cutting for fuelwood or charcoal. Sustained mangrove cover, in turn, strengthens coastal buffering against storms and flooding while maintaining nursery habitat that underpins local fisheries productivity.

While initially targeting MFA crab farmers to solve the specific feed bottleneck, BSF farming demonstrates clear cross-sectoral benefits, making it a versatile livelihood intervention:

- Direct Beneficiaries: MFA crab farmers who achieve faster growth rates and higher profitability.
- Expanded Livelihood Benefits:
    - Poultry, pig and fish farmers: Can use BSF larvae as a high-protein feed supplement.
    - Home gardeners and farmers: The nutrient-rich frass (larval excrement) is an excellent organic fertiliser, reducing dependency on chemicals.
    - Waste managers: The system addresses local organic waste challenges, offering a decentralised solution.
    - Entrepreneurs: Potential exists for selling surplus larvae, starter colonies or frass fertiliser, creating new micro-enterprises, particularly for women and young people.

Intervention design and delivery

MERA is integrating BSF farming as a supporting Nature-based Solution within the broader MFA livelihood and mangrove restoration package, to strengthen the reliability of locally produced crab feed while creating a practical pathway for village-level organic waste valorisation. BSF units are designed to be small, low-cost and quick-cycle, and can be operated at either the household or shared-village-scale depending on waste availability, labour and demand for larvae. (BSF is widely recognised as a promising way to convert organic waste streams into feed and fertiliser products when appropriate controls are in place.)

Community operators are trained to run simple production units with clear operating steps, as follows: (1) hatch BSF eggs in basic trays, (2) rear larvae on approved organic substrates (for example, segregated kitchen/market waste), (3) harvest larvae before pupation for use as crab feed and (4) maintain breeding cages/nets to sustain an ongoing egg supply. Where relevant, the unit design can be adapted for safe handling, low lifting and task sharing, making it more accessible to a wider range of community members, including people with disabilities.

Environmental and social safeguards are built into standard operating procedures. These include approved feedstock lists (excluding contaminated or high-risk wastes that may carry pesticides, heavy metals or other toxic substances), basic hygiene protocols and odour/pest controls to minimise nuisance and health risks. Procedures also cover safe handling and short-term storage/processing of larvae intended for animal feed, recognising that good feed practices and basic risk management are essential for any feed value chain. Unit siting

Black Soldier Fly Units / MERA

is agreed with communities to avoid disruption to neighbours (minimum distances from neighbouring plots, drainage, ventilation) and to ensure waste deliveries and residue handling remain orderly. Frass (larval residue) is collected and, where appropriate, used as an organic fertiliser in home gardens, with producers responsible for ensuring that frass quality and hygiene are properly managed and handled safely.

BSF farms are managed by Community Forest User Groups (CFUGs). These groups make their own internal decisions, manage profit-sharing and resolve conflicts in accordance with their statutes. The Forestry Department ensures compliance with the legal framework and community forest lease agreements, which are renewable for 30 years.

In order to guarantee the quality of the larvae used to feed the crabs, a cascade training programme has been set up. It covers all stages: breeding, feeding, harvesting, hygiene, pest control (rats, geckos, etc.), humidity management and basic processing. Farmers have also developed simple preservation techniques, such as solar drying of larvae, to improve hygiene and short-term preservation.

Support followed a train-the-trainer + continuous backstopping model, as follows:

- **Initial expert-led training:** Intensive hands-on workshops led by a national BSF expert, covering the full lifecycle: breeding, feeding, harvesting and processing
- **Format:** Practical, in-village demonstrations using low-cost, locally available materials
- **Ongoing technical support:** MERA field staff conducted regular monitoring visits to provide adaptive troubleshooting support (for example, protecting colonies from pests like rats and geckos, managing moisture levels, optimising feed substrates), and
- **Peer-to-peer learning:** Successful early adopters became local champions, providing informal training and proof-of-concept to neighbours.

BSF / MERA

Outcomes and impacts

The BSF pilot is designed to strengthen livelihood and supply-chain resilience for MFA crab farmers by providing a reliable, village-level feed source that improves the timeliness, quantity and freshness of inputs. By converting locally available organic waste into protein-rich larvae (and producing frass as a potential soil amendment), BSF production also creates a practical circular-economy pathway for organic waste management at the village scale.

Expected outcomes include: lower cash expenditure on purchased feed and reduced exposure to transport/market disruptions; more consistent feeding regimes that can improve crab growth and survival; and new micro-enterprise opportunities through the sale of larvae (fresh or processed) and/or frass to nearby farmers. The technical rationale is supported by growing aquaculture evidence that BSF-based ingredients can substitute part of conventional feed inputs without undermining performance, including in crab aquaculture contexts.

By making MFA operations more viable and locally-managed, the pilot is intended to complement community mangrove stewardship: when households can rely on a stable aquaculture income stream with fewer input bottlenecks, the incentive to resort to unsustainable mangrove extraction for fuelwood or charcoal is expected to decrease. In turn, maintaining mangrove cover helps sustain the ecosystem services that local livelihoods depend on — especially fisheries productivity and coastal buffering.

BSF farming is designed and has proven to be a sustainable long-term livelihood strategy. Evidence includes:

Adoption and Innovation: Farmers are not just maintaining but innovating within the system (for example, shifting from stir-frying to solar-drying larvae for preservation, applying frass to home gardens).

Economic Integration: BSF farming is being integrated into existing farm enterprises (such as piggeries, poultry) as a core feed component, indicating its perceived economic value.

Market Potential: Interest from communities outside the initial project area and the potential to supply larger aquaculture operations point to its scalability and commercial viability beyond a pilot phase.

Challenges and lessons

- **High start-up costs for breeding and containment equipment:** To reduce the burden on individual households, consider setting up shared village hub units (one breeding nucleus serving multiple producers), combined with standardised starter kits and revolving funds to spread capital costs over several production cycles.
- **Safeguards are not yet documented clearly enough:** Develop a simple, field-friendly safeguards checklist covering approved feedstocks (and explicit exclusions), hygiene routines, odour/pest control, runoff/drainage management, safe handling/storage and a clear grievance/complaints channel. Use periodic spot checks to verify compliance and strengthen community confidence in siting decisions.
- **Uncertain market for surplus larvae and frass:** If production exceeds on-farm demand, secure offtake arrangements early (for example, with nearby livestock/aquaculture producers) and agree basic quality standards (allowed substrates, processing method, moisture/packaging rules, shelf-life guidance) so buyers can trust the product.
- **Technical gaps in processing larvae for crab feed:** Provide practical standard operating procedures (SOPs) and troubleshooting support (harvesting stage, washing, drying/processing options, storage conditions, ration guidance). Where relevant, coordinate with government technical services to align practices with feed safety expectations.
- **Biological and social risks can stall uptake:** Programmes should plan for starter-colony/egg supply risks (backup colonies, local sourcing plans, contingency support if egg-laying fails) and proactively manage social acceptability through community engagement on siting, odour control and operating discipline.
- **Value-added products are a second-phase opportunity:** Products like larvae meal/powder can improve storability and market reach, but they typically require additional equipment, quality control and stable demand; treat these as a later phase once basic production reliability, safeguards and local markets are proven.

Enabling conditions and scalability

BSF farming is enabled by two practical advantages: readily available organic waste streams (kitchen and market waste, where safely segregated) and simple, learnable production methods that communities can operate with modest equipment. When managed with basic biosecurity and hygiene, BSF systems can reduce unmanaged organic waste while producing a local protein feed input for aquaculture/livestock and frass that can be used as an organic soil amendment — supporting household income and local food security through circular-economy principles.

Scaling potential is strongest where villages can (i) organise reliable waste segregation and collection, (ii) apply clear operating safeguards (approved substrates, hygiene, pest/odour and runoff control) and (iii) link production to a defined and dependable user base (for example, MFA crab farmers) and/or predictable local markets. This fits well with SDG 2 (food security), 8 (decent work), 12 (responsible consumption/production) and 13 (climate action).

In Myanmar, the enabling policy space most plausibly sits at the intersection of the National Waste Management Strategy and Master Plan (2018–2030) and the Environmental Conservation Law/Rules (for waste and pollution management); and the Animal Health and Livestock Development Law and related SPS/feed controls (for animal feed oversight), alongside the Department of Fisheries' mandate over aquaculture regulation and licensing.

MERA

In this political context, the intervention aligns with Myanmar's Forestry Law (2018) and Community Forestry Instructions (2019), which provide the legal framework for sustainable forest management linked to livelihood development through community forestry. Supervision and monitoring are structured accordingly: MERA provides technical facilitation and implementation; the Forestry Department provides regulatory oversight to ensure compliance on state forest lands; and community-based 'BSF Champions' act as auxiliary technicians, supporting day-to-day operations, problem-solving and peer learning at the village level.

For the period from March 2024 to March 2027, larger-scale deployment is planned in coastal and delta regions, including the Ayeyarwady Delta, Rakhine State and Tanintharyi Region. This expansion will be supported by a combination of (i) starter kits (including BSF colonies, trays and illustrated manuals) financed by renewable community funds, (ii) the creation of micro-enterprises, targeting women and young people in particular, as a livelihood option requiring little space and physical effort and (iii) the gradual development of commercial linkages to absorb surplus production beyond household or village demand.

BSF farming is highly replicable in most of Myanmar's coastal and delta regions, given the following conditions:

- **Climatic suitability:** It thrives in tropical and subtropical climates with consistent warmth. It is ideally suited to the Ayeyarwady Delta, Rakhine State and Tanintharyi Region. Replication in cooler upland areas would require simple temperature management (for example, by using insulated bins).
- **Availability of organic waste:** The model depends on a steady stream of low-cost or free organic substrates (kitchen scraps, market waste, agricultural by-products), which are ubiquitous in rural and peri-urban Myanmar.
- **Livelihood Context:** It is most readily adopted in areas with existing small-scale animal husbandry or aquaculture, where the feed cost burden is already felt.

Key enablers for moving from successful pilots to widespread adoption include:

Starter support packages: Bundling initial BSF colonies, simple rearing equipment (trays, nets) and pictorial manuals into low-cost starter kits via revolving community funds or micro-finance.

Building local expertise: Developing a network of community-based 'BSF champions' or para-technicians who can provide localised advice and troubleshooting.

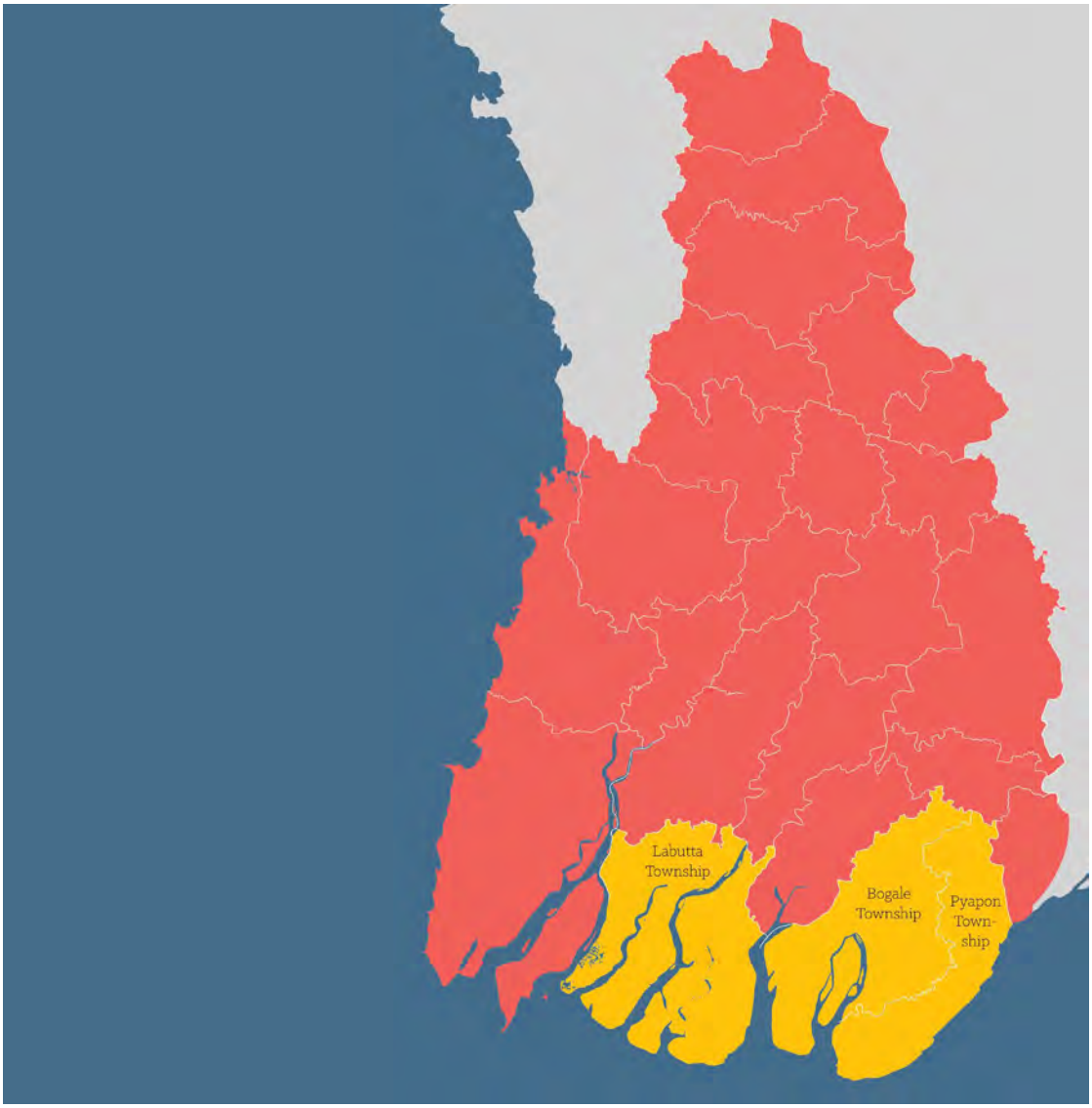
Creating market linkages: Facilitating connections between BSF producer groups and larger feed markets (such as fish farms, poultry cooperatives) to demonstrate clear income potential.

Policy integration: Advocating for the inclusion of insect farming in township-level waste management, climate adaptation and livelihood development plans, providing formal recognition and potential public resource allocation.

Gender and youth focus: Actively promoting the model as a low-space, low-physical-strength enterprise suitable for women and youth-led household businesses.

Case 4 — Scaling pathway for Case 1: Community-based mangrove restoration and mangrove-friendly aquaculture in the Ayeyarwady Delta

LOCATION:	**Ayeyarwady Region, Myanmar**
ORGANISATIONS:	**WWF Myanmar; Green Environmental Development Association (GEDA); MERA; local civil society organisation partners**
PERIOD:	**April 2022 – July 2024**
AUTHOR:	**WWF Myanmar**



Context and climate risks

Illegal logging, land expansion and unsustainable livelihoods have contributed to the loss of more than 60% of Myanmar's mangrove forests in the last 20 years, undermining coastal protection and mangrove-dependent incomes. In the Ayeyarwady Delta, mangroves support farming and fisheries and help buffer cyclones. At the same time, communities face coastal flooding and erosion, poverty and unemployment, over-exploitation of natural resources (water, fisheries, mangroves, non-timber forest products) and persistent land tenure and land-use conflicts.

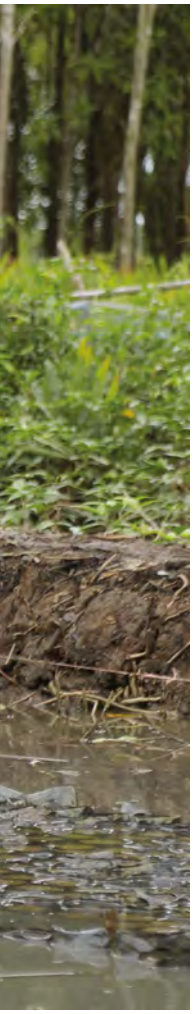
This case documents the scaling pathway that has enabled community-based mangrove restoration and MFA to be replicated across multiple CFUGs. It provides the programme-level 'how scaling happened' architecture, while Case 1 should be read as the companion implementation instance documenting the detailed MFA design parameters and operational lessons. The programme currently spans 20 communities across priority townships in the Ayeyarwady Delta, including Labutta, Pyapon and Bogale, with expansion planned to reach approximately 50 communities by 2027.

WWF

Intervention design and delivery

WWF-Myanmar , with MERA and GEDA, used a pilot-to-scale delivery model. First, the programme piloted a community-based sustainable mangrove management ‘best model’ in two communities using a consultative approach with CFUGs. Through intensive stakeholder consultations and needs assessments (covering both conservation and livelihood priorities), communities developed operational plans to restore and manage mangroves within their community forests. Based on early results, the approach expanded to ten additional communities, scaling restoration through community-based MFA that supports livelihoods while restoring and conserving degraded mangrove areas and avoiding land expansion into remaining forests.

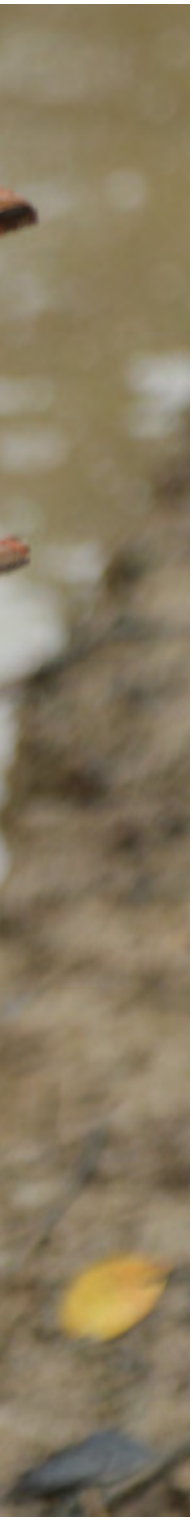
To operationalise scale and make the approach repeatable, the programme set out a comprehensive ‘replication package’ that communities, local partners and township authorities use to move from interest to implementation. This package integrates: (i) an entry and screening protocol covering tenure status, mangrove condition and tidal water access; (ii) a choice of production models, such as polyculture (shrimp/crab) in lower sites versus crab culture in slightly higher elevations — the latter often preferred as it requires smaller, shallower pond modifications; (iii) a minimum technical standard for pond or pen layouts that protects mangrove cover and maintains tidal exchange; (iv) a short training curriculum for community operators and local trainers; and (v) a participatory planning and benefit-sharing process with clear operating rules and a simple grievance routine to ensure aquaculture permissions are strictly tied to mangrove stewardship.



The scaling logic is reinforced by cost–benefit evidence generated by MERA and programme partners (2022–2024), showing higher net income and faster payback in ponds with mangroves than ponds without mangroves, and by a landscape investment analysis conducted as part of the programme’s delta-wide feasibility assessment. This analysis links scale-up to three core investment needs: pond establishment, mangrove planting/rehabilitation within pond landscapes and capacity development (with good aquaculture practice safeguards). At the delta scale, this suitability and investment analysis strengthens the case for replication by identifying where upgrading existing ponds to MFA is feasible without expanding into remaining forests. The assessment identifies substantial areas of pond landscapes already located on mangrove land that could be improved through blended finance — combining public funding, grants and potentially private value-chain investment.

A practical scaling pathway is therefore phased: start with a small number of demonstration sites, document performance and compliance and then expand through peer-to-peer learning between CFUGs, supported by local civil society organisations and technical partners. As the number of sites increases, the focus shifts from ‘project delivery’ to ‘system support’: coordinated seed and feed supply, basic grading and handling standards for market access and predictable extension support so that small producers can maintain animal health and water conditions through seasonal variability and extreme events. By securing early agreement with forest and fisheries authorities on what constitutes ‘mangrove-friendly’ practice, the project ensures that scaling does not trigger unintended regulatory barriers. Ultimately, the

programme frames mangrove restoration and compatible livelihoods as a single adaptation investment: mangroves provide physical defence against cyclones and storm surges, while livelihood returns sustain the community's stewardship and remove the economic pressure to clear forests.



Outcomes and impacts

With WWF funding, local civil society organisations and conservation networks delivered training and workshops on sustainable MFA and mangrove restoration, alongside broader capacity building, awareness-raising and material/financial support (including the establishment of mangrove nurseries and provision of livelihood inputs). As a result, ten communities in the Ayeyarwady Delta were empowered to protect and sustainably manage approximately **1,495ha of mangrove forest**.

The livelihood component is primarily shrimp and mud crab farming integrated with mangroves — using the forest as breeding grounds and food sources — with agroforestry (seasonal crops) included, where appropriate, to diversify income and reduce livelihood risk.

These mangrove-integrated aquaculture and agroforestry approaches are highly effective because they can be integrated into existing mangrove landscapes without requiring land expansion and with minimal ecosystem harm, helping sustain mangrove functions while supporting household incomes. Within these MFA systems, mud crabs are cultivated under mangrove shade to support faster growth and reported outcomes include improved market access and strengthened community enterprises.

To situate this programme-level scaling within a wider investment and replication logic, delta-scale analysis identifies **38,269ha of 'pond areas on mangrove land'** suitable for upgrading to MFA. It estimates that scaling implementation across suitable land over 2022–2042 would require **US$50.83–61.92 million (present value)**, with around half of the total investment linked to planting and rehabilitating mangroves within pond landscapes. This delta-scale analysis identifies **Labutta, Pyapon and Bogale townships** as priority areas for scaling, based on the concentration of suitable pond areas on mangrove land.

Across the current scaling phase, which began in two communities in 2022 and expanded to **20 communities by 2025**, the project targeted households with a high pre-project dependence on mangroves for food, livelihoods and fuelwood. The outcomes for the mangrove forests focus on improving management and interventions aimed at enhancing natural regeneration to reduce deforestation pressure across CFUG areas. Consequently, mangrove condition indicators remain qualitative, including strengthened natural regeneration and maintenance of canopy cover.

Livelihood diversification through MFA is explicitly intended to reduce pressure on mangrove resources by providing alternatives to fuelwood collection and cutting. Inclusion is addressed through community-based governance structures, with decision making embedded in CFUG processes; however, specific disaggregated metrics on women and youth participation are not reported, and indicative yield or profit ranges are not yet systematically documented at the programme scale.

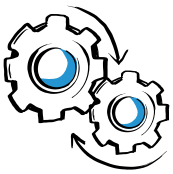
Finally, MFA is framed as a climate adaptation response to cyclone risk, flooding and environmental stress in the Ayeyarwady Delta, supporting livelihood resilience while maintaining mangrove cover as a natural buffer. **However, as the programme targets**

50 communities by 2027, a primary scaling bottleneck is the current reliance on wild crab larvae and mangrove seeds; future investment must prioritise hatchery capacity to maintain technical integrity and ensure reliable seed quality, biosecurity and stable supply. Hazard-specific indicators, such as erosion reduction or recovery time following storm events, are not yet quantitatively monitored.

Challenges and lessons

Scaling mangrove restoration linked to MFA from pilots to multiple CFUG sites reveals five recurring constraints.

- Adoption can lag even when long-term returns are attractive because households face high upfront costs and short-term opportunity costs; blended finance, low-interest terms and grace periods matter.
- Input constraints can cap productivity: reliance on wild larvae/seed and limited hatchery capacity make stocking unreliable at scale.
- 'Mangrove-friendly' integrity depends on enforceable safeguards — no net mangrove loss, water-quality management and controls on contaminated feed and chemical runoff.
- Governance risks (tenure disputes, elite capture, uneven benefit-sharing) can undermine compliance: replication needs minimum CFUG standards plus transparent benefit rules and grievance routes.
- Market volatility and weak grading standards erode margins: value-chain support and monitoring systems must scale alongside the sites.



Enabling conditions and scalability

This scaling approach aligns with Myanmar's climate and sector priorities, which recognise mangrove conservation and climate-smart aquaculture as part of adaptation and low-carbon development. Myanmar's Nationally Determined Contribution plan, updated in 2021, references major forestry contributions, including the Myanmar Reforestation and Restoration Programme's aim to restore around one million ha of degraded/deforested land through plantations, community forestry, agroforestry, natural regeneration and enrichment planting. The Department of Fisheries' National Aquaculture Development Plan includes targets to expand mangrove-friendly farming systems to 6,000ha and improve access to finance for farmers/enterprises, alongside an emphasis on good aquaculture practice. Enablers for scaling include zoning/suitability assessments, capacity development and blended finance (loans with grace periods plus grant support), alongside community and private-sector involvement in value chains.

This scaling pathway is enabled by Myanmar's Community Forestry framework, under which CFUGs are legally recognised to manage mangrove areas for conservation and livelihood purposes. While the establishment of new Community Forests is currently constrained by broader legal and land tenure challenges, existing CFUG arrangements continue to provide the institutional basis for community-based mangrove management and MFA in the project area.

The next phase scaling plan targets expansion from the current 20 communities to 50 communities by 2027. Scaling will be supported through a combination of revolving fund mechanisms, initial start-up and investment funds provided by WWF and community-enterprise development approaches. Within this framework, WWF plays a lead role in capacity building, institutional strengthening and facilitating market access; local CSO partners focus on community mobilisation and livelihood training; and communities/CFUGs are responsible for local governance, implementation and management of revolving funds.

Case 5 — Nature-based solutions for human–elephant conflict (HEC): coffee-centred agroforestry for coexistence

LOCATION:	**South-eastern Western Forest Complex (sWEFCOM), Kanchanaburi Province, Thailand (transferable model for Myanmar HEC landscapes)**
ORGANISATIONS:	**WWF UK; Zoological Society of London (ZSL); Human Elephant Voices Network (HEVN) / EcoExist**
PERIOD:	**July 2023 – December 2024**
AUTHOR:	**WWF Myanmar**

Context and climate risks

The south-eastern Western Forest Complex (sWEFCOM) is a biodiversity-rich forest–farm landscape where increasing human-elephant conflict (HEC) threatens both wildlife conservation and local livelihoods. Smallholder farmers cultivate cash crops such as cassava, sugarcane and banana, which are highly attractive to elephants. This increases crop raiding, economic losses and safety risks and can erode tolerance for elephant conservation. Long-term monitoring in the wider sWEFCOM landscape recorded more than 4,400 crop-raiding events across 24 communities (2013–2021), with around 70% of incidents involving cash crops. In target communities, reported damages over a five-year period exceeded one million Thai baht (approximately US$31,270 – source : World Bank, 2021), indicating the severity of the livelihood shock.

Environmental degradation compounds this conflict dynamic: soil degradation, deforestation and declining ecosystem connectivity reduce habitat quality and limit elephants' safe movement. Climate change intensifies these pressures, including through more frequent drought and water scarcity that can reduce forage and water availability in forest areas. When forest resources are constrained, elephants may range further and spend more time near settlements and farms in search of food and water. In this context, WWF UK and partners piloted NbS that combine ecological restoration with climate-resilient agroforestry to reduce conflict, improve land-use sustainability and strengthen both community and ecosystem resilience.

The project aimed to develop sustainable, investible agroforestry models that reduce HEC by transitioning farmers from elephant-attractive cash crops to coffee-centred agroforestry systems. The intervention was designed around a clear risk pathway: reduce highly attractive field conditions and increase farm-level resilience, while improving landscape connectivity and habitat quality so that elephants can move and forage with less pressure to enter farms.

At the farm level, the project co-designed coffee-based agroforestry models with farmers and local stakeholders. Coffee was planted under a canopy of native shade trees, with diversified planting and supplementary crops to spread risk and stabilise income. The agroforestry design was intended to improve soil structure, increase shade and soil moisture retention, reduce erosion and create more stable microclimates — features that increase drought resilience while also changing the structure of farm edges that often become the interface for conflict by planting denser, shaded and more diverse vegetation. Practical deterrence and 'buffer' measures were integrated where locally appropriate (for example, boundary plantings and other non-lethal deterrent approaches), alongside training on farm management and safe production practices.

At the landscape level, the project supported ecological restoration, the creation or strengthening of ecological corridors and improved sustainable use of natural resources to address fragmentation and reduce pressure points along elephant movement routes.

A defining feature of this project was the focus on ‘investment readiness’ for scaling. The project supported business model development capable of generating long-term financing for adoption, including cooperative/community-enterprise structures to aggregate production, improve quality, access markets and reduce risk for smallholders. Project activities included farm mapping and suitability assessments and the testing of models across different agroclimatic zones (for example, variations in elevation and rainfall) so that the approach could be adapted under changing climate conditions.

Outcomes and impacts

At the time of reporting, the project was still in its early stages, with key indicators scheduled for measurement in 2024–2025; accordingly, outcomes are best understood as (i) baseline evidence establishing the problem, (ii) early delivery milestones for adoption readiness and (iii) near-term targets for scaling and impact measurement.

Baseline monitoring provides strong justification for the intervention: across the broader sWEFCOM landscape, long-term monitoring recorded over 4,400 crop-raiding events across 24 communities during 2013–2021, with cash crops involved in the majority of incidents. This reinforces that conflict reduction requires structural change in land-use and livelihood models, not only short-term deterrence.

Early progress includes structured engagement and co-design with conflict-affected communities. Focus group engagement across 17 communities involved 375 households, with significant participation of women (around 41%) and Indigenous households (around 13%, predominantly Karen and Mon). This engagement was used to identify barriers and opportunities for agroforestry adoption and to tailor farm models to local needs and climate conditions.

Institutionally, cooperative or community-enterprise development has progressed to support future scaling. A community coffee group (Chang Yim) was formed to improve organisation, develop business planning and strengthen market access and quality processes. Work is under way to develop and apply shared standards that link ‘elephant-friendly’ production with safe practices and non-violent deterrence and to build local learning capacity through peer exchange and training.

In terms of intended outcomes, the intervention aims to achieve 2,000ha of land under improved sustainable management over time, combining conflict reduction (fewer raids and crop losses), livelihood resilience (more stable and diversified incomes) and ecological benefits (increased tree cover, improved habitat connectivity, improved soil and water retention and long-term carbon sequestration). The climate benefits are explicit: agroforestry improves drought buffering at the farm level, while restoration and corridor strengthening reduce fragmentation stress and improve habitat resilience — both of which are expected to reduce the frequency and severity of conflict pressures in a warming and more variable climate.

Challenges and lessons

1. Transitioning farmers away from familiar cash crops is complex because agroforestry benefits accrue over the medium term. Adoption is more likely when farmers receive a credible transition package that reduces short-term income risk (including, for example, inputs, technical support and access to finance).
2. Land tenure and land-lease insecurity can deter investment in trees and farm restructuring. Strengthening or stabilising lease arrangements and clarifying rights are important enabling steps.
3. The 'farm model' alone is insufficient: scaling depends on an enabling architecture: cooperative governance, standards for quality and safety, market access and reliable finance instruments that make adoption investible and durable.
4. Monitoring and attribution are challenging because conflict fluctuates with rainfall, water availability, crop calendars and elephant movement patterns. Impact tracking requires consistent incident logs, household loss data and ecological indicators (such as tree cover, corridor functionality and farm-level resilience indicators).
5. Climate stress can amplify conflict dynamics (especially water scarcity). Agroforestry's resilience benefits should therefore be measured as part of the conflict-reduction pathway, not treated as a separate co-benefit.

Re-preparation the check-dam (18)_Grassland & check-dam area_Ngaputaw / WWF

Enabling conditions and scalability

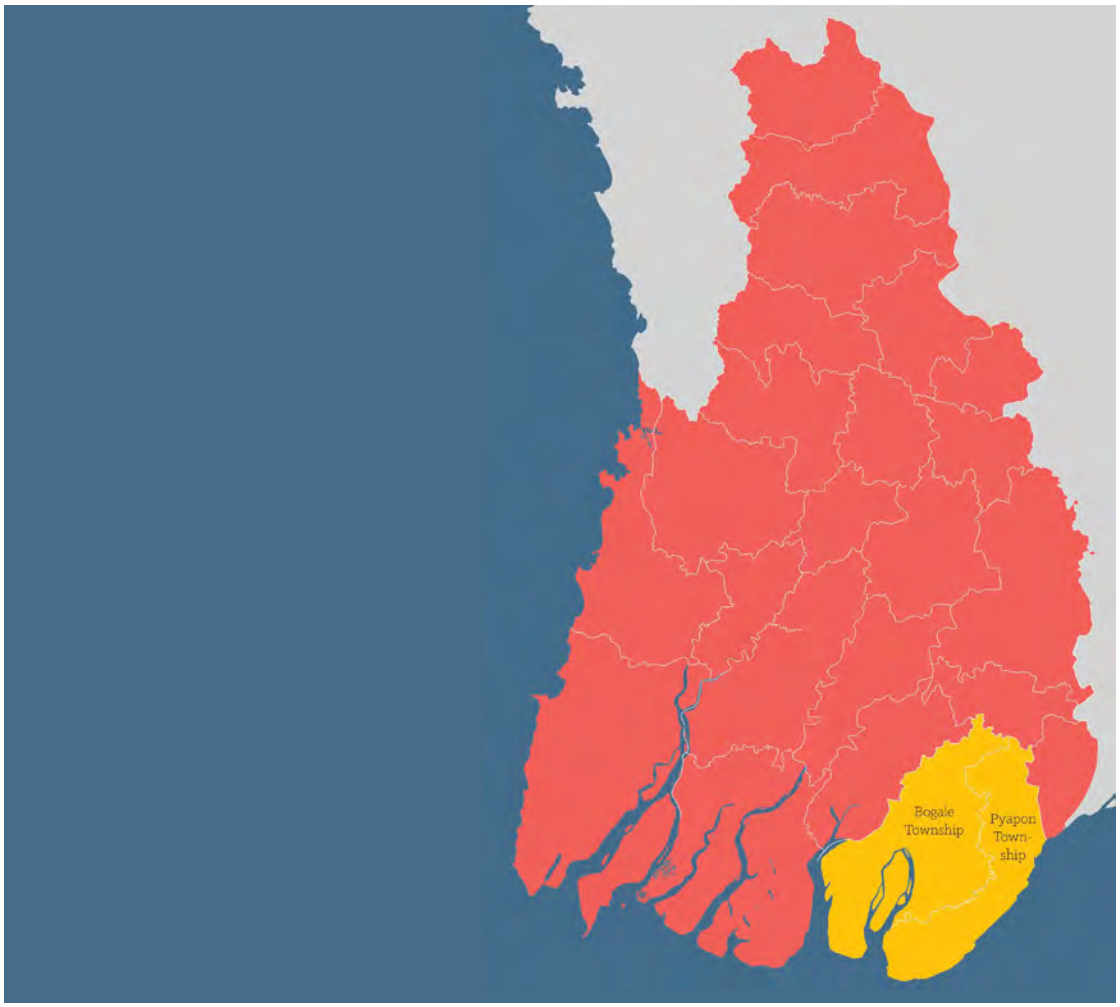
Key enabling factors include strong community co-design, technical capacity for agroforestry and restoration planning and viable market pathways for climate-resilient coffee and diversified tree-based products. The approach aligns with SDGs 1 (poverty reduction), 2 (food security and resilient livelihoods), 8 (decent work), 13 (climate action) and 15 (life on land), and it contributes to integrated landscape management by linking restoration and sustainable production to risk reduction.

Scalability depends on three factors: (i) replicable agroforestry 'packages' adapted to agroclimatic zones and elephant movement patterns; (ii) cooperative/community-enterprise structures that can aggregate production, maintain quality and negotiate market access; and (iii) finance mechanisms that bridge the transition period (for example, agri-loans and outcome-based instruments) while demonstrating measurable impacts on conflict and resilience. The project is explicitly framed as an investment-readiness pathway, aiming to create an implementable model and a credible investment proposition to support expansion across a 2,000ha target landscape.

If used as a transferable model for Myanmar, the key takeaways are: frame HEC as a climate resilience issue (water stress and degraded connectivity); pair farm-level land-use change with corridor restoration; and plan financing and market access as part of the NbS design from the beginning.

Case 6 — Community-led mangrove restoration and climate resilience in the Ayeyarwady Delta

LOCATION:	**Pyapon and Bogale Townships, Ayeyarwady Region (Delta), Myanmar**
ORGANISATIONS:	**UN-Habitat (through the Myanmar Climate Change Alliance Phase II Programme (MCCA2)), township stakeholders and village-level committees, local civil society and community-based organisations; technical support partners.**
PERIOD:	**2023–2025 (major planting implemented by the end of the 2024 rainy season; continued support and scaling actions were planned through 2025. This case study was prepared prior to full project closure).**
AUTHOR:	**UN-Habitat Myanmar**



Context and climate risks

The townships of Pyapon and Bogale are located in Myanmar's coastal delta and are highly exposed to climate hazards, including cyclones and storm surges, coastal and riverine flooding, sea-level rise and saline intrusion and periods of extreme heat. These shocks and stresses undermine agriculture, aquaculture and fisheries-based livelihoods, damage housing and local infrastructure and increase health risks when drinking water sources are contaminated or services are disrupted. In many delta communities, limited protective infrastructure and persistent poverty reduce households' ability to absorb repeated losses and invest in recovery, making risk reduction urgent and strongly tied to everyday livelihoods.

In the Pyapon district, mangrove cover had decreased by approximately 70% prior to the intervention. Across the Irrawaddy Delta, Cyclone Nargis (2008) alone destroyed nearly 14,000ha of mangroves. The disappearance of mangroves is caused by several climatic hazards (cyclones, floods, rising sea levels) and human activities, such as land conversion to rice paddies and aquaculture. Nearly 43% of delta households rely on mangrove-related livelihoods (including firewood, fish, crabs and prawns), and mangrove degradation has contributed to reduced fish stocks, increased coastal erosion, weakened storm protection, displacement following major cyclones and heightened poverty and food insecurity.

This case responds to the loss and degradation of delta mangroves. Mangroves function as 'living infrastructure': they can reduce wave energy, dampen storm surge impacts, stabilise shorelines and sustain fisheries habitat, while also storing carbon. The programme treats mangrove restoration not as a stand-alone environmental activity, but as part of a wider resilience package that begins with local climate-vulnerability assessment and local climate action planning. Through this process, communities and township actors identify priority climate risks and practical responses and then implement selected actions through community-led delivery mechanisms that build local capability and stewardship over time.

Climate-vulnerability assessments and local action plans for Pyapon and Bogale were finalised in March 2024. Although they are not publicly available online due to political and operational constraints, they are available to local authorities, community partners and MCCA2 project stakeholders. Key livelihood groups identified in the vulnerability assessment include households that are highly dependent on mangrove resources for income and food security, as well as female-headed households and communities that rely on fishing and aquaculture in village areas most exposed to climate change.

Intervention design and delivery

This intervention combined township-level climate-vulnerability assessment and local climate action planning with community-led mangrove restoration designed to deliver protective ecosystem functions and livelihood co-benefits.

Step 1 — Climate-vulnerability assessment and local climate action planning

UN-Habitat, working through local civil society and community-based organisations, organised structured consultations and workshops to identify priority climate vulnerabilities and feasible actions. This planning process emphasised gender-responsive local climate action, ensuring women's experiences of risk and practical priorities were reflected in the agreed actions.

Step 2 — Community delivery set up and governance

Village-level governance arrangements were established or strengthened to ensure local oversight and long-term continuity. Implementation was managed through **Community Mangrove Plantation Cluster Committees** and **CFUGs**, with a specific focus on women's representation in decision making roles.

Under this model, roles were clearly defined, as follows:

- **Community Committees** were responsible for planning, implementation and financial management under Community Implementation Agreements.
- **CFUGs** provided the legal foundation, ensuring site management and long-term land-use rights within designated community forest areas.
- **UN-Habitat Myanmar** provided programme design, technical oversight and the transfer of funds.
- **The Forest Department under the Ministry of Forest and Environmental Conservation and local partners (GEDA)** provided regulatory support and technical guidance on species selection and pest control.

This delivery model prioritised practical, local routines that communities could maintain independently, recognising that durability depends on local stewardship rather than a constant external presence.

Step 3 — Mangrove restoration operations and continuity measures

Community members carried out restoration activities, with technical oversight from UN-Habitat and guidance from the Forest Department and local civil society organisations on species selection and pest control. Activities included planting in community-managed areas and establishing or strengthening nursery capacity to supply seedlings, support replacement planting where mortality occurred, and enable continuity beyond the initial planting season. Importantly, the intervention extended beyond planting by introducing sustainable harvesting, management and monitoring practices so that restored mangrove belts could be maintained and

defended over time. Where relevant, restoration choices were informed by a blend of technical guidance and local ecological knowledge about suitable sites, seasonal rhythms and practical protection needs.

The restoration covered a total area of approximately 50.5ha across the two townships (about 30.5ha in Pyapon and 20ha in Bogale) and was implemented in several villages. Although detailed protocols regarding planting density, spacing and species-specific survival rates were not officially communicated, the intervention focused on restoring degraded mangrove areas and enhancing natural regeneration through community management.

Step 4 — Linking restoration to livelihoods and co-benefits

The programme linked restoration to household resilience by supporting women's livelihood development groups associated with mangrove-related products. This was intended to strengthen incomes and reduce pressures that can drive mangrove cutting or conversion, reinforcing the durability of restoration.

Complementary measures within the wider resilience approach

The local climate action planning process also prioritised and implemented other resilience actions in some sites, such as solar lighting installations. In addition, school-led climate action and community awareness activities helped connect ecosystem recovery to everyday practices and longer-term behaviour change, strengthening the social conditions for stewardship between hazard events.

UN Habitat / Source

Outcomes and impacts

Restoration delivered at meaningful scale: By the end of the 2024 rainy season, programme reporting described the planting of around 150,000 mangrove trees across the two townships, with more than 80,000 trees planted on approximately 30.5ha in Pyapon and more than 60,000 trees planted on approximately 20ha in Bogale. A related programme case account describes nearly 50.5ha restored across Pyapon and Bogale, alongside short-term local employment generated during planting and restoration activities.

Resilience mechanisms: Mangrove recovery strengthens coastal buffering by reducing storm surge and wave impacts, stabilises shorelines and supports fisheries habitat. These benefits matter most during extreme events when built infrastructure and services are disrupted. The programme also frames mangroves as a climate mitigation asset through carbon storage, while prioritising adaptation outcomes for vulnerable delta communities.

Inclusion and livelihoods. Livelihood impacts include 252 community members employed through cash-for-work plantation activities and the formation of women's livelihood development groups (99 women across six villages).

UN Habitat

Programme materials describe these women's livelihood development groups as linked to restoration (including nearly 100 women involved in selling mangrove-related products), signalling a deliberate effort to connect ecosystem restoration with household-level resilience and meaningful participation.

The groups have accessed new income opportunities linked to fisheries (crab, shrimp and fish farming), agroforestry and mangrove-based products, alongside savings and self-help funds providing low-interest community loans.

Reach, learning and indirect benefits

The programme reached more than **12,000 beneficiaries** through its broad-spectrum climate resilience activities, including solar lighting, school-led climate action and community awareness. Within this wider reach, **500 individuals** received direct, specialised training in mangrove restoration and NbS. These numbers highlight the programme's ability to combine wide-scale community awareness with the technical capacity building required for direct restoration in the Pyapon and Bogale townships.

The intervention also contributed to a structured set of NbS options and practical learning that can support replication across Myanmar's different geoclimatic regions. It also strengthened community awareness of climate risks and the role of mangrove ecosystems in supporting livelihoods and resilience.

Environmental impact and ecosystem services

Direct restoration outputs: By the end of the 2024 rainy season, the programme successfully restored approximately **50.5ha** of degraded mangrove areas through the planting of around **150,000 trees.** This physical recovery was distributed across the two townships as follows:

- **Pyapon:** ~80,000 trees planted on approximately 30.5ha
- **Bogale:** ~60,000 trees planted on approximately 20ha.

Observed indirect benefits: These direct outputs have triggered a range of indirect ecosystem services that strengthen coastal buffering and support fisheries habitat. Reported observations include:

- **Coastal defence:** Reduced coastal erosion and dampened storm surge impacts, which stabilise shorelines during extreme weather.
- **Biological recovery:** Improved fish breeding habitats and increased biodiversity, supporting the 43% of households reliant on mangrove-related fisheries.
- **Climate mitigation:** Enhanced long-term carbon sequestration potential ('blue carbon') while prioritising adaptation for vulnerable communities.

While these qualitative benefits are evident, quantitative post-event performance data and formal survival-rate monitoring were not yet formally documented at the time of reporting.

Challenges and lessons

Operational constraints and access: Programme documentation notes that Myanmar's operating environment can create access restrictions that affect field monitoring and implementation continuity. This increases the importance of community-led routines for nursery management, replacement planting and basic monitoring when external support is intermittent.

Institutional coordination: Coordination with relevant line departments, including those involved in forest governance, can create delays if approvals, roles or benefit-sharing expectations are unclear. Sustained coordination and practical problem-solving are important to keep restoration activities moving and to protect restored areas over time.

Maintenance and continuity are the real test: Mangrove planting succeeds only if post-planting care, replacement of dead seedlings and protection from cutting or encroachment are sustained over multiple seasons. This requires clear local roles, simple monitoring routines and credible incentives that make stewardship worthwhile.

Lesson for replication: Restoration is most effective when treated as a 'platform' intervention: it should be paired with repeatable local governance routines (committee oversight, monitoring, inclusive participation), livelihood pathways that reduce pressure on mangroves and complementary everyday resilience measures that keep engagement active between hazard events.

UN Habitiat

Enabling conditions and scalability

The Myanmar Climate Change Alliance Phase II is designed to support implementation of Myanmar's climate policy through local-level resilience building, gender-responsive climate action and strengthened climate dialogue and knowledge. The Pyapon/Bogale approach benefits from:

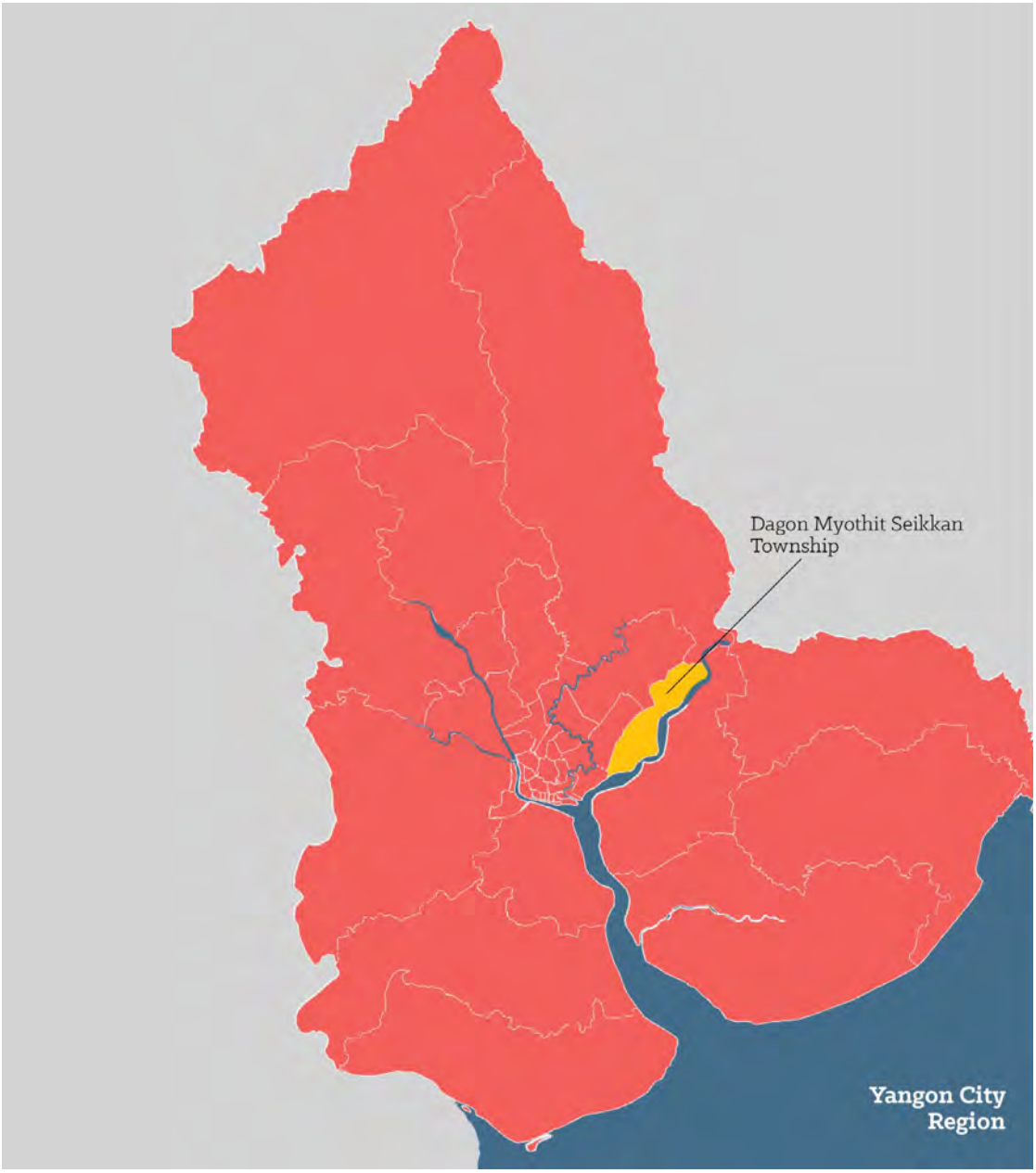
- A planning-to-implementation pathway in which local climate-vulnerability assessment and local climate-action planning translate local risk into specific, funded investments
- Community participation as a delivery mechanism, strengthening legitimacy, stewardship and continuity of restored areas, and
- Clear donor alignment, with European Union support documented in programme communications.

Restoration sites are managed through CFUGs, which hold legal land-use rights in designated community forest areas. While township-level climate action plans informed investment priorities, specific township budget allocations or carbon finance mechanisms were not identified within the current implementation phase.

Link to other cases in this compendium. This case can be presented as a restoration-and-governance foundation that enables livelihood-oriented, mangrove-compatible models. In the compendium narrative, restoration and local planning form the 'risk-reduction base,' while mangrove-friendly livelihood models (such as MFA described in Case 1 and the scaling pathway described in Case 4) provide a 'resilience-plus-livelihoods' layer that helps sustain protection by reducing extractive pressure and strengthening local stewardship capacity.

Case 7 — Community-led sustainable urban drainage (SUD) improvement and access upgrade in an informal settlement

LOCATION:	**Dagon Seikkan Township, Yangon, Myanmar**
ORGANISATION(S):	**Doh Eain Myanmar and one of the CSOs in Myanmar**
PERIOD:	**October–November 2025**
AUTHOR:	**Swan Yee Tun Lwin, Kyaw Zin Hein (Doh Eain)**



Context and climate risks

The Dagon Seikkan Township, which translates to ‘new Dagon port’, is located in the eastern part of Yangon and, as of 2015, was home to more than 167,000 residents. An estimated 32% of this population lives in informal settlements, and this project focuses on one such informal community. This community has a population of approximately 1,200 residents, or 400 households, and is located in one of the low-lying wards of the Township.

This community faces debilitating challenges due to a critical lack of formal infrastructure and high exposure to climate-related hazards, most critically, chronic urban flooding. Due to its informal status and lack of inclusion in formal urban planning processes, the settlement has no dedicated drainage outlet to aid in water flow and a limited network of paved roads. As a result, rainwater has no effective outlet and portions of the community remain permanently inundated for much of the year, with conditions worsening significantly during periods of heavy rainfall.

The impacts of persistent flooding are severe and multidimensional. Daily mobility is significantly constrained, particularly for elderly residents and children, limiting access to education, healthcare and livelihoods. Prolonged waterlogging contributes to heightened health risks, including waterborne diseases, and undermines household wellbeing. Recurrent flooding frequently damages homes and personal belongings, forcing some families into temporary displacement and deepening economic vulnerability.

These intersecting environmental and socio-economic challenges highlight the urgent need for context-appropriate, climate-resilient interventions that can address flooding while improving living conditions in informally-developed urban or peri-urban areas such as those in Dagon Seikkan Township.

Before implementation – main road

Intervention design and delivery

The intervention aimed to reduce chronic flooding, improve year-round accessibility and strengthen climate resilience in a low-lying informal settlement in Dagon Seikkan Township through a hybrid approach combining engineered drainage with nature-based and locally-adapted design elements. Traditional grey infrastructure techniques were used mainly for reinforcement and structural support, which was also preferred by the local community, while maintaining vital links to the local natural system.

The primary objectives were to restore water flow in a permanently inundated area, protect households from flood damage and improve safe mobility for residents, particularly children, older persons and people with limited mobility.

During implementation – community participation

The core physical interventions involved:

- **Permeable access corridor (48.76m):** A main access street was upgraded into a high-performance permeable corridor by using a stratified base of crushed brick and stone compacted with sand in lieu of traditional asphalt or concrete. This nature-inspired porous design promotes natural infiltration and surface drainage, while brick retaining walls provide the structural stability required for vehicular traffic. Side channels were also integrated to direct excess runoff into a newly added culvert below. The design balances the community's need for durable transit with locally sourced materials to maintain the hydrological connection between the street surface and the underlying soil.
- **Integrated culvert and structural bridge:** To resolve chronic water stagnation in dense residential areas of the community, a culvert was engineered to provide a high-capacity discharge route linking the community to the existing municipal system. A small reinforced bridge was added atop the culvert to bolster the structural integrity of the existing street, providing a 'grey' solution where spatial constraints deterred purely green interventions. The culvert acts as a critical 'blue' artery that efficiently evacuates trapped floodwaters from the low-lying areas of the community and connects it to the larger hydrological system.
- **Bio-engineered pedestrian elevation (108m):** In high-risk areas previously subject to 60cm deep inundations, the walking paths were elevated using nature-based techniques. Moving away from temporary sandbags, bamboo piling and mats were combined with a compacted mixture of local debris and silty sand to create a stable and breathable walkway. Drainage outlets were also incorporated at regular intervals to prevent water accumulation in peak monsoon events.
- **Hybrid conveyance channel (35.35m):** An existing, shallow channel was restored to improve efficiency by excavating the original drain path and preserving the existing riparian vegetation and natural soil banks. By retaining these 'green' edges, the design maximises the natural absorptive capacity of the banks and utilises roots and biofiltration for erosion control with additional reinforcement via the brick-lined channel walls. The walls were also engineered with a slanted, trapezoidal profile to optimise hydraulic efficiency, designed to provide a durable and efficient outlet for accumulated floodwater.
- **Flow and waste regulation:** A simple sluice gate was installed at the intersection of the conveyance channel and the municipal drain to regulate water flow and capture solid waste, preventing blockages.

Complementing these physical interventions was robust community-led participation, including labour contributions, local oversight and coordination with local authorities. This participatory process ensured alignment with local needs, strengthened ownership and enhanced the long-term sustainability of the intervention by empowering residents to manage the interventions while fostering a deeper relationship between the built environment, the local ecosystem and residents.

Outcomes and impacts

The project achieved outcomes that exceeded its original technical and social objectives, demonstrating the effectiveness of community-led, climate-resilient infrastructure in informal urban contexts. Implementation surpassed the initially planned distances for drainage and road upgrading due to savings from locally sourced materials, reflecting both strong local commitment and adaptive problem-solving during construction. Deep community integration was a critical success factor: residents contributed voluntary labour, organised meal provision for workers and participated in on-site decision making, fostering strong local ownership and accountability.

Beyond physical improvements, the intervention played an important role in strengthening social cohesion. The settlement is characterised by long-standing tensions linked to religious and social differences; however, the collective nature of the works transformed construction sites into shared spaces of cooperation. This process of place-based collaboration helped reduce tensions, build trust across groups and reinforce a shared sense of community identity.

From a technical perspective, close coordination with Doh Eain – a Yangon-based social enterprise focused on inclusive urban regeneration – and local administrative authorities ensured high-quality, sustainable solutions. Design challenges related to water flow, elevation levels and construction sequencing were resolved through joint planning and site visits, resulting in infrastructure that is both robust and context-appropriate.

Measurable impacts are significant. Chronic flooding, previously a year-round hazard, has been effectively resolved. Elevated roads and functional drainage now ensure uninterrupted mobility throughout the year, including during heavy rainfall. Improved accessibility has contributed to socio-economic gains, including increased property values, safer movement for children and older people and a visibly cleaner and healthier living environment.

Previously flooded and inaccessible areas have been reclaimed as functional public spaces, supporting social interaction, recreation and wellbeing. By prioritising the hiring of local residents, the project also generated short-term income and vocational experience. Overall, the intervention stands as a replicable model of how community-led infrastructure can transform vulnerable informal settlements into resilient, inclusive and thriving neighbourhoods.

Challenges and key lessons learnt

The project faced several interrelated challenges that offer valuable lessons for implementing climate-resilient infrastructure in informal urban settings. Market volatility significantly affected construction planning, as sharp increases in the cost of limestone base materials threatened budget viability. This was addressed through a strategic shift to using locally sourced recycled broken bricks, demonstrating how material flexibility can maintain structural stability while controlling costs. Space constraints within the densely built settlement posed another challenge, as narrow, uneven road widths required careful negotiation with residents to reclaim limited public space without exacerbating social tensions or displacement risks.

Environmental preservation emerged as a critical concern when the ward administration's initial road-widening proposals included removing trees. Through constructive engagement with local authorities, the project team successfully advocated for the environmental and social value of existing greenery, leading to a redesign of the road alignment which protected mature trees while still achieving flood-resilience objectives. Weather-related disruptions further tested implementation, as unseasonal heavy rainfall flooded open drainage excavations. In response, the team rapidly adapted by reprioritising road elevation works, reducing delays and maintaining overall progress.

Key lessons highlight the importance of flexibility, diplomacy and resourcefulness. Adaptive scheduling is essential when working in flood-prone or monsoon-affected contexts. Community-based negotiation, rather than forced clearance, builds trust and enables equitable solutions, particularly in informal settlements. Finally, the use of recycled and locally available materials offers a practical strategy for managing cost fluctuations while supporting sustainable construction practices. These insights are directly transferable to similar urban contexts facing climate and infrastructure challenges.

After implementation – informal road improvement

Enabling factors and policy relevance

The intervention's success was enabled by strong community ownership, close collaboration with ward authorities and the strategic use of locally available and recycled materials. These factors allowed technically robust solutions to be delivered despite financial, spatial and climatic constraints. The project aligns closely with national urban resilience and climate adaptation priorities, as well as international frameworks, including the Sustainable Development Goals, particularly:

- SDG 9 (Industry, innovation and infrastructure)
- SDG 11 (Sustainable cities and communities)
- SDG 13 (Climate action) and
- SDG 15 (Life on land)

By integrating flood risk reduction with inclusive access and environmental preservation, the intervention demonstrates the practical application of people-centred climate adaptation in informal settlements.

The solution has strong scalability and replication potential across other flood-prone urban and peri-urban contexts. Its modular design allows drainage, road elevation and housing upgrades to be adapted to varying settlement densities, hydrological conditions and resource availability. The emphasis on community-led implementation, negotiated space-sharing and flexible material use makes the approach transferable to regions with limited formal infrastructure and governance capacity. With early engagement of local authorities and tailored technical support, the model can be expanded ward by ward or integrated into broader municipal upgrading and resilience programmes.

After implementation – outlet from the community into the drainage

Case 8 — Community-led water-sensitive interventions (WSI) with waste management in informal settlements

LOCATION:	**North Dagon Township, Yangon, Myanmar**
ORGANISATIONS:	**Doh Eain Myanmar; Sharing Myanmar**
PERIOD:	**October–November 2025**
AUTHOR:	**Swan Yee Tun Lwin, Kyaw Zin Hein (Doh Eain)**

Context and climate risks

The North Dagon Township of Yangon comprises 27 wards with an estimated population of more than 190,000 residents as of 2019. This project focused on two neighbouring informal settlement communities within a single ward of North Dagon, both characterised by high levels of socio-economic vulnerability. Residents in both communities predominantly depend on irregular and informal forms of employment, resulting in unstable incomes. In addition, these settlements lack access to basic services, including sufficient sanitary facilities or a reliable water supply for drinking water and domestic purposes.

Both settlements are highly exposed to climate-related hazards, particularly flooding and water insecurity. These hazards are exacerbated during the monsoon season and the summer, with extreme heat days.

Settlement A developed informally along two municipal drainage channels that discharge into the Pazundaung Creek. Its location at the downstream end of the drainage system made it particularly vulnerable to flooding, especially as solid waste and sediment from upstream neighbourhoods accumulated near the outlet. Chronic blockages in the drains significantly reduced water conveyance capacity, leading to frequent overflows and prolonged inundation during periods of heavy rainfall. Combined with the waste, these incidents also pose a significant threat to residents' health.

Settlement B, located southwest of Settlement A, faced acute environmental health challenges due to the absence of formal waste management and sanitation infrastructure. This not only impaired the health and wellbeing of the residents but also negatively affected a central pond within the settlement. This critical natural asset served as the primary water source for both settlements, used for household needs and, in some cases, despite the poor water quality, for drinking water. Ongoing contamination from solid waste and exposed sewage in Settlement A posed serious risks to water quality, public health and ecosystem functioning of the pond. However, due to the lack of affordable or accessible alternatives, residents continued to rely on the pond.

Before implementation – drainage

This dependency on the pond for essential water needs, combined with poverty, insecure tenure and limited institutional support, heightened the communities' vulnerability to climate impacts, environmental degradation and associated health outcomes. These intersecting socio-economic and environmental conditions shaped the local challenge the project sought to address through nature-based and community-driven interventions.

Intervention design and delivery

The project implemented a set of integrated, community-led nature-based interventions across two neighbouring informal settlements in North Dagon Township, addressing interconnected challenges of flooding, water pollution, heat stress and public health. The process closely followed Doh Eain's tried and tested Climate Adaptation Championship (CAC) programme, which is a community-led action research initiative that empowers communities to co-design and prototype resilient climate adaptation solutions launched in 2023.

In Settlement A, interventions focused on reducing flood risk and restoring drainage functionality through community-based waste and water management. Key interventions include:

- A system of low-cost trash barriers made from bamboo poles and wire mesh was installed along key drainage lines, riverbanks and at the river mouth to intercept solid waste before it accumulated downstream.
- These measures were complemented by large-scale desilting and waste removal from blocked municipal drains and trenches, significantly improving water flow during the monsoon season.
- New and rehabilitated drainage structures were constructed alongside vegetated embankments.
- Waste trenches were filled and stabilised with sandbags and soil to discourage future dumping.
- Tree protection, walkway construction and community-led maintenance systems further reinforced the long-term functionality of these interventions.

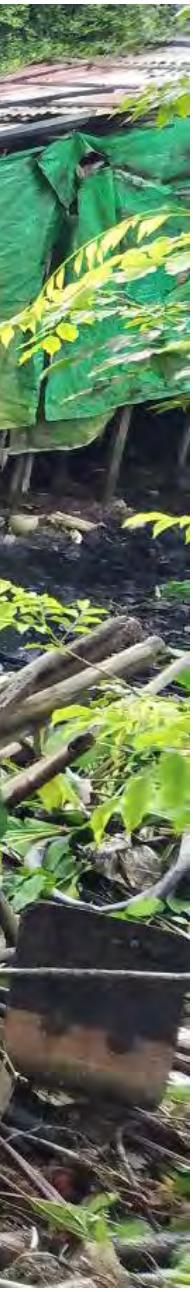
In Settlement B, the project centred on the conservation and restoration of a community pond that serves as a vital water source. Activities included:

- Clearing waste from the pond and its surroundings
- Reinforcing embankments with bamboo and wooden posts as a form of bioengineering erosion control
- Planting trees to enhance ecosystem health and reduce heat exposure through additional shade as a form of NbS, and
- Constructing small footbridges to improve safe access and water management, while protective treatments extended the lifespan of natural materials.

Across both settlements, degraded plots of land accumulating waste were transformed into multifunctional green spaces using layered soil restoration techniques and climate-resilient vegetation, such as bamboo, vetiver grass and coconut trees. The polluted land was restored by removing the trash, improving soil quality by nourishing it and making it suitable for planting. These spaces also incorporated child-friendly elements for recreation.

All physical interventions were supported by sustained community engagement, capacity building and water, sanitation and hygiene (WASH) education. Community committees were formed and trained to promote hygiene practices, manage shared infrastructure and monitor outcomes, strengthening local ownership and long-term climate resilience.

During implementation – drainage improvement in front of Mainmahla informal settlement



Outcomes and impacts

The project delivered measurable environmental, social and economic benefits by applying integrated community- and NbS to address flood risk, environmental degradation and public health challenges in two informal settlements in North Dagon Township. Through the installation of rubbish barriers along key drainage lines and riverbanks, water flow capacity was significantly improved, reducing waste accumulation and preventing recurrent blockages that previously caused localised flooding.

Pond conservation and embankment restoration works enhanced the pond's water retention capacity and reduced stagnation, contributing to improved rainwater management and water quality. The transformation of a waste-filled trench into a green space increased local green cover and restored degraded land, while also creating a safe, accessible public area for recreation and community interaction. These interventions contributed to improved air quality, reduced heat exposure and enhanced local biodiversity.

Community awareness and participation were central to the project's effectiveness. WASH education campaigns and hands-on involvement in construction, planting and maintenance activities led to demonstrable improvements in residents' knowledge of waste management, sanitation and hygiene practices. Active participation by women, older people and people with disabilities strengthened social cohesion and fostered a strong sense of ownership, supporting long-term sustainability.

Economically, improved drainage and flood prevention reduced damage to homes and personal assets, lowering recovery costs for already vulnerable households. Reduced time spent clearing drains and responding to flood impacts enabled residents to focus on income-generating activities. Participation in ecosystem maintenance and green space management also supported skills development, with potential livelihood benefits.

For the implementing local community-based organisation, the project demonstrated the effectiveness of voluntary, trust-based community engagement and generated practical lessons for replication and scaling. The organisation was able to leverage lessons from pilot activities from prior Climate Adaptation Championship projects, including pond conservation works, and is confident that it can provide guidance for future expansion to other wards. The organisation also strengthened local partnerships by collaborating with ward authorities, community leaders and residents to ensure smooth implementation and sustainable outcomes.

Overall, the project improved local climate resilience by integrating environmental restoration, social inclusion and economic co-benefits, resulting in lasting improvements in health, safety and living conditions.

Challenges and key lessons learnt

The project encountered several operational, institutional and social challenges that offer important lessons for future implementation. Delivering a wide range of physical and community-based activities within a condensed timeframe of just over one month placed significant pressure on both the project team and community participants. Engagement was further constrained by residents' competing livelihood demands, making it difficult to convene participants for awareness and training sessions. Administrative delays, frequent inspections by authorities and the broader political context created uncertainty and stress for the team, highlighting the need to develop improved strategies for engaging with local institutions. Technical challenges also emerged, including limited local expertise in constructing bamboo- and wood-based structures, material supply instability, health discomfort from waste-related odours and weather-related disruptions that affected construction schedules. Finally, the project underscored that achieving sustained behavioural change around waste management requires longer-term engagement beyond a single project cycle.

The key lessons learnt point to practical strategies for overcoming these barriers. Voluntary, non-coercive community engagement proved essential for building trust and long-term ownership. Empowering local leaders and involving residents in participatory decision making strengthened collective responsibility and alignment with community priorities. Flexibility in planning and adaptive management enabled the team to respond effectively to unexpected challenges, such as rainfall and administrative delays. Capacity building in environmental management and hygiene emerged as critical for sustaining benefits over time.

Actionable insights for replication include prioritising trust-based engagement, allocating sufficient time for behavioural change, investing in early technical training for nature-based construction and proactively planning institutional engagement to reduce delays and team stress.

After implementation – drainage clearance and green space creating for public space

Enabling factors and scalability

The project was enabled by strong community trust, active local leadership and the use of low-cost, locally available nature-based materials, allowing solutions to be implemented despite institutional and resource constraints. It aligns closely with national climate adaptation priorities and international frameworks, particularly the Sustainable Development Goals, including:

- SDG 6 (Clean water and sanitation)
- SDG 11 (Sustainable cities and communities)
- SDG 13 (Climate action) and
- SDG 15 (Life on land)

The approach is highly scalable and replicable, as it relies on asset-based, community-managed interventions that can be adapted to different urban and peri-urban contexts by tailoring designs, materials and engagement strategies to local environmental conditions and governance structures.

Case 9 — Care-based alley and pocket-space upgrading for heat and flood resilience and scaling via the Neighbourhood Network

LOCATION:	**Yangon (multiple neighbourhoods), Myanmar**
ORGANISATION(S):	**Doh Eain (with neighbourhood groups, youth volunteers, community leaders and selective coordination with ward-level actors)**
PERIOD:	**2017–2025 (with scaling through the Neighbourhood Network from 2020 onwards)**
AUTHORS:	**Doh Eain and IIED (Alejandro Barcena, senior researcher; Giorgia Grist, research consultant)**

Context and climate risks

Yangon is Myanmar's largest city, shaped by rapid urbanisation, deep inequality and widespread service deficits that are felt most acutely in informal and low-income neighbourhoods. These areas often face chronic environmental stress from poor drainage, solid waste accumulation, limited sanitation and insecure access to safe public space. Climate change intensifies these conditions through more disruptive monsoon rainfall and recurrent flooding, as well as severe heat that increases health and livelihood risks in dense settlements with limited shade and cooling options.

Since 2021, Myanmar's operating environment has been shaped by institutional and operational challenges, which have affected the consistency of public service provision and made climate action and everyday urban management more complex. In this context, resilience is often supported through local civil society, youth groups and community-based networks that respond to risks through practical, locally grounded improvements.

This case documents Doh Eain's approach to nature-based and care-oriented urban adaptation: transforming neglected alleys and small 'pocket spaces' into greener, safer, well-maintained public environments, while building the routines and community coordination capacities needed to sustain these gains over time. In addition, the impacts of these pocket parks are being scaled to a city-level through the Neighbourhood Network (NN) infrastructure, which supports learning, coordination and resourcing across neighbourhood groups beyond any single intervention site.

Rain water harvesting

Intervention design and delivery

Doh Eain's method combines practical upgrading with social mobilisation and maintenance design. Rather than delivering large stand-alone 'green infrastructure', the approach works through small, visible changes that build trust, reconfigure everyday practices and establish shared routines of stewardship.

Step 1 — Identify an everyday gap that links to climate risk

Interventions typically start with identifying local stress points that are felt daily and worsen under monsoon flooding or extreme heat: blocked drains, stagnant water, dumping hotspots, unsafe walkways, overheated spaces with no shade or degraded alleyways that are avoided rather than cared for. This framing helps residents connect short-term liveability improvements with longer-term risk reduction.

Step 2 — Co-design with residents through low-risk, incremental steps

Doh Eain works with residents through structured co-design processes that keep early steps manageable and socially safe. Early activities often prioritise shared, low-stakes actions — clean-ups, small greening, murals and collective repair — so residents can test collaboration before committing to larger changes. These steps help build legitimacy for shared responsibility for space, which is essential in contexts shaped by precarious livelihoods and insecure tenure.

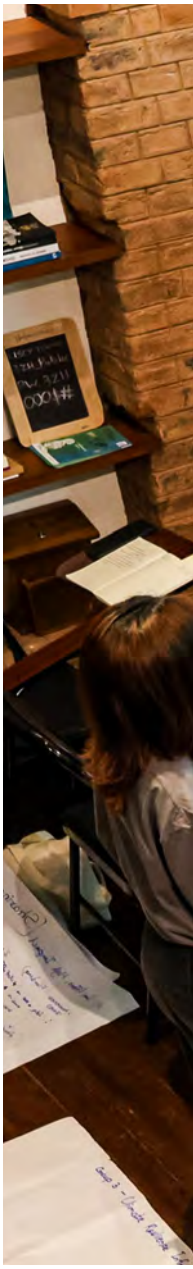
Step 3 — Upgrade alleys and pocket spaces using nature-based, low-cost features

Upgrading typically includes combinations of:

- **Greening and shade:** potted plants, planting beds, small trees and vegetated edges that cool microclimates and make spaces usable during periods of heat
- **Basic public space improvements:** safer walking routes, seating, play-friendly corners and small amenities that encourage everyday use
- **Waste and water improvements:** measures that reduce dumping and improve the function of small drainage corridors, lowering flood stress during heavy rainfall periods, and
- **Community-led construction:** collaborative building sessions that build ownership and reduce costs through local labour and locally available materials.

Step 4 — Activation and upkeep routines to sustain benefits

The intervention is designed around repeatable practices rather than a one-off 'delivery moment'. Doh Eain supports community routines such as periodic clean-up days, informal task division and simple monitoring of dumping and drainage conditions. Ongoing community use of the space increases the likelihood that improvements are maintained and defended.



Step 5 — Scaling through citywide connective infrastructure (NN)

Doh Eain complements place-based upgrading with the NN, a ‘network of networks’ established during the first wave of COVID-19 to connect grassroots groups, strengthen coordination capacity and support mutual aid. By 2024, Doh Eain reported 19 public spaces co-designed through its processes (approximately 19,000m²) and wider capability-building support to neighbourhood organisations.

NN later expanded beyond Yangon to support neighbourhood networks across multiple cities, strengthening training, coordination and access to small resources that help sustain local initiatives when formal systems are constrained.

Brainstorming with NNs

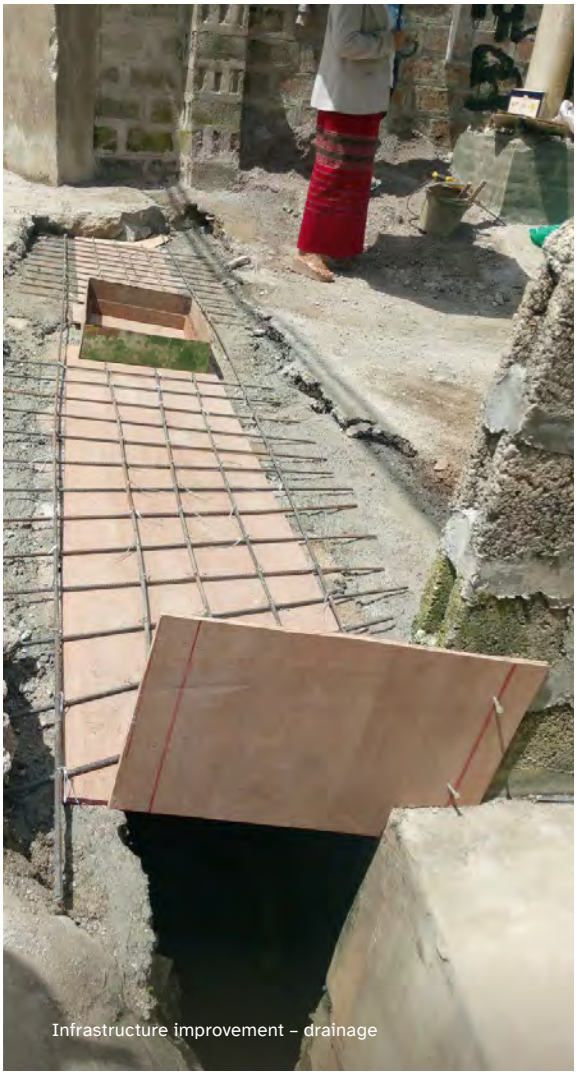
Outcomes and impacts

Improved local liveability with clear adaptation value

Alley and pocket-space transformations improve daily conditions in ways that directly relate to climate resilience. Cleaner, greener public micro-spaces can reduce heat exposure by creating shaded and socially-used environments, while reduced dumping and improved local drainage can lower flood impacts by keeping water pathways less obstructed during monsoon rainfall. Upgraded spaces also improve safety and mobility during wet periods by reducing mud, stagnation and hazards in narrow walkways.

Stronger self-organisation and local capacity for collective response

Beyond the physical outputs, the interventions build 'practice infrastructure': repeated routines of noticing problems, negotiating responsibility, coordinating action and undertaking upkeep. As residents develop shared habits of maintenance and repair, they strengthen their capacity to respond to new stressors — including climate extremes — without waiting for external action.



Infrastructure improvement – drainage

Network-enabled scaling and mutual support beyond single sites

The NN functions as an enabling layer that helps local groups coordinate, access training and connect to resources. By 2024, Doh Eain reports neighbourhood network reach across 48 townships, delivery of 96 training modules to 9,000+ members and support reaching 350,000+ individuals through member activities across five cities. This type of network support can reduce the friction of collective action: groups are more able to share solutions, mobilise quickly and sustain maintenance across seasons.

Co-benefits for wellbeing and community cohesion

Upgraded spaces create platforms for social interaction and play, which can reduce conflict and isolation and strengthen informal support systems. This matters during climate shocks, when households often depend on neighbour-to-neighbour support for temporary shelter, assistance and recovery coordination.

Challenges and key lessons learnt

Maintenance is not automatic and cannot be assumed.

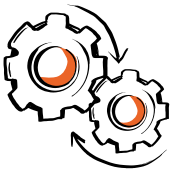
Upgraded spaces can revert to dumping or disrepair if municipal systems are weak and local routines are not continuously supported. Post-crisis conditions can increase breakdown pressures, making 'keeping it going' as important as initial delivery.

Iteration is normal and should be planned for.

Doh Eain's experience shows that interventions often require redesign or pausing due to seasonality, local constraints or changes in participation. In at least one documented example, an early alley garden was temporarily closed and explicitly re-planned after the rainy season — highlighting that resilience work is cyclical, not linear.

Start small but build capacity to travel.

Small upgrades are most powerful when they generate transferable skills: convening, negotiation, task sharing and collective upkeep. Over time, these capacities can be reactivated for flood response, mutual aid or other climate-related needs beyond the original site.



Enabling factors and policy relevance

This approach is enabled by its low-cost, locally adaptable design, its emphasis on community-led delivery and its focus on repeatable maintenance routines rather than one-off construction. The additional enabling layer — NN as a scaling and support platform — helps sustain coordination and learning when individual neighbourhoods face constraints that exceed local capacity.

Policy relevance is strong for urban adaptation because the case demonstrates how nature-based practice in cities often functions through distributed micro-interventions — greening, drainage support, waste management, shading and safer public spaces — rather than large flagship parks. These interventions align well with climate resilience priorities that focus on risk reduction for low-income communities, while also supporting wider co-benefits for public health and liveability.

In compendium terms, this case complements ecosystem-scale interventions (such as mangrove restoration and watershed protection) by showing how urban climate resilience is also built through everyday care systems — small improvements that reduce risk, sustain functioning and create community capacity to respond during uncertainty.

Key messages for practitioners and funders (MCAN)

This compendium shows that NbS can deliver meaningful climate adaptation benefits in Myanmar, but only when they are designed as **durable systems of risk reduction, livelihoods and governance** rather than one-off environmental projects. The case studies highlight the following cross-cutting messages for future programming and investment:

- **NbS should be recognised as a direct means of delivering climate adaptation**, not a supplementary environmental activity. The strongest cases reduce climate risk in practical ways — buffering storms and floods, stabilising land and water systems, reducing heat exposure and improving everyday liveability in vulnerable communities.
- **Durability depends on care systems, not only technical design.** Long-term success comes from repeatable local routines and roles: who maintains restored areas, clears blockages, replants, monitors, repairs and mobilises after climate shocks. Maintenance should be funded and designed, not assumed.
- **Livelihood alignment is essential for long-term stewardship.** NbS scale most effectively when they strengthen incomes and reduce pressure on ecosystems, rather than asking communities to forgo the livelihoods they depend on in order to protect nature.
- **Rights, inclusion and safeguards determine legitimacy and equity.** Clear tenure arrangements, transparent benefit-sharing and meaningful participation are not optional add-ons; they are the conditions that prevent exclusion and sustain long-term outcomes.
- **Scaling requires repeatable models and enabling institutions.** Effective scaling depends on suitability screening, minimum standards, technical support systems and clear coordination across relevant agencies and community structures.
- **Scaling can also occur through networks of practice.** Urban cases show that distributed, low-cost interventions — such as alley upgrading, pocket-space greening and drainage-adjacent improvements — can spread through neighbourhood networks and shared learning, especially when formal systems are constrained.
- **Hybrid approaches are often necessary in dense urban contexts.** Effective resilience frequently combines nature-based measures (shade, vegetation, infiltration, restoration of local assets) with basic engineered improvements (drainage, culverts, access routes) to address compound climate risks.
- **Credible evidence strengthens investment confidence.** Monitoring does not need to be complex, but it must be consistent and proportional to claims: for example, tracking survival and ecosystem recovery, livelihood performance and risk-reduction signals such as reduced flood duration, fewer blockages or improved recovery after shocks.

Together, these lessons position NbS not as isolated projects, but as **scalable pathways** for climate resilience in Myanmar — built through practical design, inclusive governance, livelihood feasibility and sustained care.

Synthesis and comparative learning across cases

This compendium shows that NbS can strengthen climate resilience in Myanmar, but only when they are treated as adaptation delivery systems rather than isolated environmental projects. Across the case studies, NbS work best when they are built as a practical package that combines risk reduction, livelihood feasibility, clear governance and safeguards and long-term care and monitoring. In other words, successful NbS are rarely only about the ecological asset (mangroves, agroforestry systems, restored habitats). They depend on the social and institutional conditions that allow those assets to keep functioning under climate stress.

A key insight across the cases is that NbS in Myanmar operate across a spectrum — from ecosystem-scale restoration (mangroves and coastal landscapes) to small, distributed urban interventions (alley greening, pocket spaces, vegetated corridors and community-managed micro-infrastructure) that reduce heat, improve drainage performance and strengthen everyday liveability under stress.

The cases also illustrate that Myanmar's operating environment makes durability even more important. Where access constraints, weak enforcement or fragmented authority limit continuous external support, outcomes depend heavily on community-led routines and simple governance arrangements that enable maintenance, compliance and adaptation over time. This shifts the practical question from 'Can we implement NbS?' to 'Under what conditions can NbS remain effective, equitable and scalable?'

What the cases collectively demonstrate

1. **NbS reduce climate risk most effectively when linked to livelihoods and incentives**

   The strongest interventions do not assume that ecosystem protection will succeed through awareness alone. Instead, they connect restoration and stewardship to livelihood pathways that reduce pressure on ecosystems and make protection economically realistic. In the delta cases, mangrove stewardship becomes more durable when linked to income strategies that depend on mangroves remaining intact. Similarly, agroforestry-based approaches to land-use conflict and resilience require viable farm economics, not only ecological arguments. This demonstrates a key principle: climate adaptation succeeds when the everyday logic of income and survival aligns with ecological outcomes.

2. **Governance is not a supporting element — it is the mechanism of adaptation delivery.**

   Across cases, outcomes depend on who has authority to manage land and resources, how roles are agreed and what institutions can enforce basic rules. Community-based governance arrangements work as 'interfaces' that translate ecosystem goals into enforceable local responsibilities. Governance is most effective when it becomes practical and routine: clear criteria for participation, transparent benefit-sharing, grievance mechanisms and monitoring roles that communities can perform. Without these, restoration and protection can become fragile, and investments can unintentionally heighten local tensions or exclusion.

3. Durability is built through care systems, not only technical design.

Across the cases, durability depends on whether interventions generate repeatable care routines: who cleans, replants, repairs, checks drainage, protects trees and mobilises after storms. Urban alley and pocket-space upgrading demonstrates that resilience is often produced through ordinary, continuous actions rather than single delivery moments. This reinforces a wider lesson across ecosystem and urban cases alike: NbS succeed when maintenance is designed as a social system (roles, incentives, routines and small but reliable resources), rather than being treated as post-project volunteerism.

4. Scaling is possible, but only when interventions become repeatable packages — and when networks support diffusion.

The compendium offers a contrast between isolated 'good pilots' and interventions that can plausibly scale. Scaling is most credible when the programme can define:

- a **site suitability screen** (where the model is likely to work and where it is not)
- a **minimum practice standard** (what must be protected, measured and enforced)
- a **replication process** (training, peer learning, technical coaching and supply chains)
- a **finance logic** (who pays for what and how continuity is secured), and
- a **local institutional and government foundation** (securing the engagement, endorsement and where necessary the formal authorisation of township authorities, line departments and relevant government bodies)

Where these elements exist, scaling becomes a realistic pathway rather than a hopeful ambition.

The cases also show that scaling does not only happen through replicating a single design. It can also happen through network-based scaling, where neighbourhood groups and local organisations share practical methods, build confidence and mobilise resources across multiple sites. The NN approach demonstrates how a network of practice can enable distributed urban nature-based action — small greening and upgrading steps that accumulate into wider resilience benefits — especially when formal systems are constrained.

5. Credible evidence matters: avoid over-claiming and invest in simple monitoring.

Not all cases are at a stage where outcomes can be quantified in the same way. Some interventions are still early-stage, and others have partial monitoring due to access constraints or limited resources. However, the comparative lesson is not that monitoring must be complex. What is needed is a minimum credible evidence set that matches the claims being made: simple ecological indicators (survival, canopy recovery, regeneration), practical livelihood indicators (net margin, income stability, repayment rates) and risk-relevant measures where feasible (erosion proxies, recovery time after shocks, avoided losses).

For distributed urban interventions, credible indicators can also include frequency of drain blockages, observed dumping recurrence, shaded area created, user counts for upgraded spaces and the regularity of maintenance routines (for example, clean-ups per month, repairs completed and committee activity). These measures strengthen accountability while remaining feasible for community-based monitoring.

Cross-cutting challenges and practical lessons

Across the cases, five recurring challenges emerge:

1. **Ecological fit and site selection are decisive**
   NbS can fail when implemented in unsuitable conditions, even with strong community buy-in. Hydrology, elevation, water exchange, soil conditions and ecosystem health strongly shape outcomes. Effective programmes treat site selection as a non-negotiable step, supported by simple screening tools and local knowledge.

2. **Rights, land tenure and access determine who benefits**
   Unclear tenure and exclusionary access rules can undermine legitimacy and long-term care. Even where formal frameworks exist, communities often require ongoing support to navigate documentation, compliance and institutional interfaces. Without this, NbS can unintentionally reinforce inequality or make benefits vulnerable to political discretion.

3. **Livelihood transitions require time and protection against risk**
   Where NbS involve changing production systems, benefits often take time to materialise and can expose households to new risks. Programmes need realistic timelines, transitional support and safeguards to prevent households from bearing undue burden during the shift.

4. **Markets and inputs can become the weak link in resilience chains**
   Many NbS-livelihood models depend on stable access to feed, seed, tools, buyers, transport and price stability. Climate shocks disrupt supply chains, which can damage income and confidence. Resilience, therefore, requires not only ecosystem restoration but also deliberate attention to the enabling ecosystem around livelihoods.

5. **Coordination across institutions is difficult but essential**
   Even well-designed community interventions can stall without alignment from relevant departments, township actors and intermediaries who can navigate approvals and responsibilities. The cases show that coordination is often a continuous function, not a one-off meeting.

MCAN Recommendations for future NbS implementation in Myanmar

Based on the comparative learning in this compendium, MCAN recommends the following priorities for strengthening NbS as reliable adaptation pathways:

Recommendations for NGOs, practitioners and local implementers

1. Start from climate risk and local vulnerability, not from a solution menu. Define the hazard pathway clearly (flooding, storm surge, erosion, drought stress, heat, livelihood collapse) and build the intervention logic around reducing that risk.
2. Design NbS as integrated delivery packages. Combine ecosystem actions with livelihoods, governance routines and practical safeguards.
3. Treat rights, safeguards and participation as core design elements. Make benefit-sharing transparent, define roles and ensure that grievance channels are in place from the beginning.
4. Plan maintenance as an operational system. Assign responsibilities, define upkeep routines and ensure continuity resources exist beyond the project phase.
5. Use simple monitoring that can be sustained locally. Prioritise a minimum indicator set that communities and partners can track reliably.

Recommendations for funders and programme designers

1. Fund enabling functions, not only visible outputs. Allocate resources for coordination, monitoring, maintenance and local capability building.
2. Assess whether scaling conditions are built into the project design. Require a replication package: suitability screening, minimum standards and a plan for institutionalisation.
3. Protect communities from transition risks. Ensure livelihood components include buffering support, realistic timelines and inclusion safeguards.
4. Support evidence generation that builds investment confidence. Promote measurable, comparable indicators across projects without overburdening implementers.
5. Invest in intermediaries who translate between communities and institutions. Durable scaling depends on actors who keep rules usable and projects legible to public systems.

Recommendations for policy and public agencies

1. Strengthen the governance conditions that make NbS durable. Support clear community stewardship mandates, practical enforcement routines and inclusion requirements.
2. Integrate NbS into formal planning and budgeting cycles. NbS become reliable when embedded in local action plans, township development priorities and public finance pathways.
3. Use standards to protect equity and ecological integrity. Promote minimum safeguards to prevent harm, dispossession or ecosystem degradation disguised as 'green action.'
4. Support hybrid solutions where needed. NbS should complement appropriate grey infrastructure and service delivery, especially under compound climate risks. In dense urban and peri-urban areas, effective adaptation often requires hybrid packages: drainage restoration, waste interception and safe access improvements, paired with vegetation, shade, permeable surfaces and reclaimed micro-spaces that reduce heat and improve liveability.
5. Enable scaling through learning systems. Encourage peer exchange, township learning loops and policy guidance that supports replication.

Conclusions: From projects to pathways

The central message of this compendium is that NbS can deliver meaningful climate adaptation benefits in Myanmar, but only when designed as durable systems of care, governance and livelihood viability, not as one-off restoration projects. The case studies show that effectiveness depends on the quality of institutional arrangements, the feasibility of livelihood incentives and the continuity of maintenance and monitoring. They also demonstrate that scaling is not a question of simply 'doing more NbS,' but of making them repeatable through clear standards, suitability screening and supportive finance and governance pathways.

Finally, the compendium shows that scaling can also be achieved through networks that connect and strengthen local practice. When neighbourhood organisations and community groups can share methods, coordinate maintenance and access small resources reliably, distributed urban nature-based action becomes feasible even in constrained environments.

MCAN offers this compendium as a collective contribution to strengthen NbS practice in Myanmar: grounded in what has been implemented, what has worked, what has been difficult and what needs to be improved. The next phase of NbS in Myanmar should focus less on producing isolated pilots and more on building credible, equitable and scalable pathways that reduce climate risk for communities while sustaining the ecosystems they depend on.