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Foreword

Forestry and land use are inextricably linked to a variety of other economic sectors, including energy, and are poised to receive greater attention in climate discussions in coming years as longstanding forests—representing significant carbon stocks—come under threat. While avoiding the destruction of existing forest carbon stocks is undoubtedly a significant challenge, a separate dilemma also exists: how to catalyze large-scale forest restoration.

While the potential for reforestation and afforestation to contribute to climate mitigation and other sustainable development goals is immense, it has historically been hampered by the lack of a coherent, scalable economic model. Clean energy has proven that it can attract financing, compete with incumbent fossil energy sources, and generate attractive profits (often within an advantageous policy framework). But what would lead capital to flow into sustainable forestry?

This report offers a clear-eyed, thoughtful, and comprehensive look at the challenges and opportunities that face forest restoration financing in Southeast Asia, a region of the world with immense reforestation potential. While many of the specific context and data in the report is specific to Southeast Asia, the broader analytical framework, and the insights derived therein, are exceedingly relevant to other critical forested regions of the world, from the Amazon to Congo Basin and beyond. After working methodically through the existing body of research on restoration financing, the authors calculate the carbon price range that would be needed to make restoration projects competitive against other potential uses of forested land. Finally, the authors present a set of sound recommendations for how to translate the conceptual viability of large-scale restoration financing into a bankable reality.

The Atlantic Council Global Energy Center is pleased to publish this timely, important, and pioneering report.

David Livingston
Deputy Director for Climate and Advanced Energy,
Global Energy Center
Atlantic Council

Preface

My personal interest in forests dates back to childhood, when I first experienced the magic of a forest that changes with seasons in my native Denmark.

I was of course clueless then about the multiple purposes that a forest can serve, besides being a home for animals (that I cared about—but only the "nice ones") and a place to play.

Much later, in my professional career, I was puzzled as to why afforestation could not simply take place. What was so hard about planting some trees?

My interest in writing this report stemmed from both this experience and a desire to learn more about the complexities of afforestation.

Given my chosen profession in banking, I had a natural interest in associated financing dilemmas, especially in Southeast Asia, where I am based and carbon emissions are rapidly increasing.

I learned that afforestation is not as easy as it sounds, but that it is possible and can hopefully be a significant contributor to efforts to reduce the effects of climate change.

Through this report, I hope to share some of what I learned with others, so they too can appreciate the importance of afforestation and financing such projects, even if they do not share the same childhood memories.

Mikkel Larsen
Managing Director, Chief Sustainability Officer
DBS

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Abbreviations

ARR	Afforestation, reforestation, and forest restoration/rejuvenation
ASEAN	Association of Southeast Asian Nations (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam)
BAU	Business as usual
CDM	Clean development mechanism
CERs	Certified Emission Reductions (or carbon credits)
CO_2e	Carbon dioxide equivalent
DBH	Diameter at breast height
ETS	Emissions trading system
FAO	Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
FSC	Forest Stewardship Council
GHG	Greenhouse gas
Gt	Gigaton
Ha	Hectare
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
MH	Million hectares
MRV	Monitoring, reporting, and verification
NDC	Nationally determined contributions
NPV	Net present value
NTFP	Non-timber forest product
ODA	Official development assistance
PES	Payment for ecosystem/environmental services
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	Reducing Emissions from Deforestation and Forest Degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries
ROI	Return on investment
SEA	Southeast Asia
SDGs	Sustainable Development Goals
SPA	Strategic action plan
TEEB	The Economics of Ecosystems and Biodiversity
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WRI	The World Resources Institute
WWF	The World Wildlife Fund
ZNDD	Zero net deforestation and degradation

Moss, environment, leaf and lush. Photo Credit: Imat Bagja Gumilar (@imatbagjagumilar) on Unsplash

Executive Summary

In 2017, the tropics lost the equivalent of forty football fields of trees every minute for the entire year.[1] Tropical deforestation rates remain high in Southeast Asia (SEA). Between 1990 and 2010, forest cover in SEA declined from 268 million hectares (MH) to 236.3 MH, accounting for about a quarter of all deforestation in the last half century, which is equivalent to an area roughly the size of Italy.[2] This has resulted in an unprecedented loss of biodiversity, an alteration of water supplies, and other disruptions—threatening the livelihoods of "over a billion people that rely on benefits forests offer, including food, fresh water, clothing, traditional medicine and shelter."[3] Indeed, tropical forests have gone from being a sink for carbon emissions to a primary source of them.

Tropical deforestation is among the most significant drivers of anthropogenic global warming, accounting for 8 percent of total global greenhouse gas (GHG) emissions on a net basis.[4] Globally, tropical forests account for around 68 percent of global forest carbon stocks.[5] Southeast Asia hosts about 15 percent of the world's tropical forests and 56 percent of the world's tropical peatlands.[6,7]

In an optimistic scenario, where forest loss will decline gradually over the next two decades, the world would still lose an estimated 118 billion trees by 2050.[8] This is equivalent to a loss of approximately four hundred thousand trees for every hour of every day between January 2019 and January 2050. Most of this loss is expected to occur in tropical forests, which are considered the most valuable forest type in terms of biodiversity and carbon storage. A model projection by the Food and Agriculture Organization of the United Nations (FAO) shows that—if current trends continue—forest area in Southeast Asia will fall from 49 percent in 2010 to 46 percent in 2020. This represents a loss of 16 MH, an area just slightly smaller than Cambodia.[9] Therefore, tropical forest restoration is of paramount importance, to compensate for the likely loss of forest cover.

Southeast Asia has a great opportunity for forest restoration, because large swathes of *wide-scale* and *mosaic* areas are available to be completely or partially reforested. The amount of land available for restoration is greatest in Indonesia, followed by Vietnam, where large-scale deforestation has occurred. Nearly 67 MH of lands are available for restoration in Southeast Asia, which presents an investment opportunity of approximately $330 billion, according to the authors' calculations.[10,11]

A cost-benefit analysis suggests monoculture plantations, such as palm-oil plantations, are more profitable than sustainable timber plantations if ecosystem co-benefits such as carbon storage, hydrological functions, and flood prevention are not priced in. This paper finds that sustainable timber production in SEA has a net profit per hectare of $4,450, whereas alternative

1 Mikaela Weisse and Elizabeth Dow Goldman, "2017 Was the Second-Worst Year on Record for Tropical Tree Cover Loss," World Resources Institute, June 26, 2018, https://www.wri.org/blog/2018/06/2017-was-second-worst-year-record-tropical-tree-cover-loss.

2 H.J Stibig, F. Achard, S. Carboni, R. Raši, and J. Miettinen, "Change in Tropical Forest Cover of Southeast Asia from 1990 to 2010," *Biogeosci* 11 (2014): 247–258, https://doi.org/10.5194/bg-11-247-2014.

3 "Deforestation," World Wildlife Fund, accessed December 3, 2018, https://www.worldwildlife.org/threats/deforestation.

4 Michael Wolosin and Nancy Harris. *Tropical Forests and Climate Change: The Latest Science*, World Resources Institute, June 2018, https://www.wri.org/publication/ending-tropical-deforestation-tropical-forests-and-climate-change-latest-science.

5 Daniel P. Bebber and Natalie Butt, "Tropical Protected Areas Reduced Deforestation Carbon Emissions by One Third from 2000–2012," *Scientific Reports 7* (2017): 14005, https://doi.org/10.1038/s41598-017-14467-w.

6 Stibig, et al., "Change in Tropical Forest Cover of Southeast Asia from 1990 to 2010."

7 Matthew Warren, "Tropical Peatlands of Southeast Asia: Functions, Threats and the Role of Fire in Climate Change Mitigation," https://conference.ifas.ufl.edu/INTECOL/presentations/046/1120%20M%20Warren.pdf.

8 Thomas W. Crowther, et al., "Predicting Global Forest Reforestation Potential," *bioRxiv* (2017), 3–7, https://www.biorxiv.org/content/biorxiv/early/2017/11/07/210062.full.pdf.

9 UN Food and Agriculture Organization, *Southeast Asia Subregional Report: Asia-Pacific Forestry Sector Outlook Study II* (Bangkok: FAO, 2011), http://www.fao.org/docrep/013/i1964e/i1964e00.pdf.

10 Martin Greijmans, David Gritten, Ronnakorn Triraganon, and Lina Jihadah, *Community Forestry and Forest Landscape Restoration: Attracting Sustainable Investments for Restoring Degraded Land in Southeast Asia* (Bangkok: RECOFTC, 2018), https://doi.org/10.13140/rg.2.2.34892.26246.

11 Simmathiri Appanah, ed., *Forest Landscape Restoration for Asia-Pacific Forests* (Bangkok: FAO and RECOFTC, 2016), http://www.fao.org/3/a-i5412e.pdf.

investments, such as those in palm-oil plantations, yield a net profit of $11,400 per hectare.[12,13] On average, without considering the return to land and length of project cycle, such monoculture plantations derive $6,900 more profit per hectare than typical restoration projects.

For restoration projects to be profitable, the external benefits of forest resources need to be internalized. There are several external benefits, such as water conservation and biodiversity conservation. For this report, the authors specifically examined the role of potential revenues from carbon offsets in restoration investments. The authors found that at the current level of carbon price—which is an average of $8 per ton of carbon dioxide equivalent (tCO_2e) for afforestation, reforestation, and forest rejuvenation (ARR) projects in voluntary carbon markets—the net carbon benefit per hectare of forest in SEA would be only $60.[14]

A sensitivity analysis of carbon price scenarios reveals that restoration projects in SEA become as competitive as monoculture plantations at a minimum price of approximately $40 per t$CO_2$e. These findings align with other regional studies that have found that restoration projects in SEA require carbon prices of $30–$51 per tCO_2e to break even against costs. A recent study by the Organisation for Economic Co-operation and Development (OECD), International Energy Agency (IEA), and International Renewable Energy Agency (IRENA) also recommended carbon prices in developing countries of $30 per t$CO_2$e by 2030, $60 by 2040, and $80 by 2050, in a scenario that would be compatible with limiting the rise in global mean temperature to 2 degrees Celsius by 2100—with a 66 percent probability of successfully limiting the temperature increase.[15]

While a robust carbon price would enhance the profitability of restoration projects, several other barriers must be addressed. These include: risk related to land tenure security and forest governance; limited availability of quality land at a reasonable price; competition from other crops and land uses; forestry's lack of recognition as an asset class; the difficult nature of debt financing and the weak availability of both domestic and foreign financing; lack of easily available information on sites; growth rates of different tree species; matching compatible tree species to selected sites; lack of political and economic stability; and, last but not least, the intangibility of ecosystem services in the current market.

Why does this matter to the broader economy? Financial institutions are increasingly looking to align their lending activities with the Paris Agreement. Insofar as carbon prices rise to levels aligned with a temperature increase of less than 2 degrees, institutions will find investment in ARR increasingly attractive as forests also work as carbon sinks.

Key recommendations for solutions that should work in concert in order to attract investment into this sector include the following:

- Blended and innovative financing (e.g., payment for results) are being considered as market-based financing models, and policymakers have increasingly used them in the last decade. "Payment for results" schemes—such as the Forest Carbon Partnership Facility (FCPF) housed at the World Bank, or the UN Reducing Deforestation and Forest Degradation (UN-REDD) Programme managed jointly by FAO, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP)—are good examples. Several REDD+ funds—a newer initiative supported by UN-REDD—have been created in the past several years and are being led by private-sector actors with private investments.

- As described earlier, carbon price has a positive impact on restoration-related interventions. The recognition of market-based emissions-reduction systems, enshrined in Article 6 of the Paris Agreement, has more than one hundred countries considering the use of carbon pricing to achieve their emission-reduction targets under their nationally determined contributions (NDCs). The emergence of regional carbon-emission-trading schemes, and the al-

12 Lubomir Šálek and Roman Sloup, "*Economic Evaluation of Proposed Pure and Mixed Stands in Central Vietnam Highlands,*" *Journal of Agriculture and Rural Development in the Tropics and Subtropics* 113 (2012), https://kobra.uni-kassel.de/handle/123456789/2012061541313.

13 Tereza Svatoňová, David Herák, and Abraham Kabutey, "Financial Profitability and Sensitivity Analysis of Palm Oil Plantation in Indonesia," *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* 63 (2015): 1356–1373, https://doi.org/10.11118/actaun201563041365.

14 Kelley Hamrick and Melissa Gallant, *Unlocking Potential: State of the Voluntary Carbon Markets 2017* (Washington, DC: Forest Trends' Ecosystem Marketplace, 2017), https://www.forest-trends.org/wp-content/uploads/2017/09/doc_5591.pdf.

15 OECD/IEA and IRENA, *Perspectives for the Energy Transition—Investment Needs for a Low-Carbon Energy System*, March 2017, https://www.irena.org/publications/2017/Mar/Perspectives-for-the-energy-transition-Investment-needs-for-a-low-carbon-energy-system.

lowance for forest carbon credits in such compliance obligations, would also be a positive development. Countries should start exploring these avenues.

- The Brazilian government's strict anti-deforestation policies—such as the creation of protected areas and recognition of indigenous lands, enforcement of existing forest laws, prosecution of businesses that distribute soy and beef products produced through deforestation, enforcement of soy and beef moratoria using sophisticated satellite imagery—and other activities such as jurisdictional blacklists of and credit restrictions to actors involved in deforestation are good examples of how restrictive policies and law enforcement could decouple agricultural revenue from deforestation. Similarly, the removal of perverse incentives such as unnecessary agricultural subsidies could help attract restoration investment to lands that are otherwise profitable only for monoculture agricultural plantations.

- The use of short-term borrowing to finance long-term assets exposes private forest-restoration firms to high liquidity risk. This maturity mismatch needs to be addressed with more innovative financing modalities. A reduction in borrowing costs can also be achieved, to some degree, through the use of emerging technologies, potentially including some blockchain applications like those being used in agroforestry projects in Africa.

- Most restoration projects in SEA are small, both in scale and cost, because of the mosaic nature of deforested lands. Furthermore, these small investments would only increase transaction costs for large corporate and institutional investors. Therefore, it is important that the state facilitates access to financing, and makes the process easier for smallholders and small and medium-sized private enterprises while, at the same time, incentivizing private investors to make small investments. There is a need to address conflicting laws and regulations among various governments' departments and ministries, which can lead to high transaction costs.

- Technical standards and practical guidelines on land-tenure registration and security are very important. Recognition and enforcement of customary land tenure, as has been done successfully in Latin America, would be a key to improving land-tenure security in the region.[16] This would reduce conflicts between local and indigenous people and companies or the government, and also ensure the availability of collateral for any productive land use.[17] Further, integrating local land tenure into local governments' spatial planning, with full participation of the local community, would ensure that development needs of local communities and indigenous people are protected.[18]

- The quantification, valuation, and monetization of environmental externalities could also help blend different sources of capital for a restoration project. The value of ecosystem services can be estimated through various methods, including hedonic pricing, mitigation, and avoided costs.

Purpose of the Report

Prominent forest-conservation experts have published several reports on deforestation and reforestation. However, few are focused on Southeast Asia, and they lack a dedicated focus on the financing opportunities from the need to reforest the region to limit temperature rise, as required by the Paris Agreement.[19] This report is an attempt to address that. It is intended to be less technical—and, therefore, more accessible—even if the topic, by definition, requires some technical explanations. This report's findings are based on meta-analysis of a number of publicly available studies on restoration financing, supplemented by extensive consultation with experts in forestry, investment, and development finance.

The purpose of this report is, first, to raise awareness of the importance of forests in the global economy and

16 Gerardo Segura Warnholtz, "Land Tenure for Forest Peoples, Part of the Solution for Sustainable Development," World Bank: *Voices*, September 29, 2017, https://blogs.worldbank.org/voices/land-tenure-forest-peoples-part-solution-sustainable-development.

17 International Fund for Agricultural Development, *Agriculture—Pathways to Prosperity in Asia and the Pacific*, IFAD Asia and the Pacific Division, March 2011, vii, https://reliefweb.int/sites/reliefweb.int/files/resources/Full_Report_247.pdf.

18 Tessa Toumbourou, *Improving Indonesia's Forest and Land Governance—Using a Delphi Approach to Identify Efficacious Interventions*, Asia Foundation, 2015, https://asiafoundation.org/resources/pdfs/ImprovingLandGovernanceIndonesia.pdf.

19 "Paris Agreement: Essential Elements," UNFCCC, last updated October 22, 2018, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.

the balance of the global ecosystem. The impact of forestation on people's daily lives is tangible and direct.

Second, the report aims to show that there is a business case for restoration (a term that includes afforestation, reforestation, and forest rejuvenation) in Southeast Asia under a feasible, near-term scenario.20 It highlights the importance and value of sustainable forest-management practices, including principles of sustainable logging. This report focuses on sustainable timber production as the primary source of r evenue, and the generation of forest carbon credits as the secondary source of revenue. Hence, it advocates an integrated approach of multiple-use forestry (forest products, ecosystem services, and public goods). The report estimates what the regional carbon price in SEA should be in order to halt deforestation, as well as to make forest restoration as competitive as monoculture plantations such as palm oil and rubber.

Third, the report aims to shed light on the major barriers to restoration financing in Southeast Asia, and propose solutions to unlock those barriers.

The authors believe forest restoration should not be limited to one-off philanthropic projects. When done appropriately, it can offer competitive returns on investment. Mainstream finance professionals may not be aware of potential opportunities for restoration investments in Southeast Asia. Accordingly, this study sheds light on restoration-investment opportunities in the region. Other readers, including government decision-makers, may find the report useful as well.

Background

According to the World Resources Institute (WRI), the world has steadily lost tree cover in the tropics over the past seventeen years (see Figure 1).[21] The worst years on record for tropical tree-cover loss were 2016 and 2017. In 2017, according to Weisse and Goldman, the tropics lost an equivalent of "forty football fields of trees every minute for the entire year."[22]

Although annual global rates of deforestation have stabilized around 0.08 percent in recent years, deforestation still remains a serious problem in the tropics, especially in SEA.[23] Tropical deforestation rates also remain high in Latin America (e.g., Brazil) and Central Africa (e.g., Democratic Republic of Congo).[24] However, while Brazil has taken steps in recent years to combat deforestation, the problem is becoming worse in SEA. Between 1990 and 2010, forest cover in SEA declined from 268 MH to 236.3 MH, accounting for about one quarter of all deforestation in the last fifty years, and an area roughly the size of Italy.[25]

Tropical deforestation is among the most significant drivers of anthropogenic global warming.[26] At the same time, out of all the available *natural climate solutions*—such as terrestrial conservation and improved natural-resource management—forests offer by far the most impactful climate benefits, and reforestation and sustainable forest management in the tropics represent some of the most cost-effective ways to mitigate climate change.[27] A growing awareness of the global problems created by deforestation led to the 2008 establishment of the UN-REDD Programme, which helps developing countries create and implement reforestation and deforestation-mitigation projects that meet the strict REDD+ standards developed by the United Nations Framework Convention on Climate Change (UNFCCC), which disincentivizes deforestation by paying for forest-related carbon sequestration.[28] In 2011, the Bonn Challenge was launched, which aims to restore 150 MH of degraded land by 2020, and 350 MH by 2030.[29]

The Paris Agreement and the UN Sustainable Development Goals (SDGs), both promulgated in the

20 The terms "restoration" and "afforestation, reforestation, and forest rejuvenation (ARR)" are used interchangeably in this report.

21 Weisse and Goldman, "2017 Was the Second-Worst Year on Record for Tropical Tree Cover Loss."

22 Ibid.

23 Food and Agriculture Organization of the United Nations, press release, "World Deforestation Slows Down as More Forests are Better Managed," September 7, 2015, http://www.fao.org/news/story/en/item/326911/icode/.

24 Stephen Leahy, "Tropical Forest Loss Slowed in 2017—To the Second Worst Total Ever," *National Geographic*, June 27, 2018, https://news.nationalgeographic.com/2018/06/tropical-deforestation-forest-loss-2017/.

25 Stibig, et al., "Change in Tropical Forest Cover of Southeast Asia from 1990 to 2010."

26 C.E. Scott, et al., "Impact on Short-lived Climate Forcers Increases Projected Warming Due to Deforestation," *Nature Communications* 9 (2018), p. 157, https://www.nature.com/articles/s41467-017-02412-4.

27 Bronson W. Griscom, et al., "Natural Climate Solutions," *Proceedings of the National Academy of Sciences 114* (44) (2017), 11645–11650, http://www.pnas.org/content/pnas/114/44/11645.full.pdf.

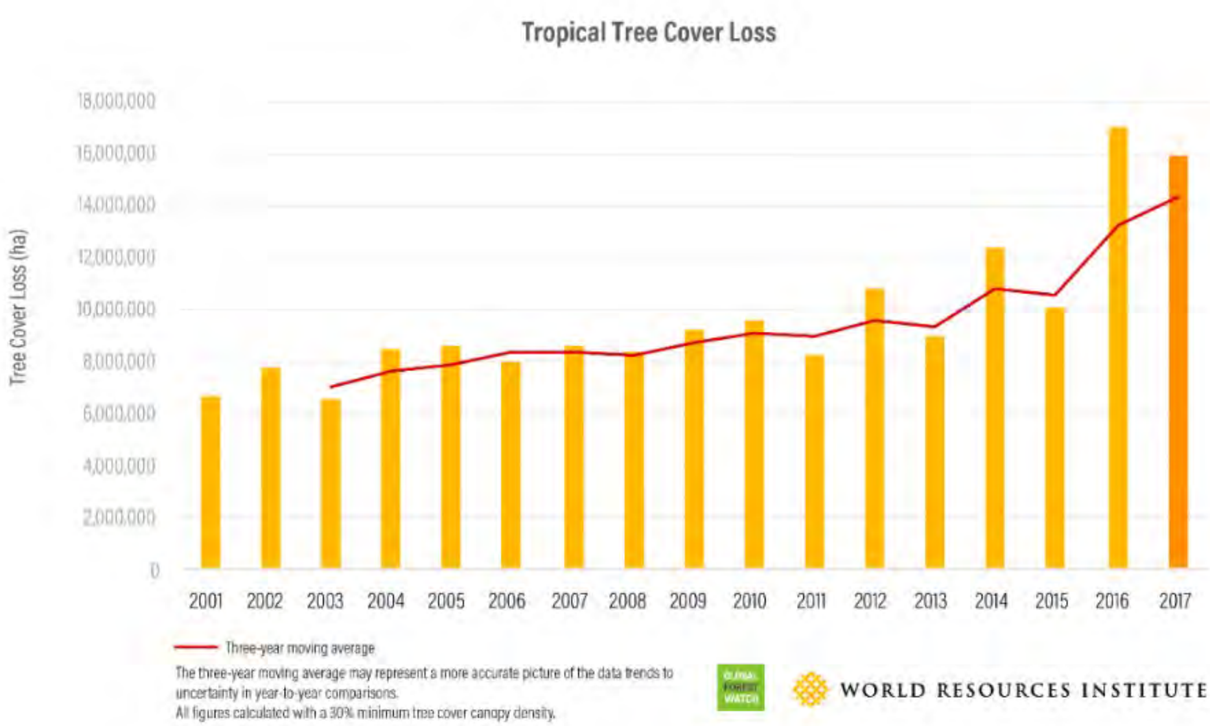
28 "About REDD+," UN-REDD Programme, last updated April 18, 2018, https://www.unredd.net/about/what-is-redd-plus.html.

29 "The Challenge: A Global Effort," Bonn Challenge, accessed August 22, 2018, http://www.bonnchallenge.org/content/challenge.

second half of 2015, have also emphasized the importance of private investment in climate-change mitigation and adaptation, and in sustainable development more generally. In particular, the UN SDG Goal 15.2 aims to "promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally by 2020."[30]

Combined with a growing recognition of climate change and other socio-ecological threats that represent material risks to any financial decision—and a rapidly developing conservation-finance sector—a huge opportunity exists to proactively invest in afforestation, reforestation, and forest rejuvenation, particularly in Southeast Asia. Studies have shown restoration of degraded landscapes, including tropical forests, is a good investment, yielding between $7–30 for every dollar invested, with impacts "extending well beyond the economic sphere."[31] However, the financing—particularly from the private sector—has been a challenge because of high political and regulatory risk on the one hand, and high credit and capital markets risk on the other.[32] In the subsequent sections, this report aims to unpack these investment opportunities, barriers, and potential solutions.

Figure 1. Tree-cover loss in the tropics.



Source: Weisse and Goldman, "2017 Was the Second-Worst Year on Record for Tropical Tree Cover Loss."

30 "15: Life on Land," United Nations Sustainable Development Goals, accessed September 15, 2018, https://www.un.org/sustainabledevelopment/biodiversity/.

31 Helen Ding, et al., *Roots of Prosperity—The Economics and Finance of Restoring Land* (Washington, DC: World Resources Institute, 2017), https://www.wri.org/sites/default/files/roots-of-prosperity.pdf.

32 DBS and UN Environment Enquiry, *Green Finance Opportunities in ASEAN*, November 2017, https://www.dbs.com/iwov-resources/images/sustainability/img/Green_Finance_Opportunities_in_ASEAN.pdf.

1. Definitions and Scope

Definitions

According to the Food and Agriculture Organization of the United Nations, a *forest* consists of "land spanning more than 0.5 hectares (ha) with trees higher than 5 m and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use."[33] Furthermore, according to the Intergovernmental Panel on Climate Change (IPCC), "*afforestation* and *reforestation* both refer to establishment of trees on non-treed land. Reforestation refers to establishment of forest on land that had recent tree cover, whereas afforestation refers to land that has been without forest for much longer."[34]

The purpose of *forest restoration or rejuvenation*, according to the FAO:

> Is to restore a degraded forest to its original state—that is, to re-establish the presumed structure, productivity and species diversity of the forest originally present at a site. The purpose of *forest rehabilitation* is to restore the capacity of degraded forestland to deliver forest products and services. Forest rehabilitation re-establishes the original productivity of the forest and some, but not necessarily all, of the plant and animal species thought to be originally present at a site.[35]

The emerging concept of forest landscape restoration (FLR) refers to

> An approach to forest restoration that involves stakeholders in all affected land-use sectors as well as participatory decision-making processes. FLR is an approach to managing the dynamic and often complex interactions between the people, natural resources and land uses that comprise a landscape. It makes use of collaborative approaches to harmonize the many land-use decisions of stakeholders with the aims of restoring ecological integrity and enhancing the development of local communities as they strive to increase and sustain the benefits they derive from the management of their land.[36]

It is pragmatic for both investors and conservationists to consider all of these approaches. For convenience, the authors refer to afforestation, reforestation, and forest rejuvenation collectively as ARR—or, simply, restoration—in the rest of this report. The report is focused on long-term ARR projects, as opposed to, for example, the establishment of mono-species timber plantations, oil-palm plantations, or rubber plantations. This is not to refute or diminish the important role sustainable agroforestry practices play in reducing emissions through reducing deforestation and forest degradation (REDD/REDD+), or in local economic development. However, because the economic case for those types of forestry projects is relatively well established, this report focuses instead on ARR projects that generate a diverse—and, arguably, more sustainable—range of social, environmental, and financial returns.

Scope

This report focuses on long-term ARR projects, specifically in ASEAN (Association of Southeast Asian Nations) countries—Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam—also interchangeably called *Southeast Asia* or *SEA* throughout the report.[37] This focus is relevant for a number of reasons:

- The deforestation rate in ASEAN is alarming. This region has the highest rate of deforestation of any tropical region, followed by Latin America and Africa. The region has

33 Food and Agriculture Organization of the United Nations, *Global Forest Resource Assessment 2020: Terms and Definitions FRA 2020*, 2018, http://www.fao.org/3/I8699EN/i8699en.pdf.

34 Robert T. Watson, et al., eds., *IPCC, 2000* (Cambridge, UK: Cambridge University Press) 375, https://www.ipcc.ch/report/land-use-land-use-change-and-forestry/.

35 "Sustainable Forest Management (SFM) Toolbox: Forest Restoration and Rehabilitation," Food and Agriculture Organization of the United Nations, accessed August 24, 2018, http://www.fao.org/sustainable-forest-management/toolbox/modules/forest-restoration-and-rehabilitation/basic-knowledge/en/.

36 Ibid.

37 While ASEAN and Southeast Asia are technically not entirely the same, for the purpose of this report, both refer to the ten members of the ASEAN.

lost 14.5 percent of forest cover in the last fifteen years.[38] The Philippines alone have already lost 93 percent of their original forest cover, causing irreversible biodiversity loss.[39]

- With the exception of sub-Saharan Africa, ASEAN has one of the highest rates of population increase on Earth, due to the combination of relatively high birth rates and increasing standards of living and life expectancy.[40] According to a study by ASEAN Up, the region is expected to grow to more than six hundred and sixty million inhabitants in 2020, and more than seven hundred and twenty million by 2030.[41] Authors Busch and Ferretti-Gallon also found that population growth is a consistent driver of deforestation.[42] Other major drivers include logging for small and large oil-palm and rubber plantations, along with export-oriented logging for wood pulp and biofuel production.

- By 2012, more than half of the population of ASEAN countries lived in cities, and urbanization has continued at a rapid pace.[43] A study by UOB Global Economics & Markets Research estimates that 55.8 percent of the ASEAN population will live in urban areas by 2030, an increase from 47.6 percent in 2015.[44] Urbanization is another important driver of deforestation, but also presents important opportunities for long-term ARR projects related to tourism and improvements in water and air quality.

- Tropical deforestation is responsible for 8 percent of total global greenhouse gas (GHG) emissions on a net basis, and tropical forests globally account for around 68 percent of global forest carbon stocks.[45,46] Southeast Asia hosts about 15 percent of the world's tropical forests and 56 percent of the world's tropical peatlands.[47,48] Tropical peatlands store more carbon per hectare than any other tropical forest type. To put this into perspective, the ASEAN peatlands store approximately 50 Gt of carbon, roughly the same amount of carbon-dioxide (CO_2) emissions that the global aviation industry is estimated to generate between 2016 and 2030 in a business-as-usual scenario.[49,50]

- 55 percent of ASEAN's GHG emissions in 2010 was attributable to changes in land use, the bulk of which originated from deforestation and subsequent land degradation in Indonesia.[51] The deforestation and land degradation accounts for more than 70 percent of Indonesia's emissions.[52] In terms of absolute GHG emissions, Indonesia is among the top ten countries globally.

38 Alice C. Hughes, "Understanding the Drivers of Southeast Asian Biodiversity Loss," *Ecosphere 8* (1) (2017), https://doi.org/10.1002/ecs2.1624.

39 Ibid.

40 United Nations Department of Economic and Social Affairs Population Division, *World Population Prospects: Key Findings & Advance Tables* (New York: United Nations, 2017), https://population.un.org/wpp/Publications/Files/WPP2017_KeyFindings.pdf.

41 "Infographic: Top Cities and Urbanization in ASEAN," ASEAN UP, last updated July 5, 2017, https://aseanup.com/infographic-top-cities-urbanization-asean/.

42 Jonah Busch and Kalifi Ferretti-Gallon, "What Drives Deforestation and What Stops It? A Meta-Analysis," *Review of Environmental Economics and Policy* 11(1) (2017): 3–23, https://doi.org/10.1093/reep/rew013.

43 "Growth Projections," US-ASEAN Business Council, Inc., last updated May 16, 2017, https://www.usasean.org/why-asean/growth.

44 UOB Global Economic & Markets Research, "ASEAN Focus," *Quarterly Business Outlook Q4 2015*, 2015, https://www.uobgroup.com/assets/pdfs/research/ASEAN-Focus_4q15.pdf.

45 Wolosin and Nancy Harris. *Tropical Forests and Climate Change: The Latest Science.*

46 Daniel P. Bebber and Natalie Butt, "Tropical Protected Areas Reduced Deforestation Carbon Emissions by One Third from 2000–2012," *Scientific Reports 7* (2017): 14005, https://doi.org/10.1038/s41598-017-14467-w.

47 Stibig, et al., "Change in Tropical Forest Cover of Southeast Asia from 1990 to 2010."

48 Warren, "Tropical Peatlands of Southeast Asia: Functions, Threats and the Role of Fire in Climate Change Mitigation."

49 Susan Page and Jack Rieley, "Tropical Peat Swamp Forests of Southeast Asia," January 2016, 1-9. https://www.researchgate.net/publication/310740563_Tropical_Peat_Swamp_Forests_of_Southeast_Asia.

50 Vera Pardee, *Up in the Air: How Airplane Carbon Pollution Jeopardizes Global Climate Goals*, Center for Biological Diversity, December 2015, https://www.biologicaldiversity.org/programs/climate_law_institute/transportation_and_global_warming/airplane_emissions/pdfs/Airplane_Pollution_Report_December2015.pdf.

51 David A. Raitzer, et al., *Southeast Asia and the Economics of Global Climate Stabilization* (Manila: Asian Development Bank, 2015), https://www.adb.org/sites/default/files/publication/178615/sea-economics-global-climate-stabilization.pdf.

52 Ibid.

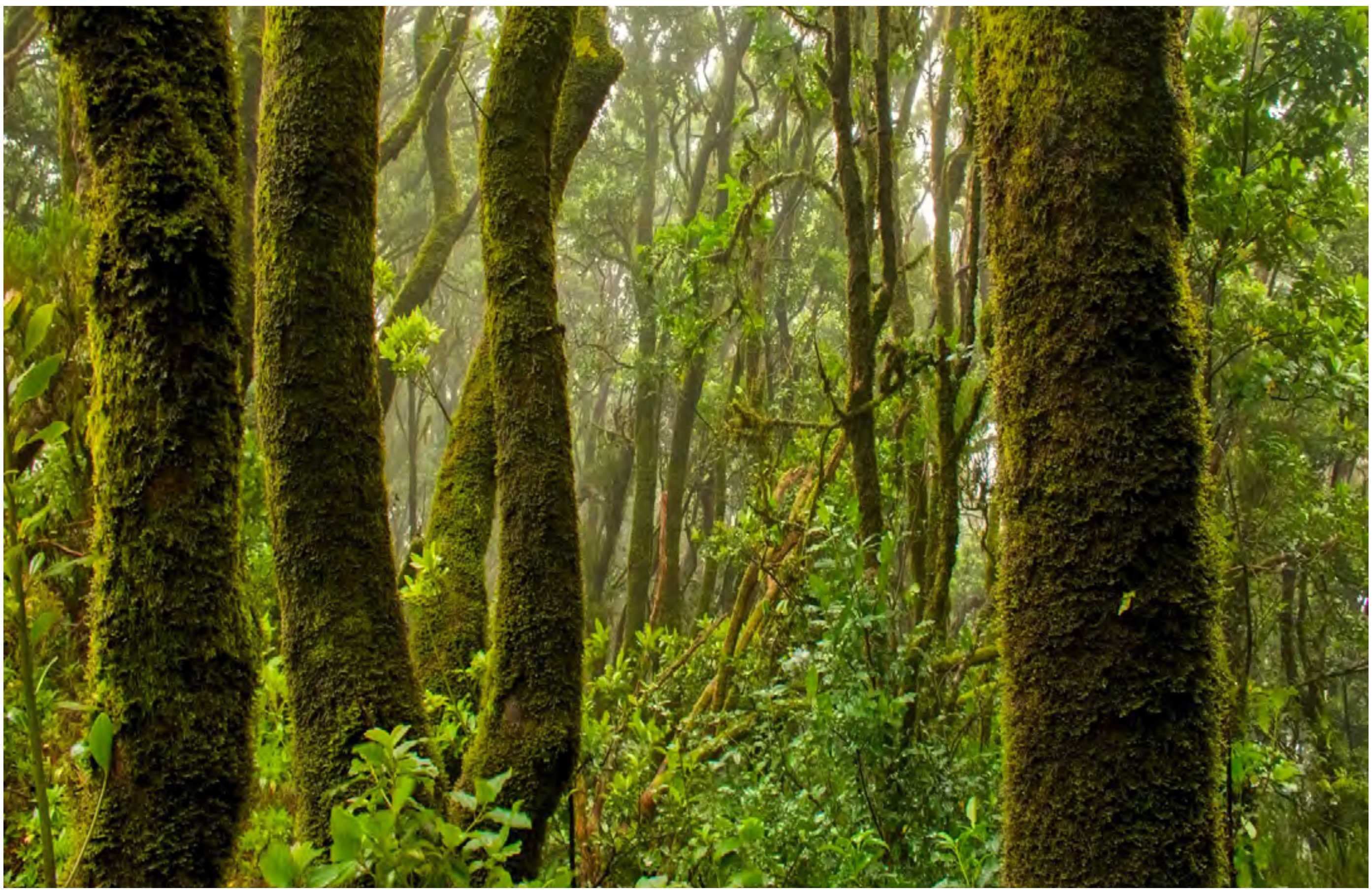
- The future outlook for ASEAN is also alarming. A model projection by Khun and Sasaki suggests that "if current trends continue, the total area of forests (natural and plantation) in ASEAN declines about 0.51% or about 1.25 MH between 1990 and 2050."[53] The deforestation rate was 0.67 percent between 2000–2010. These rates are significantly higher than the global average of 0.08 percent forest loss from 2010–2015.[54]

- ASEAN countries are already facing serious consequences from past deforestation, including landslides, erosion, threats to the water supply, and increased vulnerability to tropical storms.[55]

- There is limited research on the economic viability of private financing of ARR projects, especially in ASEAN.

- Finally, there is an increasing awareness of the consequences of deforestation in ASEAN countries, matched by a growing interest in directing capital toward more socially and environmentally sustainable economic growth.[56,57]

Source: pixabay.com



53 Vathana Khun and Nophea Sasaki, "Re-Assessment of Forest Carbon Balance in Southeast Asia: Policy Implications for REDD+," *Low Carbon Economy* 5 (4) (2014), http://file.scirp.org/Html/3-2900192_51303.htm#ref8.

54 "World Deforestation Slows Down as More Forests are Better Managed," FAO, September 7, 2015, http://www.fao.org/news/story/en/item/326911/icode/.

55 Mariya Chechina and Andreas Hamann, "Choosing Species for Reforestation in Diverse Forest Communities: Social Preference Versus Ecological Suitability," *Ecosphere* vol. 6, no. 11 (2015), 1–13, https://doi.org/10.1890/ES15-00131.1.

56 "Deforestation Costs Acknowledged," *Khmer Times*, May 11, 2016, https://www.khmertimeskh.com/news/24876/deforestation-costs-acknowledged/.

57 Pamela Victor, "Deforestation—a Modern-day Plague in Southeast Asia," *ASEAN Post*, September 23, 2017, https://theaseanpost.com/article/deforestation-modern-day-plague-southeast-asia.

2. Causes and Consequences of Deforestation and Forest Degradation in ASEAN

Drivers of Deforestation and Forest Degradation

The most important drivers of deforestation in SEA are land-use changes associated with commercial agriculture, such as: forest clearing for crops (mainly palm oil), pastures, and timber plantations; subsistence farming; mining; infrastructure development; and urban expansion, which is related to both population growth and growing urban sprawl. Drivers of forest degradation, on the other hand, include: both legal and illegal logging, uncontrolled fires, livestock grazing in forests, fuel-wood collection, and charcoal production for both domestic and international markets. Unsustainable timber harvest is the dominant cause of forest degradation in SEA. Indonesia, Malaysia, and the Philippines are among the top-five countries globally in terms of the highest emissions from forest degradation.[58]

Even more important are the complex political and institutional factors that underlie these drivers. Political ecologists studying deforestation and forest degradation have shown that issues such as land tenure (the rights of people and organizations to exploit land for agriculture, mining, etc.), gender disparities in terms of women's access to and control over forest resources, and divergent rural-urban social and economic interests greatly impact the success of reforestation and other sustainable-development programs, and investors must consider the local context of their investments. The introduction of formalized property rights in government-owned forests in Vietnam in the 1990s, for example, undermined established social and economic relationships among indigenous forest users, and changed the way they classified many of the forests' goods and services.[59] Nevertheless, poorly defined and unprotected property rights often create a *tragedy of the commons,* regardless of whether local communities or foreigners are exploiting forest resources. Political instability and poorly defined property rights also increase the financial risk of ARR projects, thus decreasing expected returns.[60]

Many of the drivers of deforestation are country-specific. The use of the defoliant Agent Orange by the United States during the Vietnam War was responsible for the deforestation of approximately 4.5 million hectares of the country's forests.[61] Similarly, a case study of the causes of deforestation in Cambodia identified engagement of local government officials in illegal timber sales and license issuance as a driver. Such activities, along with the granting of illicit land concessions to the highest bidder, displace local populations and exacerbate conflicts over access to resources.[62]

In order for resources like forests to be used efficiently, the rights of people and organizations to use them must be established and protected. Ironically, many top-down programs meant to address deforestation actually end up exacerbating the problem, because they do not properly integrate local expertise and experiences.[63]

Consequences of Deforestation and Forest Degradation

The consequences of deforestation and forest degradation are diverse, ranging from increased greenhouse gas

58 Timonthy R. H. Pearson, Sandra Brown, Lara Murray, and Gabriel Sidman, "Greenhouse Gas Emissions from Tropical Forest Degradation: an Underestimated Source," *Carbon Balance and Management* 12 (2017): 3, https://doi.org/10.1186/s13021-017-0072-2.

59 Mucahid Mustafa Bayrak, et al., "Restructuring Space in the Name of Development: the Socio-cultural Impact of the Forest Land Allocation Program on the Indigenous Co Tu people in Central Vietnam," *Journal of Political Ecology* 20 (2013): 36-52, accessed August 28, 2018, https://dspace.library.uu.nl/bitstream/handle/1874/303664/Bayrak.pdf?sequence=1.

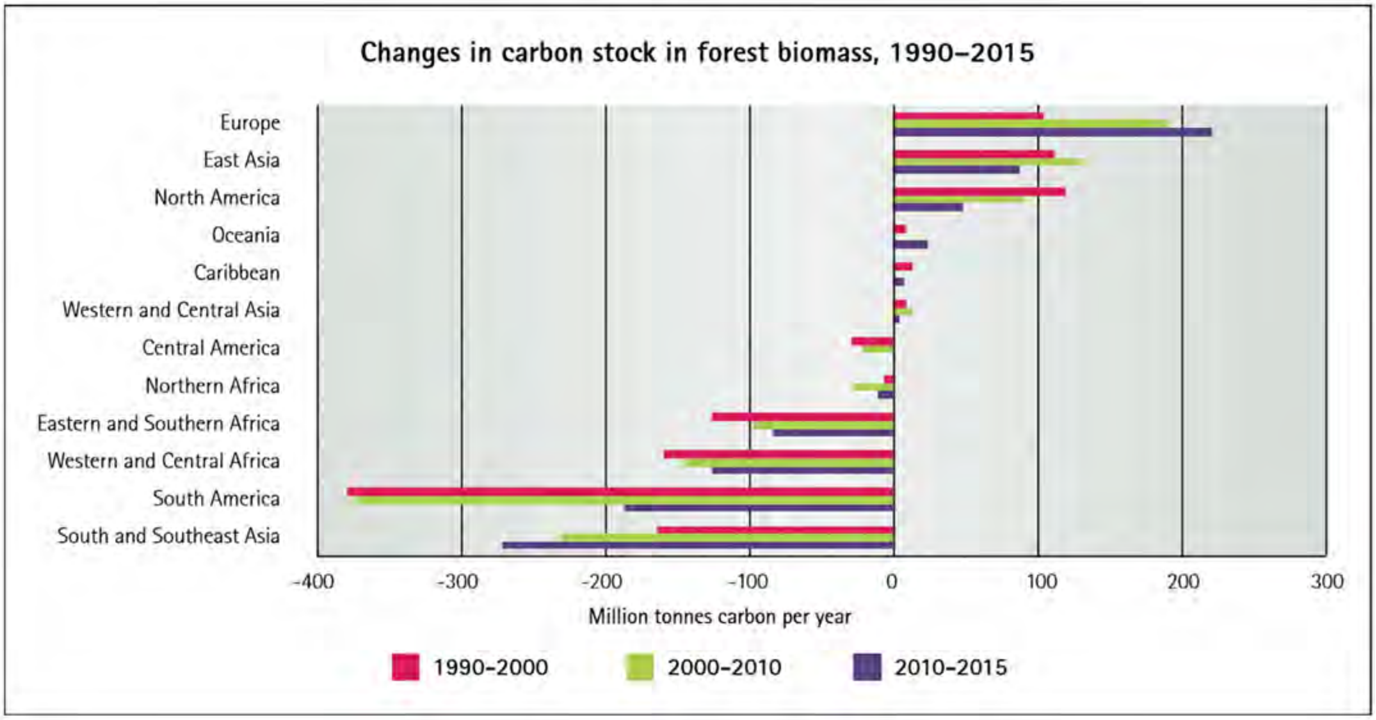
60 Robert Mendelsohn, "Property Rights and Tropical Deforestation," *Oxford Economic Papers* 46 (1994): 750–756, https://community.plu.edu/~reimanma/doc/pr-deforestation.pdf.

61 Nguyen Hoang Nghia, "Forest Rehabilitation in Vietnam," *Keeping Asia Green: Volume I*, 1995, https://www.iufro.org/science/special/spdc/actpro/keep/sea/.

62 Mark Poffenberger, "Cambodia's Forests and Climate Change: Mitigating Drivers of Deforestation," *Natural Resources Forum* 33 (2009): 285-296, https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1477-8947.2009.01249.x.

63 Michael R. Dove, "Theories of Swidden Agriculture, and the Political Economy of Ignorance," *Agroforestry Systems*, 1 (2) (1983): 85-99, https://doi.org/10.1007/BF00596351.

Figure 2. Changes in carbon stock in forest biomass, 1990–2015.



Source: FAO, *Global Forest Resources Assessment 2015 How are the World's Forests Changing? Second Edition* (Rome: FAO, 2016), 31, http://www.fao.org/3/a-i4793e.pdf.

concentrations in the atmosphere and consequent global warming to biodiversity loss, and to air and water pollution. Deforestation has been a consequential issue for a very long time, as evidenced by the fact that some scholars have even linked it to the fall of the Mayan empire.[64] Some of the major impacts are discussed below.

Biodiversity Loss

Southeast Asia is home to at least six of the world's twenty-five *biodiversity hotspots*—biogeographic regions where "exceptional concentrations of endemic species are undergoing exceptional loss of habitat."[65] ASEAN houses 20 percent of the world's plant and animal species, 35 percent of global mangrove forests, and 30 percent of global coral reefs.[66,67,68] Tropical deforestation in the region has created a biological threat, leading to the decline or extinction of many plant and animal species.[69] This is especially true in Indonesia and Malaysia. Under a business-as-usual (BAU) scenario, the region could lose as much as 13–42 percent of its species by 2100, and at least half of those could represent global extinctions.[70]

64 Elliot M. Abrams and David J. Rue, "The Causes and Consequences of Deforestation Among the Prehistoric Maya," *Human Ecology* 16 (4) (1988): 377-395 https://doi.org/10.1007/BF00891649.

65 Norman Myers, et al., "Biodiversity Hotspots for Conservation Priorities," *Nature* 403 (6772) (2000): 853, http://vm005.jbrj.gov.br/enbt/mestrado_profissional/seminario/25_Myers%20et%20al%202000.pdf.

66 Suneetha M. Subramanian, Alexandros Gasparatos, Ademola K. Braimoh, and Wendy Elliott, "Unraveling the Drivers of Southeast Asia's Biodiversity Loss," United Nations University, November, 8, 2011, https://unu.edu/publications/articles/unraveling-the-drivers-of-southeast-asia-biodiversity-loss.html#info.

67 J. Honculada-Primavera, "Mangroves of Southeast Asia," (proceedings of the Workshop on Mangrove-Friendly Aquaculture organized by the SEAFDEC Aquaculture Department, Iloilo City, Philippines, January 11-15, 1999), pp. 1–12), https://www.oceandocs.org/bitstream/handle/1834/9105/primavera2000-mangroves-of-southeast-asia.pdf?sequence=1&isAllowed=y.

68 Henriette Litta, Regimes in Southeast Asia—An Analysis of Environmental Cooperation (Berlin: VS Research, 2011), 31, https://tinyurl.com/y7l8qxjg

69 Alice C. Hughes, "Understanding the Drivers of Southeast Asian Biodiversity Loss," *Ecosphere*, January 6, 2017, https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1624.

70 UN Food and Agriculture Organization, *Southeast Asia Subregional Report: Asia-Pacific Forestry Sector Outlook Study II*.

On a global level, the Living Planet Index, which tracks the state of global biodiversity, recorded "an overall decline of 60 percent in species population sizes between 1970 and 2014, the most recent year with available data."[71]

Disruption of Ecosystem Services

The ecosystem services derived from forests are necessary for the region's growing population and its forest-dependent communities. Quantification and commoditization of the ecosystem services is a challenging task, but leading researchers and policymakers have tried to create proxy markets for these goods and services by estimating their monetary value. For instance, in Cambodia, forest services account for more than $129 million per year in ecosystem services, including air purification, carbon storage, water retention, and erosion prevention.[72] Forest degradation and deforestation, however, have severely altered these ecosystem services. For instance, a disruption in the hydrological cycle has led to increased river runoff and discharge in many SEA communities.

Global Climate Change

Deforestation exacerbates climate change, and this is especially true for tropical deforestation. It creates a feedback loop, wherein deforestation-induced climate change induces more deforestation, similar to the way glacial melt in the Arctic speeds up climate change, which in turn causes quicker glacial melt. Climate change also creates resource strains, forcing countries to respond in unsustainable ways. The causes and consequences of deforestation are, therefore, both local and global.

This is especially true in Southeast Asia. Though a developing country, Indonesia has a per-capita carbon footprint much higher than that of many developed countries, which can be directly attributed to unchecked deforestation. The conversion of carbon-rich peat swamp forests in Indonesia and Malaysia releases hundreds of millions of tons of carbon dioxide into the atmosphere each year. The irony, of course, is that Southeast Asian nations will bear the brunt of climate change in the coming years. As a result, carbon stock in forest biomass has decreased the most in South and Southeast Asia in the last few years, as illustrated in Figure 2.

The causes and consequences of deforestation are, therefore, both local and global. Southeast Asian nations are uniquely positioned to reduce climate change by curbing deforestation, which will have the ancillary effects of growing local economies, improving local ecosystem health, and protecting biodiversity. If there is a silver lining to the rapidly deforesting ASEAN states, it is the growing recognition of the risks, which have precipitated strong market reactions by companies that contribute to deforestation.[73] The next few sections explore the promising role for private investors in achieving these goals, through the financing of ARR projects in Southeast Asia.

71 Monique Grooten and Rosamunde Almond, eds., *Living Planet Report—2018: Aiming Higher* (Gland, Switzerland: WWF, 2018), 7, https://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_2018.

72 Aaron Walker, "Study Shows the Cost of Deforestation in Cambodia," Phys.org, August 11, 2017, https://phys.org/news/2017-08-deforestation-cambodia.html.

73 Gabriel Thoumi and Peter Graham, "How Deforestation Risks for Investors Can Become Opportunities for Conservation (Commentary)," *Mongabay*, March 9, 2018, https://news.mongabay.com/2018/03/how-deforestation-risks-for-investors-can-become-opportunities-for-conservation-commentary/.

3. Avoiding Deforestation Versus ARR

While reducing the rate of deforestation is important, there is a need to be mindful of the fact that forest loss will likely continue because of the continued demand for forest products. The current net global rates of forest loss have been estimated at more than ten billion trees each year.[74] Even in an optimistic scenario, in which forest loss will decline gradually over the next two decades, an estimated one hundred and eighteen billion trees could be lost by 2050.[75] Most of this loss is expected to be in tropical forests, which are considered the most valuable forest type in terms of biodiversity and carbon storage. Therefore, the ARR approach is of paramount importance, as a way to compensate for the likely loss of tropical forest.

Thomas W. Crowther and his colleagues have used various deforestation scenarios developed by the World Wildlife Fund's (WWF) Living Forests Model to project forest loss over the next two decades.[76] WWF's deforestation scenario has projected a total loss of one hundred and eighteen billion trees by 2050 in a business-as-usual scenario, while Crowther and colleagues estimate that the loss could be approximately one hundred and sixty billion trees by 2050 in a business-as-usual scenario. The authors have used various restoration scenarios outlined in the International Union for Conservation of Nature (IUCN) and WRI's "Atlas of Forest Landscape Restoration Opportunities," and have estimated that if only 25 percent of the mosaic areas (the areas where human activity

Figure 3. Potential ARR areas in ASEAN.

Source: "Atlas of Forest and Landscape Restoration Opportunities," World Resources Institute.

74 Thomas W. Crowther, et al., "Mapping Tree Density at a Global Scale," *Nature* 525 (7568) (2015): 201, https://doi.org/10.1038/nature14967.

75 World Wildlife Fund, *Living Forests Report*.

76 Ibid.

Table 1. Area of degraded land in selected Southeast Asian countries available for forest restoration. (Further estimates by authors.)

Country	Estimated Degraded Land (million ha)	Estimated Degraded Land As A Percentage Of Total Land Area	Current Forest Cover (Change 2010–15)	Area Available For Restoration (million ha)
Cambodia	2.6	15%	54% (-1.3%)	No report
Indonesia	56.9	30%	53% (-0.7%)	47
Laos	8.7	36%	41% (+1%)	8.7
Malaysia	1.2	-	68% (+0.1%)	No report
Myanmar	4.2	6%	44% (-1.8%)	No report
Philippines	7.6	25%	27% (+3.3%)	3.8
Thailand	2.3	4%	32% (+0.2%)	2.3
Vietnam	9.7	30%	48% (+0.9%)	5
TOTAL	93.2	-	-	66.8

Source: Greijmans, et al., *Community Forestry and Forest Landscape Restoration*. Appanah, ed., *Forest Landscape Restoration for Asia-Pacific Forests*.

is most likely to encroach on potential forest land) are available for reforestation, reforestation would require two hundred and forty-six billion trees, which would store 22 to 30 Gts of carbon in their aboveground and belowground biomass.[77]

These projections show that even the most pessimistic restoration scenario (only 25 percent of mosaic areas available for restoration) could restore approximately twice the number of trees that are likely to be deforested under WWF's business-as-usual scenario. This creates massive ARR requirements in SEA, where there has been a linear loss of forest cover over the last two decades. The huge swathes of *wide-scale* and *mosaic* areas that are available to be completely or partially reforested, can be seen in the following Atlas of Forest Landscape Restoration Opportunities, developed by the World Resources Institute and IUCN (Figure 3).[78]

Such restoration of deforested areas can be taken up in a structured manner, using various management approaches. Robin Chazdon has recommended a staircase approach for restoration, wherein the restoration technique used depends on the state of land degradation.[79] For instance, if the land is severely degraded, one should start with reclamation of the degraded land, followed by rehabilitation and reforestation. If the state of degradation is very low, one could directly adopt the technique of natural regeneration, without substantial investment of capital, labor, infrastructure, and time.

Table 1 provides an estimate of the amount of degraded land in SEA that could be available for forest restoration. Indonesia has the most land available for restoration, followed by Laos and Vietnam, which already faced large-scale deforestation. There is an opportunity to bring these degraded forestlands under ARR. A considerable amount of these restoration areas would not be available for ARR activities, as some may already be used for agriculture, and others might already contain some kind of forest and might not be totally suitable for ARR. However, the potential for ARR

77 "Atlas of Forest and Landscape Restoration Opportunities," World Resources Institute.

78 Ibid.

79 Robin L. Chazdon, "Beyond Deforestation: Restoring Forests and Ecosystem Services on Degraded Lands," *Science* 320 (2008), http://lerf.eco.br/img/publicacoes/2008_2411%20Beyond%20Deforestation%20Restoring%20Forests%20and%20Ecosystem%20Services%20on%20Degraded%20Lands.pdf.

Rainforest in Kinabalu Park, Borneo. *Photo Credit: Wikimedia Commons.*

in Southeast Asia is high, as the region has witnessed massive deforestation from meeting industry's plantation needs.

Carbon sequestration from restoration of tropical forest in SEA could be as high as two hundred tons per hectare, excluding below-ground biomass. Such carbon-sequestration potential provides an opportunity to quantify the emission reductions that can be generated from ARR activities in the region. If the ecosystem benefits are quantified in total—including associated benefits like biodiversity, poverty alleviation, ecotourism, and the hydrological cycle—the quantum of benefits derived from ARR becomes very high.

Despite the range of ecosystem co-benefits available from forest restoration, the quantification and incorporation of those benefits into project valuation has not gained much traction—primarily because of constraints in measurement of those benefits, including variable discount rates adopted by economists and planners. These constraints also lead to reduced attention from planners and policymakers, because of the lack of quantified data.

The standards currently available in the market measure only carbon and biodiversity co-benefits. Hence, there is a need to measure the different benefits under a comprehensive standard, like the Ecosystem Services Standard being developed by Route2.[80] These kinds of methodologies, if deployed, could help quantify the benefits from land restoration and measure the total ecosystem benefits. This would allow for comparisons of the costs and benefits of investments made in ARR that move beyond carbon sequestration. Although such standards do not ensure additional capital for restoration projects, the valuation in itself would raise

80 "Total Contribution Report 2017: Everything is Connected," Crown Estate, 2017, https://www.thecrownestate.co.uk/media/1692/total-contribution-report-2017.pdf.

awareness of the importance of ecosystem benefits, and would help influence policy change in favor of more sustainable planning and development.

Given the strong qualitative case for ARR, the authors describe below some of the benefits of reforestation, after which they analyze the economics of ARR.

Biodiversity Conservation

Investing in tropical forest restoration and maintenance is, in many ways, equivalent to investing in biodiversity protection, and biodiversity is crucial to ensuring a livable future. Admittedly, intact natural forests have much larger biodiversity values—namely genetic diversity, species diversity, and ecosystem diversity—than replanted forests, especially commercial forests.[81]

As the Convention on Biological Diversity saliently notes, "all human health ultimately depends on ecosystem services that are made possible by biodiversity and the products derived from them."[82] This derives, in part, from the ability of biologically diverse ecosystems to hamper the spread of certain dangerous, communicable diseases, such as malaria and parasitic flatworms. In Malaysia, for instance, the original outbreak of Nipah virus in 1998 was linked to rampant deforestation, which had forced infected fruit bats to mango plantations bordering pig farms, where pigs were infected before passing the virus on to humans. More than one hundred people ultimately died from the outbreak.[83] Thus, biodiversity loss due to tropical deforestation is an extremely serious threat to human health and socio-economic well-being.

Livelihoods Protection

The World Wildlife Fund estimates that 1.6 billion people depend on forests for their livelihoods.[84] This figure might be considered low in the macroeconomics of reforestation, but this report deems it important, as it demonstrates the possibility of monetizing certain aspects of long-term forest restoration. Research suggests that land degradation costs more than $6.3 trillion per year of ecosystem service value, or nearly 9 percent of global GDP, jeopardizing the lives and livelihoods of those who depend on forests and other natural landscapes.[85]

Clearly, it is vitally important to consider how forests provide a source of income and other non-monetary goods and services for more than 20 percent of the world's population. This includes household agriculture, timber and firewood collection, eco-tourism, and the production of artisanal goods. For an investor, central questions include whether new ARR projects could provide jobs, whether these people could be employed elsewhere, or whether the land could be used for more productive operations.

Women's access to forest resources in SEA is often constrained, and protecting their property rights is often an uphill battle. Commercial operations at every scale, however, have been shown to benefit from women's active participation, and companies have invested substantial sums in taking advantage of the financial benefits associated with improved gender equality. Improved livelihoods in SEA, then, are linked to reduced inequality not only between different socio-economic and ethnic groups, but also between genders.

Existential Reasons

A discussion of existential reasons for forest conservation may seem out of place in a report largely concerned with finance and the economics of afforestation and reforestation. Yet, the intrinsic value of forests is a crucial component of their social and economic value. The authors suspect many readers will agree that nature has value beyond its direct contributions to human welfare. Furthermore, nature has what environmental ethicists call "intrinsic value." Indeed, research has shown that most people believe that nature has intrinsic or existential value.[86]

Of course, it is easier to advocate for the preservation of a forest one has visited personally, rather

81 "Ecosystems and Human Well-being: Biodiversity Synthesis," World Resources Institute (2005), http://www.millenniumassessment.org/documents/document.354.aspx.pdf.

82 "Health and Biodiversity," Convention on Biological Diversity, accessed September 3, 2018, https://www.cbd.int/health/.

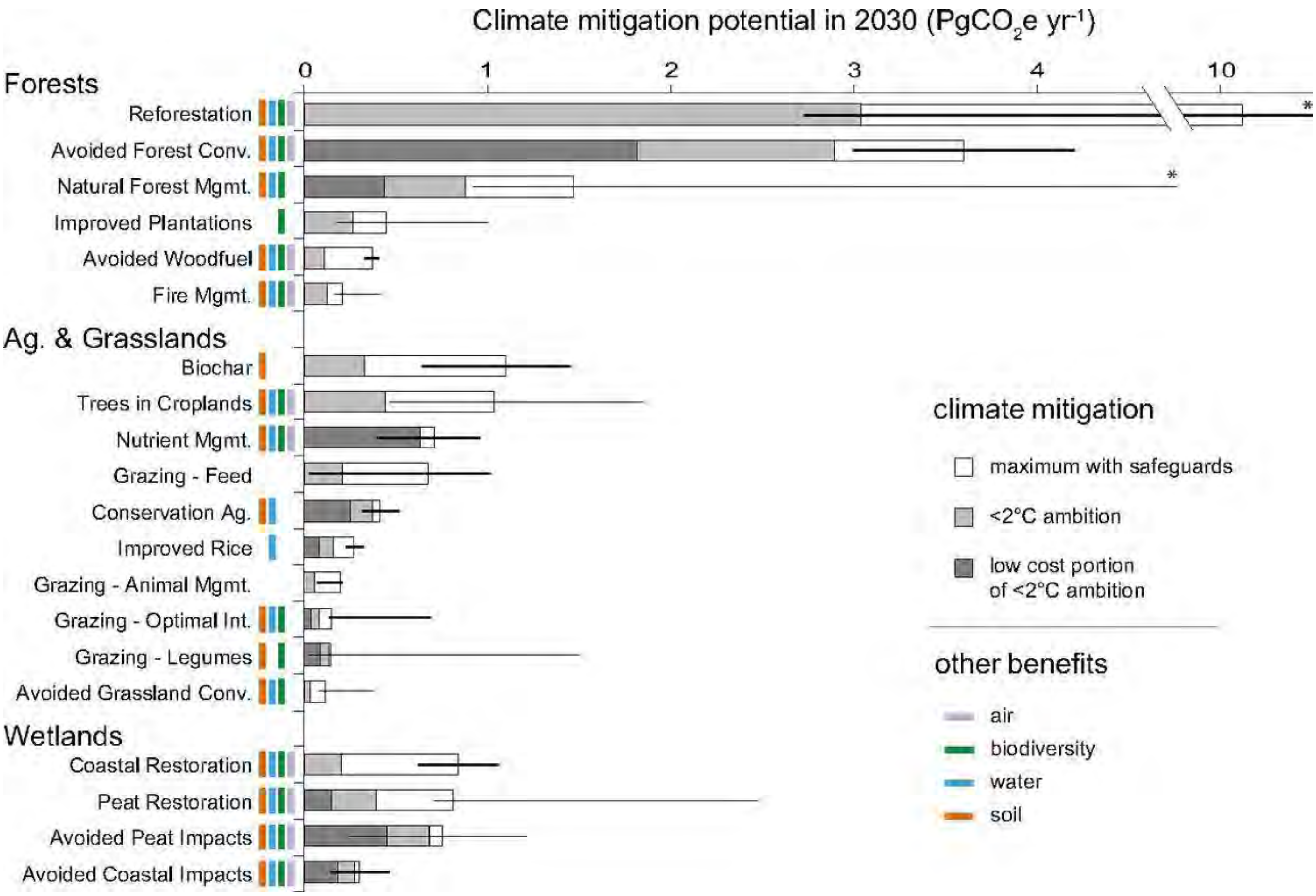
83 "C-Change, " Harvard School of Public Health, accessed September 3, 2018, https://www.hsph.harvard.edu/c-change/.

84 World Wildlife Fund, press release, "WWF Calls for Increased Funding for Forests at Global Landscapes Forum," December 19, 2017, http://www.wwfguianas.org/news/?uNewsID=319194.

85 Paul C. Sutton, et al., "The Ecological Economics of Land Degradation: Impacts on Ecosystem Service Values," *Ecological Economics* 129 (2016): 182-192, https://doi.org/10.1016/j.ecolecon.2016.06.016.

86 John A. Vucetich, "Does Nature Have Value Beyond What It Provides Humans," *Conversation*, October 2, 2015, https://theconversation.com/does-nature-have-value-beyond-what-it-provides-humans-47825.

Figure 4. Estimation of maximum climate mitigation potential of twenty natural pathways for reference year 2030.



"Light gray portions of bars represent cost-effective mitigation levels assuming a global ambition to hold warming to <2 °C (<100 \$ MgCO2e⁻¹ y⁻¹). Dark gray portions of bars indicate low cost (<10 \$ MgCO2e⁻¹ y⁻¹) portions of <2 °C levels. Wider error bars indicate empirical estimates of 95% confidence intervals, while narrower error bars indicate estimates derived from expert elicitation. Ecosystem service benefits linked with each pathway are indicated by colored bars for biodiversity, water (filtration and flood control), soil (enrichment), and air (filtration).

Source: Griscom, et al., "Natural Climate Solutions."

than simply heard about, but even distant forests possess value simply by existing. For example, willingness-to-pay surveys demonstrate that people are willing to incur varying financial costs in order to preserve rainforests they have never visited and never plan to visit. For example, Jon Strand and colleagues found that the "average willingness-to-pay levels, per household per year, to fund a plan to protect all of the current Amazon rainforest up to 2050, range from \$4 to \$36 in twelve Asian countries, to near \$100 in Canada, Germany, and Norway, with other high-income countries in between."[87,88]

87 Jon Strand, et al., *A "Delphi Exercise" as a Tool in Amazon Rainforest Valuation*, World Bank Development Research Group Environment and Energy Team, December 2014, https://openknowledge.worldbank.org/bitstream/handle/10986/21139/WPS7143.pdf?sequence=1&isAllowed=y.

88 Randall A. Kramer and D. Evan Mercer, "Valuing a Global Environmental Good: US Residents' Willingness to Pay to Protect Tropical Rain Forests," *Land Economics* 73 (1997): 196–210, https://www.fs.usda.gov/treesearch/pubs/download/3217.pdf.

Climate-Change Mitigation Through Carbon Sequestration

Perhaps the most salient and financially material reason reforestation matters is the carbon it sequesters. The UN Intergovernmental Panel on Climate Change (IPCC) recently issued a stark warning that the planet could hit a temperature rise of 1.5 degrees Celsius above pre-industrial levels by as early as 2030, exposing millions of people to severe climate change risks.[89,90] Deforestation is one of the leading drivers of climate change worldwide, so it makes sense that afforestation and reforestation help mitigate climate change. Indeed, research has shown not only that reforestation and afforestation have the highest mitigation potential, but also that ARR is one of the most cost-effective ways to slow climate change.[91]

Figure 4 illustrates natural climate solutions that could "provide over one-third of the cost-effective climate mitigation needed between now and 2030 to stabilize global warming to below 2 degrees Celsius."[92] Among the twenty conservation pathways discussed, the authors argue, "reforestation offers the largest maximum and cost-effective mitigation potential and deserves more attention to identify low-cost mitigation opportunities."[93] Although reforestation is more expensive than avoided forest conversion, because of tradeoffs associated with alternative land uses, the marginal abatement cost could be reduced further "through the involvement of private sector in reforestation activities by establishing plantations for an initial commercial harvest to facilitate natural and assisted forest regeneration."[94]

A single tree can absorb around 22 kilograms (kg) of carbon per year, or about one ton over an average lifespan of forty years.[95] An average person's yearly carbon emission—their *carbon footprint*—was approximately 5 metric tons per year in 2013, which would take around two hundred and twenty trees to soak up.[96] Carbon footprints vary dramatically between countries, and the difference between developed countries and developing countries is particularly stark. The average Vietnamese person, for instance, emits only 1.8 metric tons of CO_2 per year, compared with the average Singaporean's 10.3 metric tons.[97]

Nonetheless, multiplied by the global population, the average carbon footprint means there is a need for more than 1.5 trillion trees (in addition to the number existing today) to soak up the world's annual carbon emissions.

89 "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5ºC Approved by Governments," Intergovernmental Panel on Climate Change, October 8, 2018, https://www.ipcc.ch/news_and_events/pr_181008_P48_spm.shtml.

90 Brandon Miller and Jay Croft, "Planet Has Only Until 2030 to Stem Catastrophic Climate Change, Experts Warn," *CNN*, October 8, 2018, https://www.cnn.com/2018/10/07/world/climate-change-new-ipcc-report-wxc/index.html.

91 Griscom, et al., "Natural Climate Solutions."

92 Ibid.

93 Ibid.

94 Ibid., 2.

95 "Carbon & Tree Facts," Arbor Environmental Alliance, accessed September 3, 2018, http://www.arborenvironmentalalliance.com/carbon-tree-facts.asp.

96 Tatiana Schlossberg, "Flying Is Bad for the Planet. You Can Help Make It Better," *New York Times*, July 27, 2017, https://www.nytimes.com/2017/07/27/climate/airplane-pollution-global-warming.html.

97 "CO2 Emissions (Metric Tons per Capita)," World Bank, accessed September 3, 2018, https://data.worldbank.org/indicator/EN.ATM.CO2E.PC.

4. Economic Analysis of ARR

This section provides an economic analysis of reforestation, paying special attention to the long-term financial viability of private investments in reforestation. Following other researchers interested in the costs and benefits of afforestation and reforestation projects, a differentiation is established between *carbon plantings* (monoculture plantations whose primary environmental benefit is carbon sequestration) and *environmental plantings* (mixed-species plantations whose environmental benefits include biodiversity promotion and a range of ecosystem services for local communities, in addition to carbon sequestration).[98] The added benefits of environmental plantings should be enough to offset the forgone opportunity of more traditional monoculture plantation forestry.

Cost Structure of ARR

Quantifying the cost of forest restoration is not straightforward, as it depends on methods, locations, and other variables. Nevertheless, some authors have assessed the cost based on the stage of forest degradation. For instance, two journals have studied this in the context of SEA, as described below.[99,100]

Table 2. Costs for forest restoration based on degradation stages and different restoration approaches.

Degradation Stage	Restoration Method	Present-day (2018) Costs ($/ha)
Stage 1 (least degraded)	Protection	398
Stage 2	Assisted natural regeneration (ANR)	844
	ANR (Castilo, 1986)	3489
Stage 3	Framework Species Method	2537
Stage 4 (most degraded)	Maximum diversity with mine-site amelioration	10890
	Miyawaki method	12153

Source: Elliott, et al., *Restoring Tropical Forests: A Practical Guide*.

Prasit Wangpakapattanawong, Pimonrat Tiansawat, and Alice Sharp, "Forest Restoration at the Landscape Level in Thailand," *Forest Landscape Restoration for Asia-Pacific Forest* (Bangkok: FOA and RECOFTC, 2016), 159, http://portal.gms-eoc.org/uploads/resources/1347/attachment/forest_landscape_restoration_for_asia-pacific_forests_2016_04_eng.pdf#page=159.

Stephen Elliott, "Restoring Tropical Forests for Biodiversity Recovery: Reconciling Ecological and Economic Considerations," Forest Restoration Research Unit, Chiang Mai University, accessed September 4, 2018, http://www.rainforestation.ph/news/pdfs/Elliott.pdf.

A. Castilo, "An Analysis of Selected Restoration Projects in the Philippines," (Ph.D. thesis, University of Philippines, 1986).

98 David M. Summers, et al., "The Costs of Reforestation: a Spatial Model of the Costs of Establishing Environmental and Carbon Plantings," *Land Use Policy* 44 (2014): 110–121, http://dx.doi.org/10.1016/j.landusepol.2014.12.002.

99 Stephen D. Elliott, David Blakesley, and Kate Hardwick, *Restoring Tropical Forests: A Practical Guide* (Richmond, Surrey, UK: Royal Botanical Gardens Kew, 2013), http://www.rainforestation.ph/resources/pdf/publications/Elliott%20et%20al._2013_Restoring%20Tropical%20Forests.pdf.

100 Ani Adiwinata Nawir, et al., "Experiences, Lessons and Future Directions for Forest Landscape Restoration in Indonesia," *Forest Landscape Restoration for Asia-Pacific Forests* (2016): 53, www.cifor.org/publications/pdf_files/Books/CNawir1601.pdf.

Table 3. Four stages of degradation.

Degradation Level	Site Factor			Landscape Factor		
	Vegetation	Soil	Sources Of Regeneration	Forest	Seed Dispensers	Fire Risk
1 (Least degraded)	More trees than weed	Mostly fertile	Viable soil, seed bank, dense seed-ling bank, tree stumps	Large remnants remain as seed sources	Common (large and small species)	Low
2	Mixed trees and her-baceous weeds	Mostly fertile, low erosion	Seed and seedling banks depleted, live tree stumps common	Remnants as seed sources	Large species becoming rare, small species still common	Medium
3	Herbaceous weeds dominate	Mostly fertile, low erosion	Incoming seed rain, a few saplings and live tree stumps may remain	Remnants remain as seed sources	Mostly small species dispensing small seeds	High
4 (Most degraded)	Same as level 3	Erosion risk increasing	Very few	Absent within seed dispersal distances of the site	Mostly gone	Very High

Source: Wangpakapattanawong, et al., "Forest Restoration at the Landscape Level in Thailand."

The costs of restoration depend on the site and stage of degradation, and the plantation activities required as part of restoration efforts (see Table 6.1). The costs projected include land reclamation, and the development of appropriate programs or projects for ARR, which would include agroforestry-model development or natural regeneration based on the degradation state of the identified land. The fixed costs relate to acquisition of land, land preparation, planting material costs, plant protection costs, etc. The recurring costs relate to

Table 4. Potential investment need.

Country	Area Available For Restoration (1,000 Ha)	Average Cost Of Restoration (Based On Above Table) In Southeast Asia ($/Ha) (2018 Prices)	Investment Need ($ Billion) (2018 Prices)
Indonesia	47,000	5000	235
Laos	8,700		43.5
Malaysia	-		-
Philippines	3,800		19
Thailand	2,300		11.5
Vietnam	5,000		25
Grand Total	66,800		~ 334

Source: Authors

maintenance of the project area, monitoring, reporting, and verification (MRV), pruning, and non-timber forest product (NTFP) collection. These costs vary based on the location, and the type of viable restoration activities suitable for the project area.

The four stages of degradation that can be identified based on site observation are described in Table 3.

Based on Table 3 and the costs averaged in Table 2, Table 4 presents the potential investment requirements for ARR activities in SEA. The investment requirement per hectare is calculated based on the average of the expenses incurred in different degraded landscapes, as presented in Table 2.

Because of the lack of data on the proportion of lands at each degradation stage, a simple average of costs, corresponding to each degradation stage, has been calculated. Because this cost-calculation method has also taken into consideration expensive restoration approaches such as Framework Species Approach, maximum diversity with mine-site amelioration, and the Miyawaki method, the average cost of $5,000 per hectare is higher than the $4,000 for tropical forests globally previously estimated by the Economics of Ecosystems and Biodiversity (TEEB).[101] The authors' consultation with experts in Southeast Asia has confirmed the validity of the $5,000-per-hectare figure. This estimate is consistent with cost estimates for tropical forests in other regions of the world, such as southeast Brazil.[102]

The total potential investment need projected above may vary based on the land-degradation stage and the availability of land due to various reasons, such as agriculture and human habitations.

Revenue from Sustainable Timber

In principle, a number of revenue sources other than timber production can be derived from forests. In an ideal world, these sources work in concert to maximize income. Many income streams are dependent on location and have complex risk-return profiles; however, those considerations are outside the scope of this report. Below, the focus is primarily on revenue from sustainable timber production, which serves as the foundation for investment strategies that draw on other sources of revenue, for example: carbon credits, eco-tourism, non-timber forest products, rural livelihoods, and other ecosystem services, collectively called co-benefits. Forest-restoration projects should embrace the practices of sustainable forest management during the entire rotation period of the newly established or rehabilitated forest stands, in order to be technically sound, environmentally sustainable, socially acceptable, and economically profitable.

This section includes an analysis of an economic valu ation done by authors Lubomir Šálek and Roman Sloup for proposed pure and mixed stands in central Vietnamese highlands.[103] Because the cost of plantation and resulting benefits could vary among different countries in Southeast Asia, this cost-benefit analysis is meant to provide only a ballpark figure for the region, and should be interpreted accordingly.

For the economic valuation, the authors selected three patterns:

> The first two planting patterns were mixed and constituted acacia plantations with stripes of slow-growing tree species bringing valuable timber especially for veneer and furniture (noble hardwood). The third planting pattern constituted an acacia monoculture. The selection of slow-growing tree species corresponds to the local natural conditions and tree species composition of former indigenous forests and was carried out in accordance with conversational results that were obtained by discussions with local farmers and foresters. Since the cultivation of mixed forests embraces the principles of sustainable forestry and also generates a better economic profit while also maintaining habitat complexity and biodiversity, we have chosen the mixed pattern to further look into costs and benefits. The acacia segments are repeatedly regenerated with rotation cycle of five years while the noble hardwoods have a rotation cycle of 40 years.[104]

For the first planting pattern (a 8,000 ha plantation over forty years) at a 10 percent discount rate and a 75 percent yield, the net profit was approximately $4,450 per hectare (in 2018 prices). A sensitivity analysis using

101 *The Economics of Ecosystems and Biodiversity: Climate Issues Update*, TEEB, September 2009, http://www.teebweb.org/media/2009/09/TEEB-Climate-Issues-Update.pdf.

102 Aaron Reuben, "Lowering the Costs of Restoration—Creating Supply Chains for People and Forests," IUCN, June 5, 2015, https://www.iucn.org/content/lowering-costs-restoration-%E2%80%93-creating-supply-chains-people-and-forests.

103 Šálek, and Sloup, "Economic Evaluation of Proposed Pure and Mixed Stands in Central Vietnam Highlands."

104 Ibid.

higher discount rates revealed that the net present value (NPV) remained practically the same beyond the discount rate of 12 percent. At a 5 percent discount rate, the net profit was $17,300.[105]

The net profit per hectare could go up considerably if a number of ecosystem co-benefits are also quantified and modeled into the economic valuation, though this is beyond the scope of this report. An assessment of these co-benefits are challenging for a number of reasons: it is dependent on the development context and the scale of intervention; there exists no agreement on how to attribute co-benefits from restoration projects; and there are no standardized metrics for quantifying many of these effects.[106,107]

Some authors have, however, attempted to assess such economic co-benefits. For instance, Eric Arets

Figure 5. Potential of management systems to provide services, and importance of these services for different stakeholders.

Ecosystem service	Delivery potential				Local communities								
	Natural	SFM	CL	Plantation	Forest workers	Non forestry	Local government	Large company	Community forestry	National government	International community	Dutch consumers	International
Timber production	1	3	3	4	+++	+	++	+++	+++	++	0	+	X
Carbon stocks	4	3	3	2	+	+	+	0	+	+++	++	++	X
Wild food	4	3	2	0	+++	+++	+	0	0	+	0	0	0
NTFP	4	3	2	0	+++	+++	++	0	0	+	0	0	0
Quality of drinking water	4	2	2	-1	+++	+++	+++	+	+	++	0	0	0
Hydrological functions	4	3	3	1	+	+	+++	+	+	++	0	0	0
Water retention	4	3	3	2	+++	+++	++	+	+	++	0	0	0
Soil properties incl. erosion	4	3	2	1	++	++	+++	+	+	++	0	0	0
Flood prevention	4	3	3	1	++	++	+++	+	+	+++	0	0	0
Biodiversity	4	3	3	0	++	++	0	0	0	0	++	0	X
Indigenous culture	4	3	2	-1	+++	+++	++	0	0	+	0	0	X

Delivery potentials (first four columns):
-1 = reduced services
0 = no potential
1-4 = low to high potential
Importance:
0 = unimportant,
+ to +++ = low to high importance

Source: E.J.M.M Arets and F.R. Veeneklaas, *Costs and Benefits of a More Sustainable Production of Tropical Timber* (Wageningen, Netherlands: WageningenUR, 2014), 37, http://edepot.wur.nl/315617.

105 Šálek, and Sloup, "Economic Evaluation of Proposed Pure and Mixed Stands in Central Vietnam Highlands."

106 H.J. Albers and E.J.Z. Robinson, "A Review of the Spatial Economics of Non-timber Forest Product Extraction: Implications for Policy," *Ecological Economics* 92 (2013): 87–95, https://doi.org/10.1016/j.ecolecon.2012.01.021.

107 Mercedes Bustamante, et al., "Co-benefits, Trade-offs, Barriers and Policies for Greenhouse Gas Mitigation in the Agriculture, Forestry and Other Land Use (AFOLU) Sector," *Global Change Biology* 20 (2014): 3270–3290, https://doi.org/10.1111/gcb.12591.

and Frank Veeneklaas from Wageningen University & Research have presented a qualitative assessment of impacts of different co-benefits for three tropical-forest-management regimes (Figure 5).[108,109] It is important to note most of these co-benefits accrue to local governments in the form of lower future costs or direct income. These benefits are not directly available to profit financiers unless explicitly incorporated into the lending structure, such as via subsidies.

The co-benefit delivery potential (except timber production) for natural forests is the highest among different forest-management regimes. Although the potential of forest plantations to deliver ecosystem services is the lowest among different forest-management regimes, it is important to note that forest plantations on degraded lands could deliver the highest volume of timber production, which is important to companies, as well as local and national governments, in terms of revenue generation. The choice of a particular forest-management regime, therefore, depends on what is expected of forest restoration by various stakeholders.

Source: pixabay.com

108 *Tropical forest management regimes:*
Conventional selective logging (CL)—This is logging without implementation of specific actions to reduce the damage to the remaining forest. Only a limited number of tree species is being harvested. As a result, the residual forest remains at least partly intact, but damage may be considerable, affecting a number of services provided by the forest.
Sustainable forest management (SFM) or reduced impact logging (RIL)—This is selective logging that meets the standards of important forest certification schemes like FSC or PEFC. It uses a number of measures to minimize the damage to the residual forest, particularly to future timber trees. Negative impacts on ecosystem services like carbon sequestration, future timber, and NTFPs are likely to be less than with CL. The question is how large the effects on ecosystem services are, and what costs and benefits are involved.
Productive forest plantations—Timber plantations aim to increase timber production per unit of area. As a result, smaller areas are needed to produce the same amount of timber. Efficient production of timber by plantations may thus reduce the pressure on the primary forest, which is important for a wide variety of services.

109 E.J.M.M Arets and F.R. Veeneklaas, *Costs and Benefits of a More Sustainable Production of Tropical Timber* (Wageningen, Netherlands: WageningenUR, 2014), 37, http://edepot.wur.nl/315617.

5. The Financing of ARR

The challenge of making a profit from ARR projects is daunting because of the longer duration of return on investment (ROI), particularly taking into consideration of timber harvest time that runs anywhere from twenty to thirty years, the failure to redistribute costs and benefits of reforestation among different stakeholders, and the failure to capture the intangible benefits from forests, such as protection of watersheds, carbon sequestration, and increased competition for land for short-term profitable plantations, such as palm oil and rubber. SEA has suffered from all these challenges, making it particularly difficult to attract ARR funding and investment from both the public and private sectors. In the following sections, ROI for ARR projects is compared to alternatives, and the current state of ARR financing is examined, along with discussion of potential solutions to attract private investment into this sector.

Case Study of Plantation Forestry: Arbaro Fund

Arbaro Fund will invest in and actively manage a well-diversified portfolio of eight to twelve sustainable forestry projects in Latin America and sub-Saharan Africa. The majority of the pipeline projects are proprietary off-market transactions. The fund is expected to generate attractive, inflation-linked financial returns displaying low correlation with financial markets. Diversified sources of financial returns include the sale of products (mainly timber), of forest and land assets, and of shares in local companies.

The fund duration is 15+1 years from first closing, and the investment period is 4+1 years from first closing. The target IRR is 12 percent net per annum, with an upside case of 16 percent net per annum. The target IRR is purely derived from the sustainable harvest of timber, without factoring in any potential profit from sale of carbon offsets generated.

Source: Markus Grulke, managing director, Arbaro Advisors GmbH, Frankfurt, Skype interview with Prajwal Baral, September 18, 2018

Return on Investment for ARR Versus Alternatives

As stated in Chapter 4, sustainable timber production in SEA has a net yield per hectare of $4,450 at a 10 percent discount rate. On the other hand, a study undertaken by Tereza Svatoňová and colleagues at the Czech University of Life Sciences Prague, from the perspective of a company in North Sumatra, Indonesia, showed that alternative investments, such as those in oil-palm plantations (an eight-thousand-hectare plantation over twenty-five years), yielded a net profit of $11,400 per hectare (in 2018 prices) and a payback period of 6.75 years at a 10 percent discount rate.[110] At discount rates of 5 percent and 15 percent, the net profits for oil palm were $22,200 and $5,665, respectively, and the payback periods were 6.06 and 7.69 years.

The above comparison shows that monoculture plantations, such as oil palm, derive an average $6,900 per hectare more than ARR projects. This difference could become smaller depending on location, government subsidies (if any), and the use of advanced technologies. However, the difference will still be significant.

The monoculture plantations in SEA are, therefore, undeniably more profitable than ARR projects. Many of the conservation outcomes of ARR projects are difficult to express purely on returns, as some of the returns are intangible and do not represent the returns used by businesses to set strategy and evaluate results. The Natural Capital Coalition—a unique, global, multistakeholder collaboration that brings together leading initiatives and organizations to harmonize approaches to natural capital—has been developing a forest-sector guide that is "expected to provide methodological guidance on natural capital accounting in the forest sector and support understanding of ecological values in forest production and the supply chain."[111,112]

Role of Carbon Revenues

Among the various ecosystem benefits of ARR, carbon offsets have gained the most traction among investors

110 Svatoňová, et al., "Financial Profitability and Sensitivity Analysis of Palm Oil Plantation in Indonesia."

111 "The Natural Capital Coalition is an International Collaboration that Unites the Global Natural Capital Community," Natural Capital Coalition, accessed November 18, 2018, https://naturalcapitalcoalition.org/.

112 New Forests, 2017 *Timberland Investment Outlook*, 2017, https://newforests.com.au/wp-content/uploads/2017/09/2017-Timberland-Investment-Outlook-web-1.pdf.

Table 5 Forestry carbon project development activities.

Transaction Cost Category	Description
Search costs	• Identifying project location • Identifying project partners • Identifying project consultants
Feasibility study costs	• Conduct a feasibility study • Develop a project idea note (PIN)
Negotiation costs	• Project marketing • ERPA contracts (emission reduction purchase agreements) • Contracts with individual land owners that form part of the project • Contracts with national and/or regional government, as necessary
Monitoring costs	• Necessary measurements for baseline determination and preparation of project registration/listing documents • Measurements/monitoring for determination of emission reductions/sequestration benefits
Regulatory approval costs	• Development of new methodology • Preparation of a project design document • Validation costs • Project registration costs • Verification costs • Issuance costs • Transfer of emission-reduction costs
Insurance costs	• Project liability insurance • Risk buffer/risk insurance

Source: Timothy R. H. Pearson, et al., "Transaction Costs for Carbon Sequestration Projects in the Tropical Forest Sector," *Mitigation and Adaptation Strategies for Global Change* 19 (2014): 1209–1222, https://doi.org/10.1007/s11027-013-9469-8.

and policymakers alike. This section explores the costs involved in monetizing carbon offsets, and the resulting net benefit.

Cost Structure of Forest Carbon Projects

The quantification of carbon sequestration through validation and verification includes additional transaction costs that can be broadly classified under different categories, as shown in Table 5.[113]

The estimated transaction costs associated with select forest carbon projects that have been registered under the Clean Development Mechanism (CDM)/ Verified Carbon Standard (VCS) have been studied by Timothy Pearson and colleagues. For Southeast Asia, the transaction costs they identified of $89 per hectare ($103 in today's prices) are related to a REDD+ project (avoided deforestation). ARR projects, on the other hand, would include MRV that needs to be undertaken ex-post, which would incur additional costs. According to consultations with forest carbon experts in the region, the total project-development costs for monetizing carbon offsets from ARR projects in SEA is approximately $1,300 per hectare, on average.

This would vary depending on the local conditions and the degradation stage of the identified project land. However, the high costs of MRV associated with carbon forestry project development may be offset by the utilization of the latest technology, like drone monitoring

113 Timothy R. H. Pearson, et al., "Transaction Costs for Carbon Sequestration Projects in the Tropical Forest Sector," *Mitigation and Adaptation Strategies for Global Change* 19 (2014): 1209–1222, https://doi.org/10.1007/s11027-013-9469-8.

and satellite-based monitoring of vast landscapes.[114,115,116] Pilot studies looking at these technologies are underway, and will evolve over time. These methods are estimated to reduce the costs and effort associated with MRV activities in carbon forestry project management.

Investors interested in monetizing carbon offsets from ARR projects should, however, be cautious about unintended consequences that can increase costs and decrease revenues. For instance, investment in carbon-focused reforestation projects on degraded, but nonetheless productive, farmland can result in local food shortages, and project developers must consider both the social and financial costs of the so-called "food-carbon tradeoff," the expansion of forest carbon stocks along with the maintenance or expansion of agricultural production.[117]

Revenue from Forest Carbon Projects

Pedro Brancalion and colleagues observed that, in order to attract private investment to tropical-forest restoration projects, these projects must pay for themselves.[118] A market for carbon offsets is one way to do this, as greenhouse gas emissions, if accurately priced, can serve as a good proxy for many of the benefits generated by healthy forest landscapes. This section provides a brief overview of the role of carbon finance in reforestation and forest-restoration projects. Two principal carbon-market types are discussed: the compliance and voluntary carbon markets.

Compliance Carbon Market

The compliance, or regulatory, carbon market is underpinned by three major international climate agreements: the United Nations Framework Convention on Climate Change 1992; the Kyoto Protocol 1997; and the Joint Crediting Mechanism under Article 6 of the Paris Agreement. The regulated entities are required to obtain and surrender carbon-emissions permits (allowances) or offsets through compliance markets, in order to meet predetermined regulatory targets. The biggest and most important compliance market, in terms of overall offset demand, is the European Union-Emission Trading System (EU-ETS), which allows the companies within the scheme to surrender a certain share of their compliance with annual levels of regulated emissions, in the form of certified emission reductions (CERs).[119] However, most existing compliance markets, including the EU-ETS, do not allow forest carbon credits to be traded or used as offsets, because of issues such as carbon leakage, permanence, and complexity of forest carbon accounting. However, a few other compliance markets, such as those in California and New Zealand, allow forest carbon credits to be traded with a number of restrictions. The Chinese ETS pilot scheme also allows forestry projects to be used as one of the options. Although the current level of carbon price is low in most of these compliance markets, Carbon Tracker forecasts that EU carbon prices will double by 2021 (from €13.82 per ton in April 2018) and could quadruple to €55 a ton by 2030, as a result of the introduction of a mechanism to create the biggest supply squeeze the EU-ETS has ever seen.[120] This will likely have a positive impact on the allowed tradable forestry carbon credits in the few compliance markets.

Voluntary Carbon Market

The voluntary carbon market functions outside of the compliance market, and includes carbon-offset transactions that are not purchased with the intention of complying with any regulation. Businesses, governments, and

114 Michael K. McCall, Noah Chutz, and Margaret Skutsch, "Moving from Measuring, Reporting, Verification (MRV) of Forest Carbon to Community Mapping, Measuring, Monitoring (MMM): Perspectives from Mexico," *PloS one* 11(2016), https://doi.org/10.1371/journal.pone.0146038.

115 Habitamu Taddese Berie and Ingunn Burud, "Application of Unmanned Aerial Vehicles in Earth Resources Monitoring: Focus on Evaluating Potentials for Forest Monitoring in Ethiopia," *European Journal of Remote Sensing* 51 (2017): 326–335, https://doi.org/10.1080/22797254.2018.1432993.

116 Thomas Haeusler, Fabian Enßle, and Sharon Gomez, "Satellite Based Monitoring of Forest Resources Compliant with REDD+ and Zero Deforestation" (paper presented at the 2017 World Bank Conference on Land and Poverty, March 20–24, 2017), https://www.conftool.com/landandpoverty2017/index.php/10-08-Haeusler-296_paper.pdf?page=downloadPaper&filename=10-08-Haeusler-296_paper.pdf&form_id=296&form_version=final.

117 Stacey Paterson and Brett Anthony Bryan, "Food-Carbon Trade-offs Between Agriculture and Reforestation Land Uses Under Alternate Market-based Policies," *Ecology and Society* 17 (2012), http://dx.doi.org/10.5751/ES-04959-170321.

118 Pedro H.S. Brancalion, et al., "Using Markets to Leverage Investment in Forest and Landscape Restoration in the Tropics," *Forest Policy and Economics* 85 (2017): 103–113, https://doi.org/10.1016/j.forpol.2017.08.009.

119 Global CCS Institute, "5.1 The CDM and the Global Carbon Market," *Developing CCS Projects Under the CDM*, (2011), https://hub.globalccsinstitute.com/publications/developing-ccs-projects-under-clean-development-mechanism/51-cdm-and-global-carbon#fnr_039.

120 "EU Carbon Prices Could Double by 2021 and Quadruple by 2030," Carbon Tracker Initiative, last updated April 26, 2018, https://www.carbontracker.org/eu-carbon-prices-could-double-by-2021-and-quadruple-by-2030/.

Figure 6. Historical market-wide voluntary offset transaction volumes.

Source: Hamrick and Gallant, *Unlocking Potential: State of the Voluntary Carbon Markets,* 2017.

other entities purchase carbon offsets from the voluntary carbon market in order to offset their carbon emissions for many reasons, such as to demonstrate corporate social responsibility or achieve a carbon-neutral status. The generated offsets need to be verified by one of the standard-setting organizations, such as: Gold Standard; VCS; Climate, Community & Biodiversity Standard; Climate Action Reserve; or American Carbon Registry. These standard setters serialize carbon offsets and link them to online offset-issuance and retirement logs, in order to make sure there is no double counting or double selling of offsets. These standard-setting bodies also maintain a list of third-party validation or verification bodies that ensure proper issuance and retirement of carbon credits.

The voluntary carbon market has been growing with the participation of private and corporate entities that wish to offset their carbon footprints. The Ecosystem Marketplace tracked a total transaction of 63.4 metric tons of carbon-dioxide equivalent ($MtCO_2e$) in the voluntary carbon markets in 2016; this includes both primary (18.5 $MtCO_2e$) and secondary (44.8 $MtCO_2e$) market transactions, as shown in Figure 6 above. Cumulative transactions reached a record 1 billion tCO_2e in 2016.[121]

Although the prices for voluntary carbon offsets in 2016 ranged from \$0.50–\$50 per ton of CO_2e, the average price for forestry and land-use-derived offsets was \$5.10 per metric ton of CO_2e, with more than 13.1 million tons of CO_2e transacted, representing a total market value of \$67 million. Although projects related to REDD+ are usually among the most sought-after sources of carbon offsets, with 9.7 million metric tons of CO_2e transacted in 2016, afforestation/reforestation projects and forest-management improvements generate significantly higher prices at \$8.10 and \$9.50, respectively, compared with \$4.20 for REDD+ projects.[122] Economists at Stanford and Yale have shown the price of voluntary carbon offsets is generally higher when projects that generate offsets are certified by highly credible organizations, like the Gold Standard or the CDM.[123] The figure below illustrates the range of voluntary carbon offset price in 2016 for different project types (Figure 7).

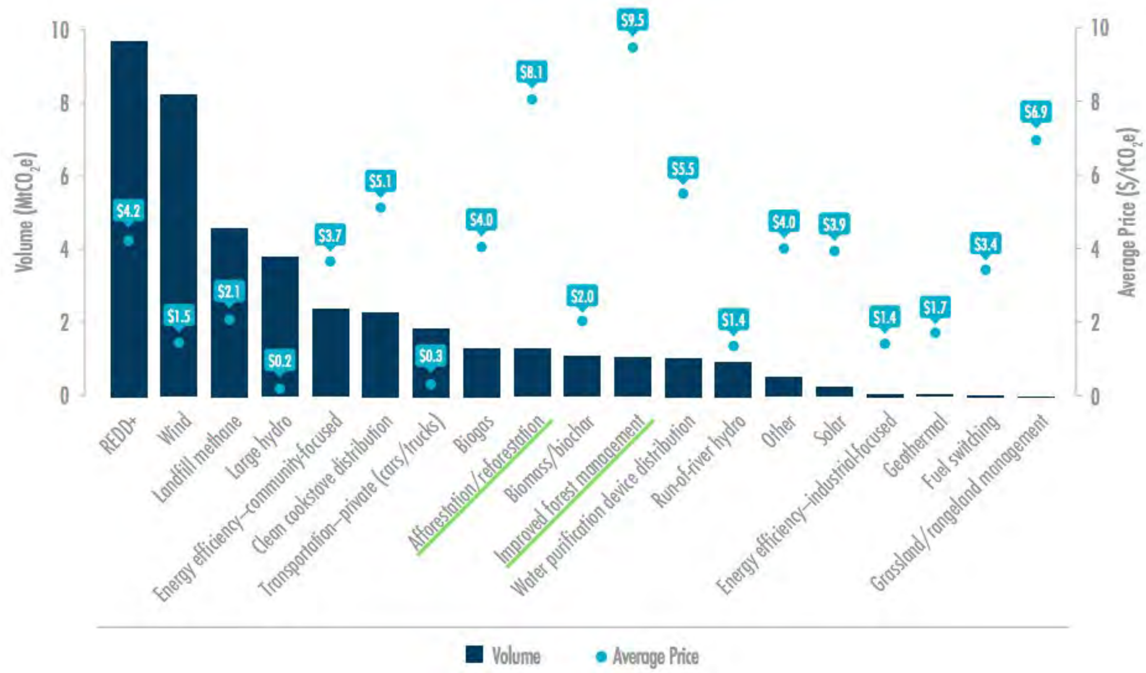
According to a study by the IPCC, the estimated CO_2 benefits of carbon sequestration through ARR projects in Malaysia were found to be 170 metric tons of CO_2 per hectare, which more or less corresponds with an estimation of tropical-forest carbon stocks in Asia by Holly

121 Hamrick and Gallant, *Unlocking Potential: State of the Voluntary Carbon Markets 2017*.

122 Ibid.

123 Marc N. Conte and Matthew J. Kotchen, "Explaining the Price of Voluntary Carbon Offsets," *Climate Change Economics 1* (2009), http://www.nber.org/papers/w15294.

Figure 7. Transacted volume of voluntary carbon offsets, average price, and price range by project type, 2016.



Source: Hamrick and Gallant, *Unlocking Potential: State of the Voluntary Carbon Markets,* 2017.

Gibbs and colleagues.[124,125] Using an average voluntary carbon offset price of $8 per metric ton of CO_2e, ARR projects could generate gross revenues of $1,360 per hectare in Southeast Asia. Since the total project-development costs for monetizing carbon offsets in SEA are approximately $1,300 per hectare, the net carbon benefit would then be $60 per hectare.

A handful of projects in SEA have already been generating forest- and land-use-based carbon offsets in numerous ways. Afforestation and reforestation projects sequester carbon that has already been emitted. An example of this is a 115-hectare mangrove-afforestation project in Indonesia's Riau Island Province, developed by YL Invest Co. Ltd. (Japan) in collaboration with the Indonesian Ministry of Forestry and local communities. Over thirty years, the mangrove forest will sequester nearly 115,000 metric tons of CO_2e.[126] Similarly, forest-management-improvement projects also prevent carbon from being emitted in the first place, by identifying ways of managing forests more sustainably, reducing waste, and maximizing returns on both financial and natural capitals. An example of this is the rehabilitation of 25,000 hectares of Dipterocarp forest in Sabah, Malaysia—a project developed by the Dutch nongovernmental organization Face the Future, which promotes sustainable forest management by planting a diverse selection of indigenous trees in logged-over areas.[127] Over the thirty-year crediting period, the project is estimated to contribute to the reduction of approximately three million $MtCO_2e$.[128]

124 IPCC, "5.2.2 Experience in LULUCF Project-Based Activities: Estimates of Sequestration, Emissions Avoidance, Substitution and Land Area Involved," in Robert T. Watson, et al., eds., *Land Use, Land-Use Change and Forestry*, (Cambridge, UK: Cambridge University Press, 2000), https://archive.ipcc.ch/ipccreports/sres/land_use/index.php?idp=253.

125 Holly K. Gibbs, et al., "Monitoring and Estimating Tropical Forest Carbon Stocks: Making REDD a Reality," *Environmental Research Letters 2* (2007): https://doi.org/10.1088/1748-9326/2/4/045023.

126 "Small-Scale and Low-Income Community-Based Mangrove Afforestation Project on Tidal Flats of Three Small Islands around Batam City, Riau Islands Province, Republic of Indonesia," REDD Desk, accessed September 7, 2018, https://theredddesk.org/countries/initiatives/small-scale-and-low-income-community-based-mangrove-afforestation-project.

127 "Infapro—20 Years of Forest Rehabilitation in North Borneo for Carbon Sequestration," Face the Future, 2015, http://facethefuture.com/wp-content/uploads/2015/05/Infapro-paper-20-years-of-forest-rehabilitation.pdf.

128 "INFAPRO Rehabilitation of Logged-over Dipterocarp Forest in Sabah," REDD Desk, accessed September 7, 2018, https://theredddesk.org/countries/initiatives/infapro-rehabilitation-logged-over-dipterocarp-forest-sabah.

Despite some progress made by voluntary carbon markets in the last decade, ARR projects have not been able to gain steam. Of the nearly eight thousand projects registered with the CDM, only sixty-six are currently listed as related to afforestation or reforestation—a paltry amount. Reasons for this include: cash-flow issues and the immediacy of returns; challenges securing finance for project development; transaction costs; and low profitability. All of these hinder access to start-up capital for new projects.

Among the very few ARR projects certified by the CDM, those that are successful tend to work with large organizations with technical expertise, including financial expertise.[129] Another challenging aspect of carbon financing with respect to ARR projects is biological—carbon credits derived from afforestation and reforestation unavoidably expire after a certain amount of time, since forest-based carbon sequestration is temporary.[130] Yet another challenge is the disparate prices that different carbon-sequestration schemes command for the carbon credits they generate, a function of the variety of certification schemes. At current price levels, carbon credits generated through ARR projects cannot compete with the large profit that could be made from rubber and palm-oil plantations, or from felling trees.[131] The next sections discuss the status of ARR financing in SEA, how and if ARR projects could be financed profitably, and how further development of carbon markets could play a key role in that.

Financing Gap

Section 6.1 estimated the investment need for forest restoration in SEA at approximately $5,000 per hectare in today's prices, which means a total of nearly $330 billion to restore all available areas in the region. An estimation using TEEB's cost-per-hectare data for global tropical-forest restoration has also generated a similar cost for SEA—a total investment need of approximately $350 billion in today's prices.[132] An additional investment would be required to undertake further quantification and commercialization of the ecosystem services associated with the restored forest.

Current Levels of ARR Financing and Sources in Southeast Asia

The current financial landscape in the SEA forestry sector consists of both private and public investors. Most of the public financing—government and Official Development Assistance (ODA)—has gone toward forest protection and preservation, as well as community forests. A study by FAO revealed the global ODA disbursement on forestry was only $800 million in 2015, which is 1 percent of the total ODA.[133] Of the $800 million, Southeast Asia's share is expected to be less than 20 percent (around $150 million), which is negligible when compared to the enormous financing need in the region.

Therefore, the ARR investment is expected to come primarily from private investors, which are not a large source at the moment. According to Tuukka Castrén and colleagues from the Program on Forests (PROFOR)—a multidonor partnership managed by a secretariat at the World Bank—private investment flows to plantation establishment in Asia-Pacific in 2011 were only $279 million.[134] Out of the total private investment in Asia-Pacific, SEA received only about $100 million, or 35 percent of the total. A more recent study by New Forests has also reported very limited private investment in Southeast Asia's forest sector.[135] Most of the limited private investment has come from domestic and foreign corporate investors, including investments from domestic smallholders, industries, and forest communities.

According to New Forests, although timberland is "an attractive asset class for institutional investors due to

129 Sebastian Thomas, et al., "Why are There so Few Afforestation and Reforestation Clean Development Mechanism Projects?" *Land Use Policy* 27 (2010): 880–887, https://doi.org/10.1016/j.landusepol.2009.12.002.

130 Michael Dutschke, et al., *Value and Risks of Expiring Carbon Credits from CDM Afforestation and Reforestation*, Hamburg Institute of International Economics, HWWA Discussion Paper 290, 2004, https://ideas.repec.org/p/zbw/hwwadp/26347.html.

131 Thomas Reuters Foundation, "Carbon Prices Too Low to Protect Southeast Asian Forests from Rubber Expansion—Report," *Eco-Business*, March 21, 2018, https://www.eco-business.com/news/carbon-prices-too-low-to-protect-southeast-asian-forests-from-rubber-expansionreport/.

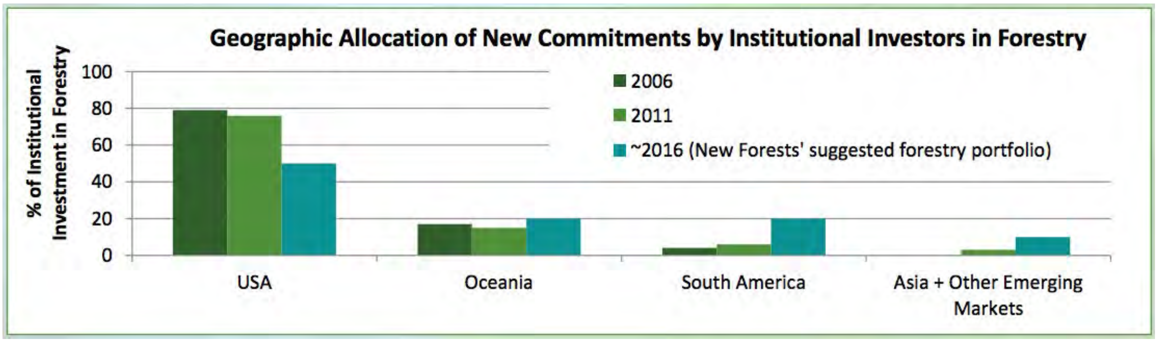
132 *The Economics of Ecosystems and Biodiversity: Climate Issues Update*, TEEB.

133 FAO, *The State of the World's Forests 2018—Forest Pathways to Sustainable Development* (Rome: FAO, 2018), 65–68. http://www.fao.org/3/I9535EN/i9535en.pdf.

134 T. Castrén, et al., *Private Financing for Sustainable Forest Management and Forest Products in Developing Countries: Trends and Drivers* (Washington, DC: Program on Forests, 2014), 127, https://www.cbd.int/financial/doc/wb-forestprivatefinance2014.pdf.

135 New Forests, 2017 Timberland Investment Outlook.

Figure 8. Institutional investment capital flows to forestry.



Source: Adam Grant, "Investors Supporting Transformation Towards Sustainability in the Forestry Sector," CIFOR Forests Asia Summit, May 2014, 5, http://www.fao.org/fileadmin/templates/rap/files/meetings/2014/140505-investors.pdf.

favorable portfolio attributes including low correlation to other asset classes, natural inflation hedging, and low volatility of returns," the investment commitment from institutional investors has also been negligible (Figure 8).[136]

Despite the natural interest of institutional investors to hold assets for the long term, the current level of ARR financing in emerging forestry markets such as SEA is low because of land-tenure security, and environmental, social, and corporate-governance risks. To account for these risks, investors seek risk-adjusted returns that are two to three times those sought for forestry investments in Europe and North America. Further, land prices in SEA have been fueled by increases in prices for agricultural land—particularly for palm oil and rubber—which affects the returns on investment.

Current Gap in Financing in Southeast Asia

There are severe limitations with regard to data availability on the financing flows to the SEA forestry sector, and particularly to ARR activities. From the preceding section, it is clear that ODA to the forestry sector in SEA is negligible. As illustrated in the preceding section, the total annual private-sector plantation investments in Southeast Asia were $100 million in 2011, excluding investments in REDD+ and landscape-restoration projects, and also excluding the investments by households, communities, and most small and medium forest enterprises.[137]

Based on the investment need discussed in Chapter 3, the financing gap in the region is expected to be vast. Limited data concerning private investments in the forest sector are a major challenge, as there is no systematic and transparent mechanism to monitor the private-fund flows into this sector. Significant data gaps also make it challenging to reliably track the private financing flows into the forestry and land-use sector. Despite such limitations, the forestry sector offers a potential opportunity for private-sector engagement.

Barriers to Private Financing

It is well known that investing in the forestry and land use sector raises a host of obstacles for commercial viability. Castrén and PROFOR colleagues have discussed a number of barriers to ARR financing, some of which are further elaborated upon below in the context of Southeast Asia.[138] The major barriers include land-tenure security, high risks related to returns, insufficient returns, and weak supply-chain governance, among others.[139]

Risk Related to Land-Tenure Security and Forest Governance

Most Southeast Asian countries have an unstandardized and complex process of land-tenure license transfer, which is further compounded by government bureaucracy and corruption. In Indonesia, for instance,

136 New Forests, 2017 Timberland Investment Outlook. .

137 Castrén et al., *Private Financing for Sustainable Forest Management and Forest Products in Developing Countries: Trends and Drivers*.

138 Castrén et al., *Private Financing for Sustainable Forest Management and Forest Products in Developing Countries: Trends and Drivers*.

139 Global Landscapes Forum, *Building the Investment Case for Sustainable Landscapes and Restoration* (paper presented at Global Landscapes Forum Investment Case Symposium, May 30, 2018), https://www.globallandscapesforum.org/wp-content/uploads/docs/Concept_Note_GLF_Investment_Case_2018.pdf.

most land is owned by the state, and lease and concession regulations are often unclear. In most Southeast Asian countries, forest governance is a serious issue, as most current forest investments are for unsustainable exploitation of natural forests, which is a huge reputational risk for mainstream investors.

Limited Availability of Quality Land at a Reasonable Price, and Competition from Other Crops and Land Uses

In SEA, availability of scalable land is challenging. For a production company, the minimum area of land required for a profitable investment would be 500 ha, but most mosaic land structures in SEA are only about 10 ha. Further, there is intense competition for such limited land with traditional agricultural land uses, such as rubber and palm-oil plantation. Castrén and PROFOR colleagues have reported that oil-palm investments are at least ten times more profitable than pulpwood plantations in Indonesia.[140] The viability of REDD+ programs is also doubtful because of extremely low carbon prices, which are not enough to compete with revenues from traditional agricultural plantations.

Insufficient Returns

The risk-adjusted returns on forestry investments vary by country. In Southeast Asia, investors expect returns to be 10 percent or higher to compensate for all the risks, which essentially raises the return targets to 25 percent. Such high returns are hard to find in developing Southeast Asian countries, so most mainstream investors screen out such investments during the due-diligence process, or even earlier.

Non-recognition of Forestry as an Asset Class

In the United States, Australia, New Zealand, and in some European countries, forestry has been recognized as a well-established asset class, even though its share of total portfolios is still very small. In developing regions like Southeast Asia, the sector is far from being recognized as a distinct asset class, and thus must compete against much more familiar and established assets like agricultural plantations or real estate.

Difficult Nature of Debt Financing

Most debt financing in SEA has extremely short payback periods (from six months to three years) and prohibitively high interest rates, which are not favorable for forest investments that are long-term in nature. Further, most domestic banks in SEA have low liquidity, and are driven by short-term returns.

Weak Availability of Both Domestic and Foreign Financing

Since most available land in Southeast Asia is of small scale, it is extremely difficult for smallholders and small-scale enterprises to obtain domestic and international equity financing for smaller projects (those costing less than $25 million).

Lack of Readily Available Information on Sites, Growth Rates, Matching Species to Sites

The lack of readily available information on land sites, growth rates of different plant species, and growth rates in available land sites, acts as a deterrent to small and medium-sized projects, because of the additional cost involved in obtaining this particular information. Furthermore, certain investors could easily be put off by the various requirements for planting different species, including their competing light and soil requirements, the lack of native seed species, the few nurseries with native-species experience, the management needs following planting, and the lack of growth and yield models.

Lack of Political and Economic Stability

Some Southeast Asian countries have unstable political and macroeconomic conditions, which are not conducive to long-term investments such as forestry. The cost of capital also rises with political and economic instability, negatively affecting return expectations.

Intangibility of Ecosystem Services

Most private investors are not interested in adding ecosystem benefits arising from forestry investments, unless these can be monetized and have a market. There is currently no attractive market for such environmental services.

Solutions for Enhanced (Improved) ROI and Private Financing

In Southeast Asia, investment in the forest sector is still dominated by state financing and loans, as well as grants from international development organizations. This is far from enough to meet the growing demand of forest products while still maintaining the overall forest cover. No

140 Castrén et al., Private Financing for Sustainable Forest Management and Forest Products in Developing Countries: Trends and Drivers.

single solution will change the forest-investment landscape overnight. The following forest-investment framework (Figure 9) succinctly captures the necessary elements for attracting investment into the forest sector. In an ideal scenario, these solutions should all work in concert.

Blended and Innovative Financing

Blended and innovative financing are considered market-based financing models, and have been increasingly used by policymakers in the last decade.[141]

Connor M. Savoy and Aaron N. Milner from the Center for Strategic and International Studies (CSIS) define blended finance as the model "when donors (bilateral/multilateral organizations) use grant money to help rebalance risk-reward profiles or mitigate risks associated with investment in countries or areas that private investors might be unwilling to invest on their own," facilitating private capital flow into otherwise risky projects.[142] Thus, blended finance is a form of partnership-based financing model, in which the public-finance component provides first-loss risk capital, making more ARR deals investable.

REDD+ mechanisms—such as the FCPF housed at the World Bank, and the UN REDD Programme managed jointly by FAO, UNDP, and UNEP—are considered innovative forest-financing models. The REDD+ mechanism primarily seeks to conserve forest carbon stocks, through national and subnational policies and interventions. REDD+ payments are currently set at $5 per tCO_2e. UN REDD reported, "in Argentina, REDD+ payments at $5 per tCO_2e are competitive with the returns of the cattle ranching sector and leave a buffer to support implementation costs."[143] REDD+ might not be able to ward off all drivers of deforestation or disincentives to invest in ARR projects, but could provide some additional incentives that might be transformational in some contexts. For instance, in some FCPF-financed projects, carbon finance has helped to overcome institutional and national risk-related barriers, and to meet project-maintenance costs. In a study on REDD+'s financial viability in Malaysia, Nicola Abram and colleagues found that "REDD+ may be a better finance alternative for smallholders who often struggle to produce good oil palm yields, especially in marginally suitable areas."[144]

Several REDD+ funds have been created in the past several years, led by private-sector actors with private investment. Examples include Althelia, Terra Global Investment Management, BioCarbon Group Pte Limited, Livelihoods Fund, and Conservation International Carbon Fund.

Increased Carbon-Offset Prices

Several scholars have studied the impact of carbon-offset price on forest-conservation-related interventions. For instance, Jonah Busch and Jens Engelmann from the Center for Global Development and University of Wisconsin-Madison, by projecting tropical deforestation from 2016 to 2050, have constructed new marginal-abatement cost curves for reducing emissions from tropical deforestation.[145] Busch and Engelmann tried to examine at what carbon price the reduction of tropical deforestation would be a cost-effective source of greenhouse-gas-emission reductions, relative to other sectors. They found that in Asia, under a business-as-usual scenario, 77 MH of tropical forest would be deforested between 2016 and 2050. At a carbon price of $20 per tCO_2 in 2020, this would drop to 58 MH; at a price of $50 per tCO_2 in 2020, it would drop to 40 MH.

Another interesting study, conducted by Nicola Abram and colleagues, assessed the financial viability of REDD+ in safeguarding unprotected forest in the Lower Kinabatangan floodplain in Malaysian Borneo.[146] This study identified specific carbon prices at which REDD+ would financially outcompete oil-palm plantations (see Figure 10).

The study found that a low carbon-offset price of $3 per tCO_2e would enable REDD+ to outcompete oil-palm

141 B. Singer, "Financing Sustainable Forest Management in Developing Countries: the Case for a Holistic Approach," *International Forestry Review* 18 (2016): 96–109, https://doi.org/10.1505/146554816818206159.

142 Conor M. Savoy and Aaron N. Milner, "Blended Finance and Aligning Private Investment with Global Development—Two Sides of the Same Coin," Center for Strategic and International Studies, March 2018, https://csis-prod.s3.amazonaws.com/s3fs-public/publication/180313_Savoy_BlendedFinance_Web.pdf?oSIJoKLxku_odK1cyFix_DHeRoKunpuc.

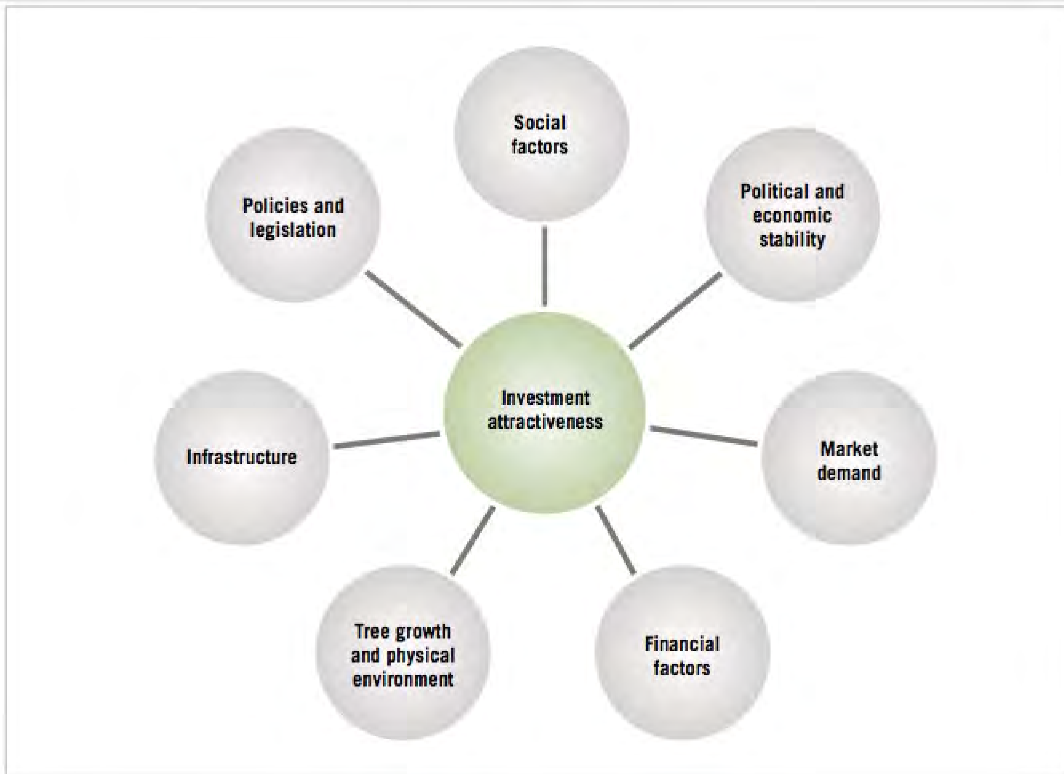
143 Gabriel Labbate, "The Innovative Character of REDD+ Payments and Their Potential for Change: Trends from Latin America," UN-REDD Programme, September 29, 2016, http://www.un-redd.org/single-post/2016/09/29/The-innovative-character-of-REDD-payments-and-their-potential-for-change-trends-from-Latin-America.

144 Nicola K. Abram, et al., "Identifying where REDD+ Financially Out-Competes Oil Palm in Floodplain Landscapes Using a Fine-Scale Approach," *PloS one* 11 (2016), https://doi.org/10.1371/journal.pone.0156481.

145 Jonah Busch and Jens Engelmann, "Cost-Effectiveness of Reducing Emissions from Tropical Deforestation, 2016–2050," *Environmental Research Letters* 13 (2017), https://doi.org/10.1088/1748-9326/aa907c.

146 Abram et al., "Identifying where REDD+ Financially Out-Competes Oil Palm in Floodplain Landscapes Using a Fine-Scale Approach."

Figure 9. Forest investment framework.



Source: T. Castrén, et al., *Private Financing for Sustainable Forest Management and Forest Products in Developing Countries: Trends and Drivers*.

investments in 55 percent of unprotected forests, while a high carbon-offset price of $30 per tCO_2e would increase REDD+'s competitiveness but still capture only 69–74 percent of the unprotected forest. Obviously, the competitiveness of REDD+ at the same price increases with increases in the carbon stock of the forest. In SEA, most old-growth or primary tropical forests have already been destroyed, or have undergone varying degrees of logging. Thus, the aboveground carbon stock of these lands would be extremely limited, requiring a much higher carbon-offset price to outcompete agricultural plantations. This price would definitely be more than $30 per tCO_2e.

Walter Vergara and colleagues have estimated the NPV that would result from restoring (through reforestation, assisted or passive regeneration of natural forests, and agroforestry) 20 MH of degraded lands in Latin America and the Caribbean over fifty years, using a discount rate of 3 percent.[147] Their estimation only considered those benefits that can be easily monetized (e.g., wood and non-wood products, income from tourism, gains in agricultural production, avoided food-security costs, and carbon storage). It did not consider intangible benefits, such as improvements in biodiversity, species recovery, and improved water supply, because of the difficulty in monetization. The authors found that the NPV gain from restoration investment would be $869 per hectare if carbon revenues were excluded. At a value of $20 per ton of carbon, the NPV gain would be $3,291; at a value of $100 per ton, the NPV gain would be $14,772.

Although the investment-and-return landscape in Latin America and the Caribbean could be very different, a crude comparison can be done with the NPV gain in Southeast Asia. In Section 6.1, this paper presented an NPV gain of $4,500–30,500 per hectare for oil-palm plantations. Assuming the restoration case in both regions is similar, a minimum carbon price of more than $20 per ton is required to at least compete with oil-palm plantations—and

147 Walter Vergara, et al., *The Economic Case for Landscape Restoration in Latin America*, The World Resources Institute, 2016, https://wriorg.s3.amazonaws.com/s3fs-public/The_Economic_Case_for_Landscape_Restoration_in_Latin_America.pdf.

Figure 10. Outputs from the four carbon-offset price scenarios.

Carbon price (US $/ $MgCO_2e$)	Extent to which REDD + outcompetes oil palm in unprotected forest in ha (and %)	Total MgC (summation of carbon within the extent where REDD+ outcompetes oil palm)	Total $MgCO_2e$ (MgC multiplied by 3.67)	Total REDD+ funds needed ($MgCO_2e$ multiplied by the carbon price in US $)
Full payment scheme				
Voluntary low case US $3 $MgCO_2e$	16,629 (55)	2,495,980	9,160,247	$27,480,740
Voluntary mid case US $7.8 $MgCO_2e$	18,999 (63)	2,887,380	10,596,685	$82,654,140
Voluntary high case US $15 $MgCO_2e$	20,376 (68)	3,413,530	12,527,655	$187,914,827
Full compliance US $30 $MgCO_2e$	22,178 (74)	3,779,505	13,870,783	$416,123,501
Staggered payment scheme				
Voluntary low case US $3 $MgCO_2e$	16,546 (55)	2,461,415	9,033,393	$27,100,179
Voluntary mid case US $7.8 $MgCO_2e$	16,629 (55)	2,495,980	9,160,247	$71,449,923
Voluntary high case US $15 $MgCO_2e$	18,999 (63)	2,887,380	10,596,685	$158,950,269
Full compliance US $30 $MgCO_2e$	20,859 (69)	3,449,755	12,660,601	$379,818,026

Source: Abram et al., "Identifying where REDD+ Financially Out-Competes Oil Palm in Floodplain Landscapes Using a Fine-Scale Approach."

could be higher, depending on the stage of degradation of land, the restoration area, and other factors.

No available study has estimated the level of carbon price that would make ARR projects more competitive than oil-palm plantations in Southeast Asia. The authors of this report have therefore used their own findings to estimate the price per tCO_2e at which ARR projects become as attractive for investment as monoculture plantations such as palm oil. From Section 7.1, it is clear that monoculture plantations derive an average of $6,900 per hectare more than ARR projects. Furthermore, from Section 7.2, the authors found the net carbon benefit at the current carbon-offset price of $8 per metric ton of CO_2e is only $60 per hectare. Hence, in order to make ARR projects as competitive as monoculture plantations, the minimum price of carbon per ton of CO_2e needs to rise from $8 to $40. Discussion with industry experts has broadly validated a 10 percent discount rate used in cost-benefit analysis in Sections 6.2 and 7.1, which is the basis for this proposed carbon price. Some industry experts have put the discount rate in these sections higher, at up to 14 percent, in which case the breakeven carbon price would go up slightly.

This paper's recommended carbon price can be compared to those from a number of relevant studies. A study conducted by Eleanor M. Warren-Thomas and colleagues, using Cambodian forest data, found that a carbon price of $30–51 per tCO_2 is required to break even against costs and compete with rubber plantations in Southeast Asia.[148] Another study by the Organisation for Economic Co-operation and Development, the International Energy Agency, and the International Renewable Energy Agency recommended carbon prices of $30 per tCO_2e by 2030, $60 by 2040, and $80 by 2050 in a scenario that would be compatible with limiting the rise in global mean temperature to 2 degrees Celsius by 2100—with a 66 percent probability of successfully limiting the temperature increase.[149] In these contexts, a carbon-price estimate of $40 per tCO_2e in SEA appears justified.

The evolution of new carbon markets—as in China, Canada, and Mexico—the initiation of reforms of the carbon-trading system in the European Union, and the likely operationalization of a carbon market for international aviation are all positive signals in this space. Over time, they may help increase demands for voluntary carbon offsets, and hence their price. *Environmental Finance*, citing First Climate's CEO Jochen Gassner, forecasts that voluntary carbon-offset prices could reach $12–17, or even more.[150]

Moreover, the emergence of regional carbon-emission trading schemes, as in China, could make a higher forest carbon price possible. In the case of the Chinese Emission Trading Scheme, the Fujan ETS lets entities submit local forestry credits (Fujan Forest Certified Emission Reduction credits) to meet up to 10 percent of compliance obligations under the offset scheme.[151] Similarly, in

148 Eleanor M. Warren-Thomas, et al., "Protecting Tropical Forests from the Rapid Expansion of Rubber Using Carbon Payments," *Nature Communications* 9 (2018), https://doi.org/10.1038/s41467-018-03287-9.

149 OECD/IEA and IRENA, *Perspectives for the Energy Transition—Investment Needs for a Low-Carbon Energy System*.

150 Elena K. Johanson, "Optimism Trumps Uncertainty," *Environmental Finance*, September 4, 2018, https://www.environmental-finance.com/content/analysis/optimism-trumps-uncertainty.html.

151 Sino Carbon, *China Carbon Market Monitor*, PMR: Partnership for Market Readiness, Q1 2017, https://www.thepmr.org/system/files/documents/PMR%20China%20Market%20Newsletter_FINAL_EN.pdf.

the case of Beijing Pilot, forest carbon projects within the city are allowed to meet offset-credit requirements.[152] However, seeing this offset value benefit forestry projects outside of China may still pose a significant challenge.

The Internationally Traded Mitigation Options under Article 6 of the Paris Agreement also have provisions for carbon trading across different countries, and there is renewed interest and discussion around including forestry credits under an international tradable agreement.[153] Colombia's integration of voluntary offset credits into a compliance scheme could set a precedent for voluntary forest carbon offsets to be used to meet countries' NDC targets. In the case of carbon forestry, it needs to be understood that the gestation period for quantifying emission reductions is in the range of two to three years.[154] Hence, it is imperative that the necessary steps are initiated in time to ensure the availability of emission reductions to meet the demand that is foreseen in 2020 and beyond.

Restrictive Policies

The Brazilian government's strict anti-deforestation policies—such as creation of protected areas and recognition of indigenous lands, enforcement of existing forest laws, prosecution of businesses that distribute soy and beef products produced through deforestation, enforcement of soy and beef moratoria using sophisticated satellite imagery—and other activities, such as jurisdictional blacklists and credit restrictions for actors involved in deforestation, are good examples of how restrictive policies and law enforcement could decouple agricultural revenue from deforestation and incentivize ARR investments. These policies and actions were able to reduce deforestation in Brazil by 47 percent.[155]

Similarly, the removal of perverse incentives, such as unnecessary agricultural subsidies, could help attract restoration investment to lands that are otherwise profitable only for monoculture agricultural plantations. In Southeast Asia, the ASEAN Economic Community, launched in 2016, focuses on food, agriculture, and forestry, with aims of achieving regional food security and increasing the region's competitiveness in global markets.[156] The enforcement of the ASEAN Economic Community is expected to make the investment climate more open, and its strategic plan of action (SPA) for sustainable forest management includes a measure to "promote inter-sectoral cooperation between the forestry sector and other sectors, including agriculture, environment, customs and trade."[157] Further, the SPA discusses the issue of strengthening legal protections and governance, including "enforcement cooperation at the ASEAN level that deals with transnational illegal forestry activities and to facilitate cross-border enforcement."[158] These measures, if properly applied, are expected to have a positive impact on the protection of forests from illegal logging activities, and to incentivize ARR investments.

In addition, credit and market restrictions, such as the removal of agricultural subsidies in some countries, could also help attract ARR investment in lands that are otherwise profitable only for monoculture agricultural plantations.

Reducing the Cost of Capital/Borrowing and Transaction Costs

The use of short-term borrowing to finance long-term assets exposes private ARR firms to high liquidity risk. This maturity mismatch needs to be addressed with more innovative financing modalities. The reduction of borrowing costs can also be achieved, to some degree, through the use of emerging technologies like blockchain—as is being done for agroforestry projects in Africa.[159] With regard to emission-reduction projects using forest carbon-offset purchases, the cost of borrowing for deploying projects can be significantly reduced if offset buyers are engaged at the beginning of the project, through a futures contract such as the Emission Reductions Purchase Agreement.

152 International Carbon Action Partnership, *China – Beijing Pilot System*, ICAP, last updated November 27, 2018, https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=53.

153 IETA, *A Vision for the Market Provisions of the Paris Agreement*, IETA, May 2016, 2018, https://www.ieta.org/resources/UNFCCC/IETA_Article_6_Implementation_Paper_May2016.pdf.

154 Johanson, "Optimism Trumps Uncertainty."

155 Busch and Englemann, "Cost-Effectiveness of Reducing Emissions from Tropical Deforestation, 2016–2050."

156 Robert Cole, G. Wong, and I.W. Bong, "Implications of the ASEAN Economic Community (AEC) for Trans-Boundary Agricultural Commodities, Forests and Smallholder Farmers," *Center for International Forestry Research* 178 (2017), https://doi.org/10.17528/cifor/006508.

157 ASEAN, *Strategic Plan of Action for ASEAN Cooperation on Forestry (2016-2025)*, August 5, 2016, 14, http://asean.org/storage/2016/10/Strategic-Plan-of-Action-for-ASEAN-Cooperation-on-Forestry-2016-2025.pdf.

158 Ibid.

159 "Microfinance 3.0: David Plattner on Building an Agro-Blockchain for Africa," *Landscape News*, May 27, 2018, https://news.globallandscapesforum.org/27621/microfinance-3-0-david-plattner-on-building-an-agro-blockchain-for-africa/.

Source: pixabay.com

Most restoration projects in Southeast Asia are small, because of the mosaic nature of deforested lands. Furthermore, for large corporate and institutional investors, these small investments would only increase transaction costs. It is therefore important that the state facilitates access to financing and makes the process easier for smallholders and small and medium-sized private enterprises, while incentivizing private investors to make small investments.

Free (Indigenous) Land Use/Tenure Rights/Land Governance

A lack of technical standards and practical guidelines on land-tenure registration is a challenge in Southeast Asia. Inefficiency and limitations in transparency and accountability of land institutions are key barriers to the implementation of projects to improve land-tenure security in the region. The first step toward resolving this issue should be a recognition and enforcement of customary land tenure, as has been done successfully in Latin America.[160] This would reduce conflicts with local/indigenous people, and also assure the availability of collateral for any productive land use.[161] The second step should be an integration of local land tenure into spatial planning by the local government, with full participation of the local community. This would "protect local communities and indigenous peoples' development needs."[162]

160 Warnholtz, "Land Tenure for Forest Peoples, Part of the Solution for Sustainable Development."

161 International Fund for Agricultural Development (IFAD), *Agriculture—Pathways to Prosperity in Asia and the Pacific*, IFAD Asia and the Pacific Division, March 2011, vii, https://reliefweb.int/sites/reliefweb.int/files/resources/Full_Report_247.pdf.

162 Toumbourou, *Improving Indonesia's Forest and Land Governance—Using a Delphi Approach to Identify Efficacious Interventions.*

6. Call to Action

The Paris Agreement and the UN Sustainable Development Goals, both promulgated in the second half of 2015, have emphasized the importance of private investment in climate-change mitigation and adaptation, and in sustainable development more generally. Forest restoration becomes integral to any effort in this direction. Combined with a growing recognition that climate change and other socio-ecological threats represent material risks to any financial decision, as well as a rapidly developing conservation finance-sector, this report's authors believe there is a huge opportunity to proactively invest in afforestation, reforestation, and forest rejuvenation, particularly in SEA. This report below identifies a list of action points for both policymakers and financial institutions.

Recommendations for Policymakers

- Develop a standardized and simple process of land-tenure license transfer, minimize government bureaucracy for land-tenure registration, and ensure transparency and accountability of land institutions.

- Remove bureaucratic and administrative hurdles that prevent different government ministries and departments—such as finance, agriculture, land planning, forestry, and environment—from working together. This would facilitate investments by those who otherwise shy away because of these hurdles.

- Strengthen the capacity of local nongovernmental organizations and smallholder companies to produce quality data on land sites, growth rates of different plant species, and these figures' applicability to available land sites. This will reduce the cost for investors and project developers.

- Ensure the enforcement of the strategic action plan of ASEAN Economic Community for sustainable forest management that could incentivize private restoration investments in the region.

- Address conflicting laws and regulations among various government departments and ministries, which lead to increased transaction costs.

  Facilitate access to financing and make it easier for smallholders and small and medium-sized private enterprises, while incentivizing private investors to make small investments. This is because most restoration projects in SEA are small, both in scale and cost, due to the mosaic nature of deforested lands. For large corporate and institutional investors, these small investments would only increase transaction costs.

Financial Institutions

- Recognize sustainable forestry as a distinct asset class, as has been done by financial institutions in the United States, Australia, New Zealand, and some European countries.

- Address the maturity mismatch with more innovative financing modalities, particularly by leveraging concessional financing from international development institutions. Borrowing costs can be reduced, to some degree, through the use of emerging technologies like blockchain, as is being done for agroforestry projects in Africa.

- Help blend different sources of capital for restoration projects through the quantification, valuation, and monetization of environmental externalities. There are various approaches for estimating the value of ecosystem services, such as hedonic pricing, mitigation, and the avoided-costs method. Financial institutions could start by applying shadow carbon pricing in all their investments that are linked to forest value chains. The banks could also pilot forest carbon-offset projects to test internalization of environmental externalities.

- Look to align lending activities with the Paris Agreement. Insofar as carbon prices rise to levels aligned with a temperature increase below 2 degrees, institutions will find investments in ARR increasingly attractive, as they also work as carbon sinks.

Source: pxhere.com

About the Authors

Mr. Prajwal Baral is managing partner at Hornfels Group Ltd., a technology investment advisory and consulting firm headquartered in Moscow. Previously, Mr. Baral worked for several public and private sector institutions including the World Bank Group (WBG), DBS Group, the World Trade Organization (WTO), the World Intellectual Property Organization (WIPO), UN Environment (UNEP) Inquiry into the Design of a Sustainable Financial System, C40 Cities Finance Facility, Climate-KIC, the World Wide Fund for Nature (WWF) and the Korean government. At Korea Technology Finance Corporation (KOTEC), Mr. Baral played a crucial role in setting up a financing facility for climate technologies, backed by a tailored technology rating and valuation system. Mr. Baral has authored numerous papers and book chapters that cover topical issues in infrastructure and development finance, international trade, energy and climate change. His work has been cited by the likes of G7 Members, sitting government ministers, popular print media, academic researchers and others. He has an academic background in Electronics and Communication engineering from Maulana Azad National Institute of Technology (India) and Environmental Management from the University of Oxford (England). He is fluent in Hindi, Nepali and English, and has working proficiency in Bengali and Urdu.

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In recent years, DBS has been strengthening its sustainability agenda in various ways. In July 2017, the Bank was the first financial institution in Singapore to issue a green bond to support the financing of green assets. It was the sole bookrunner of Singapore's first corporate green bond in April 2017. As an affirmation of its commitment to sustainability, DBS was also the first Singapore bank to be included as an index constituent of the FTSE4Good Global Index in 2017, making it one of eight Singapore-listed companies to be globally recognised for its Environmental, Social, and Governance practices.

Prior to joining DBS, Mikkel was CFO for Asia Pacific in UBS from 2009 to 2012 covering Investment Bank, Wealth Management and Asset Management. He was previously the Asia Pacific head of accounting policy and location controller for Hong Kong at UBS. Mikkel has also worked in Citigroup in London and KPMG in London and Denmark.

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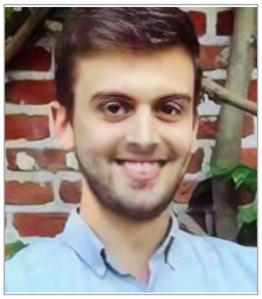

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