GGKP GGGI

The 3Returns Framework

A method for decision making towards sustainable landscapes

GGKP Expert Group on Natural Capital

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The Green Growth Knowledge Partnership (GGKP) is a global community of organizations and experts committed to collaboratively generating, managing and sharing green growth knowledge. Led by the Global Green Growth Institute (GGGI), Organisation for Economic Co-operation and Development (OECD), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO) and the World Bank Group, the GGKP draws together over 60 partner organizations. For more information, visit www.greengrowthknowledge.org.

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SUMMARY

The 3Returns Framework presents a method for assessing sustainable landscape interventions. The framework aims to facilitate decision makers with the formulation and analysis of policies, financial instruments, allocation of resources, and the identification of practices for sustainable landscape interventions. For this, the following report is composed of five chapters. The opening chapter presents the introduction and objectives of this document. Chapter 2 builds the fundamentals for introducing the 3Returns Framework as an attractive approach for landscape assessment, addressing the importance of capitals for green growth and defining landscape interventions as an investment in capitals. Chapter 3 goes through, step by step, the 3Returns Framework approach for landscape assessment. This is followed by Chapter 4, which presents an example of landscape assessment following the 3Returns Framework conducted in the Ayeyarwady Delta, Myanmar. The last chapter, Chapter 5, shares key points of the 3Returns Framework and lessons learned.

Landscape interventions in restoration and conservation, along with the development of economic sectors, must follow a holistic approach that takes into consideration one connected natural, social, and economic environment. For this, policy reforms and finance mobilization have been identified as necessary instruments for speeding up transformational growth, innovation, and efficient resource management. The need for an analytical framework that considers sustainable landscape interventions, while facilitating the analysis and design of policy and financial instruments, has led to the development of the 3Returns Framework.

The 3Returns Framework operationalizes already existing capital accounting frameworks (Natural Capital Protocol and Social & Human Capital Protocol) and presents green growth interventions for landscapes as investments in natural, social & human, and financial capital. Adequate green investments result in an increase in monetary and non-monetary benefits, which simultaneously lead to the preservation of resources required for current and future well-being (economic, natural, social, and human capital stocks). Considering the nature of green growth interventions at landscape level, the 3Returns Framework builds on the consideration of interventions as:

> **Investment in Natural Capital**: resources allocated to increase the stocks of natural assets;
>
> **Investment in Social & Human Capital**: resources allocated to increase cooperation within and among groups, individual and collective knowledge, skills, and competencies; while building/strengthening institutions for resource management, decision making, and social integration; and
>
> **Investment in Financial Capital**: resources allocated to acquire or increase the assets needed in order to provide goods or services.

Green growth interventions for landscapes therefore can be interpreted as an investment in natural, social & human, and financial capital, which in turn will result in an increase in benefits. The 3Returns Framework builds on cost-benefit analyses presenting a structure that organizes the information measured, estimated, and modeled for a landscape assessment allowing the analysis of the impacts of different interventions. Recognizing interventions as investments in capitals leads to the reconsideration of the categorization of certain expenses. In the context of landscape interventions, expenses associated with sustainable production, restoration, landscape management, capacity building, etc., have historically been treated as additional operational expenses. However, the identification of benefits and the increase in benefits from investment in capitals requires the recategorization of certain operational expenses into capital expenses. This recategorization not only implies a new way of expressing expenditures, but also a new way of interpreting and analyzing certain financial indicators. Besides the calculation of profitable measures (i.e. net present value – NPV), the structure proposed allows the computation of efficiency measures (i.e. return on investment – ROI) that, when combined with the identification of non-monetary benefits and capitals' outputs, support decision making by identifying green growth interventions towards sustainable landscapes.

The pilot study conducted in Myanmar provided the importance and usefulness of considering capitals when analyzing interventions towards sustainable landscapes and confirmed the value of the ROI for supporting decision making. The calculation of the ROI proved to be valuable in order to differentiate which green intervention can be recommended given that the NPV was quite similar when analyzing different green scenarios. Additionally, the calculation of the ROI for the business as usual scenario contributed to the understanding of the importance and necessity of reinvesting in capitals in order to continue enjoying the benefits that they provide. Among the overall benefits of following the 3Returns Framework in Myanmar, the method resulted in key information needed for analyzing policy impacts and the identification of efficient ways of allocating resources in order to improve the benefits and status of stakeholders in the area of interest. Having this information available facilitated discussion among multiple decision makers and their understanding of the implications of different interventions with potential trade-offs that can harm the implementation of them.

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LIST OF ACRONYMS

AFOLU	Agriculture, Forestry, and Other Land Use
ARIES	Artificial Intelligence for Ecosystem Services
BaU	Business as Usual
BCR	Benefit to Cost Ratio
CAPEX	Capital Expenses
CBA	Cost-Benefit Analysis
CBFM	Community-Based Fishery Management
CBSFM	Community-Based Sustainable Forest Management
CC	Capitals Coalition
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CF	Community Forestry
CFUG	Community Forest User Groups
CIAT	International Center for Tropical Agriculture
CO2e	Carbon Dioxide Equivalent Terms
CSA	Climate Smart Agriculture
DFID	Department for International Development (UK)
DIVA	Dynamic and Interactive Vulnerability Assessment
DRR	Disaster Risk Reduction
eCBA	Extended Cost-Benefit Analysis
ES	Ecosystem Services
EXACT	EX-Ante Carbon Balance Tool
FREDA	Forest Resource Environment Development and Conservation Association
FTE	Full-Time Equivalent
FUI	Fuel Use Intensity
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IPBES	Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services
IWI	Inclusive Wealth Index
JICA	Japan International Cooperation Agency
KAIST GSGG	Korea Advanced Institute of Science and Technology Graduate School of Green Growth
MIMES	Multiscale Integrated Models of Ecosystem Services
MIMU	Myanmar Information Management Unit
MMK	Myanmar/Burmese Kyat
MRRP	Myanmar Reforestation and Rehabilitation Plan
NP	National Park
NPV	Net Present Value
ODA	Overseas Development Aid

OECD	Organization for Economic Co-operation and Development
OPEX	Operational Expenses
PA-BAT	Protected Area Benefits Assessment Tool
PES	Payment for Ecosystem Services
PV	Present Value
RECOFTC	The Center for People and Forests
REDD+	Reduced Emissions from Deforestation and Forest Degradation
RF	Reserve Forest
ROI	Return on Investment
SDR	Social Discount Rate
SEEA	System of Integrated Environmental and Economic Accounting
SES	Social-Ecological Systems
SFH	Small Forest Holders
SLR	Sea Level Rise
SolVES	Social Values for Ecosystem Services
TESSA	Toolkit for Ecosystem Service Site-Based Assessment
UQ	University of Queensland
USD	US Dollar
VW	Village Woodlots
WW	WaterWorld

CHAPTER 1

1.1 INTRODUCTION

Landscape interventions in restoration and conservation, along with the development of economic sectors, must follow a holistic approach that takes into consideration one connected natural, social, and economic environment. Many actions transcend sectoral disciplines and their consequences are inter-connected across ecosystems. Beyond the importance of economic resources for development, interventions must consider the strong dependency on natural, social, and human resources. Therefore, as part of sustainable landscape interventions it is a requirement to proceed with a priority goal in mind – in this case, the good stewardship of critical inputs for current and future well-being: natural capital, human capital, social capital, and economic capital.

'Green growth' interventions at the landscape level bring together natural, social, human, and economic capital benefits. Green growth interventions promote the efficient use of natural resources, the minimization of environmental impacts, resilience in natural disasters, and encourages inclusive and equitable development while building strong economies. For this, policy reforms and finance mobilization have been identified as necessary instruments for speeding up efficient resource management, innovation, and growth. The need for an analytical framework that considers the impacts of capitals as a part of landscape interventions, while facilitating the analysis and design of policy and financial mechanisms, has led to the development of what we will from now on call: the 3Returns Framework for landscape intervention; a facilitating method for decision-making.

1.2 OBJECTIVES

The 3Returns Framework presents a new approach for the assessment of sustainable landscape interventions. This new approach provides decision makers with a structured process that allows benefits to be compared against the resources required for a green growth landscape intervention. The goal of this framework is to facilitate the formulation of policies, the design of financial instruments, the efficient allocation of resources, and the identification of best practices for sustainable landscape interventions.

This document addresses the importance of capitals for green growth and defines landscape interventions as an investment in capitals. The document demonstrates the distinction between monetary and non-monetary benefits from capital impacts, highlighting the importance of analyzing monetary benefits as returns on investment in capitals. Chapter 2 of this document builds the fundamentals for introducing the 3Returns Framework as an attractive approach for landscape assessment.Expanding on the fundamentals of green interventions in landscapes, the document explains, step by step, the 3Returns Framework approach for landscape assessment through Chapter 3. The objective of the framework is to assist a standardized approach for the assessment of landscape interventions. For this, this chapter presents a list of recommended tools and methodologies, together with examples that demonstrate the value of following the 3Returns Framework approach during landscape assessment.

Chapter 4 presents an example of a landscape assessment following the 3Returns Framework conducted in Myanmar. The Coastal Landscape Restoration Project in the Ayeyarwady Delta, Myanmar, conducted a 3Returns Assessment in order to define recommended policies, resource allocation, and improved practices. Its application demonstrated the benefit of the 3Returns Framework approach at the time of decision making. Finally, Chapter 5 shares key points of the 3Returns Framework and lessons learned.

CHAPTER 2

2.1 GREEN GROWTH

Uncontrolled and excessive resource exploitation, drastic land use change, and loss of natural habitats have drastically and negatively affected the environmental, socio-economic, and health conditions of the current global population. The 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report states: "Nature is declining globally at rates unprecedented in human history and the rate of species extinctions is accelerating, with grave impacts on people around the world now likely". Regarding human health, according to the World Health Organization, one third of deaths from strokes, lung cancer, and heart disease are due to the effects of air pollution.

In response to this, the need for a transition towards a different economic model that allows for tackling immediate and long-term environmental consequences and challenges has been emphasized. As a result, alternative economic development models have gained traction over the last decade. These include a range of concepts such as green growth.

The Global Green Growth Institute has defined green growth as a development approach that seeks to deliver economic growth that is both environmentally sustainable and socially inclusive. While pursuing a low carbon economy, green growth aims at multiple objectives in economic, environmental, and social dimensions. It considers that issues are interrelated, and that development is culturally and contextually specific. Therefore, key aspects of a green growth agenda are founded in an integrated approach with long-term objectives and local solutions that take into account global issues.

Green growth strives to:

1. Increase the quantity and quality of natural capital and environmental services, as these factors affect productivity and their availability is critical for sustainable economic growth;

2. Increase the productivity of resources that allow for higher growth with the consumption of fewer resources;

3. Develop new green technologies, or promote the innovative application of existing green technologies, as innovation is a key driver of economic growth;

4. Focus on the removal of market failures as barriers to achieving environmental, social, and economic goals; therefore, contributing to more efficient resource allocation; and

5. Pursue an inclusive and participatory approach that benefits those that rely heavily on natural resources and are the most vulnerable to the impacts of climate change.

2.2 CAPITALS, DIFFERENT PERSPECTIVES AND DEFINITIONS

Economically speaking, the concept of capital means any stock or asset from which a flow of benefits is derived (GGKP, 2020). The common interpretation of capital has been linked to the assets needed to provide goods or services, as measured in terms of monetary value. In other words, capital has been referred to only as what is known as 'Financial Capital'. However, the identification of benefits from natural and social assets has extended the concept of capital to different areas. Yet, and due to different purposes and objectives, the identification of multiple capitals has resulted in numerous definitions and interpretations promoted by individuals and organizations that have recognized the value in identifying them.

The Four-Capital Model of Wealth Creation was first developed by Ekins (1992) and includes four capital stocks: ecological (natural) capital, human capital, social and organizational capital, and manufactured capital. Manufactured capital refers to material goods, such as tools or buildings that contribute to the production process and are utilized for a long period of time, typically more than a year. Human capital relates to the individual's capacity for work, such as knowledge, skills, and health. Social and organizational capital refers to shared norms and values, networks and organizations that enable the coordination and mobilization of individuals' contributions. Ecological capital provides three types of environmental functions: the provision of resources for production, such as raw materials; the absorption of wastes that come from the production process and the disposal of consumptive materials; and most importantly, basic environmental services, which include 'survival services' such as climate and ecosystem stability, and 'amenities services' such as the beauty of natural landscapes. All of these capital stocks produce a flow of services that become valuable inputs to the productive process. Benefits of capital stocks, although difficult to assign a monetary value, can be improved through investments, which translate into an addition or improvement in capital stocks (GGKP, 2020).

According to the four-capital model of wealth creation developed by Ekins (1992) and further elaborated in Ekins (2000), capitals can only be identified as such from the flows of benefits to which they give rise. When monetization of benefits is possible, the value of the capital stock from which they are derived is simply the NPV of the flow of benefits over time. Benefits are not less real if they cannot be valued, although in this case the capital stock that gives rise to them will need to be described or quantified in a different way. It is likely that through this evaluation certain benefits, especially from social, human, and natural capital stocks, will be difficult or impossible to be given a monetary value. This, however, does not make it impossible to identify the benefits arising from an improvement in capital stocks. According to Ekins (2000), the term 'investment' in capitals represents an addition to the capital stocks, even with the limitation of monetizing all of the benefits (GGKP, 2020).

The Organization for Economic Co-operation and Development (OECD)'s **How's Life? 2015: Measuring Well-being**, focuses its attention on the key resources that influence the outcomes of future well-being. In other words, its measurement framework looks at the factors that support and shape future well-being, as well as their outcomes. Four types of resources, or capitals, are introduced, namely natural, human, social, and economic capitals. Natural capital refers to both individual assets such as land, water, minerals, etc., as well as the broader ecosystem from the natural environment, which are central to human capital through the provision of natural assets. Human capital is usually considered as an essential input to economic production, but there are also non-monetary benefits that are crucial for development, such as healthy physical and mental status, enhanced education capacity, social relationships, and the overall well-being of the individual and society (OECD, 2011). Education and skills, unemployment, and health conditions are indicators relevant to both current and future well-being, as they have the potential to contribute to both the growth and health of a society as well as being risk factors for human capital (OECD, 2015). The OECD also focuses on social capital, which is based on the interpretations of Scrivens and Smith (2013) – personal relationships; civic engagement; social network support; and trust and cooperative norms – due to its consistency with the measurements of sustainable development recommended by the Conference of European Statisticians (UNECE, 2014). Both emphasize trust and cooperative norms, along with the role of institutions in social capital. Social capital is vital for sustaining well-being over time because trust and cooperative norms enable collective action which in turn promotes efficient allocation and maintenance of human, natural, and economic capital. Economic capital refers to both produced capital (tangible assets and knowledge assets) and financial capital (various financial assets that may represent claims on produced capital) (OECD, 2015).

The United Nation's Inclusive Wealth Index (IWI) has calculations for three categories of capital – manufactured (physical, produced), human, and natural capital. Based on classical, neoclassical, and mainstream economics, along with sustainable resources of well-being, the IWI narrowed down the score of capital assets related to current and future well-being of humans. The IWI measures the inclusive wealth – the sum of the three types of capitals – to overcome the shortcomings of gross domestic product (GDP) as a measure of social well-being. Manufactured (physical, produced) capital includes all of the physical capitals produced by humans such as automobiles, buildings, and other physical infrastructures. Human capital consists of a country's stock of knowledge and skills attained through education, along with a healthy population, which can be invested in through better education, training, and health. Natural capital, classified into renewable resources and non-renewable resources, is the stock of natural assets, ranging from abiotic to biotic components (Managi & Kumar, 2018). Aside from these three categories of capitals, unconventional capitals known as the enabling assets – knowledge, population, institutions, time – facilitate the functioning of the three capitals to improve social well-being (Dasgupta P., 2015).

The World Bank's Changing Wealth of Nations computes wealth in terms of produced capital, urban land, natural capital, human capital and net foreign assets, but also acknowledges the importance of social capital. Its focus lies primarily on natural capital and human capital, as information referring to produced capital, urban land use, and net foreign assets has already been explored and is available through various institutions. The four asset categories provide the wealth estimates used in the World Bank's Changing Wealth of Nations. Produced capital and urban land include machinery, buildings, equipment, and residential and non-residential urban land, measured at market prices. Natural capital is comprised of energy (oil, gas, hard and soft coal) and minerals (10 categories), agricultural land (cropland and pastureland), forests (timber and some non-timber forest products), and terrestrial protected areas. Natural capital is measured as the discounted sum of the value of the rents generated over the lifetime of the asset. Human capital, estimated by gender and employment status, is measured as the discounted value of earnings over a person's lifetime. Net foreign assets are the sum of a country's external assets and liabilities such as foreign direct investment and reserve assets. Social capital, commonly measuring "social trust" as a key indicator, is also considered important due to its role in facilitating economic activity and increasing well-being through cooperative behaviour among groups. An important take from the World Bank's Changing Wealth of Nations is that it calculates comprehensive wealth by adding the estimates of the four assets of wealth as, for the first time, explicit estimates of human capital are provided. The expected earnings of the labour force to measure human capital are a measure that is consistent with the concept of capital used for other assets (Lange & et al., 2018).

The literature review surrounding capitals demonstrates that even similar capitals have numerous definitions, depending on the approach, objective, and the intended use. Currently, there is no consensus on the definition or common standards when defining capitals. However, most of the classifications of capitals identify and define four capitals that interactively enable the environment where humans interact and gain benefits. Capitals, regardless of their intended use and considering the definitions above, can be grouped as follows: **natural** (ecological) **capital**, **human capital**, **social** (and organizational) **capital**, and **economic** (manufactured/produced) **capital**. These capitals form an essential part of the complex ecosystem that frames human well-being, making them a necessary and integral part of the consideration of sustainable, or green, assessments. Furthermore, their consideration becomes crucial when analyzing the impacts, benefits, and potential trade-offs of differing interventions.

2.3 CAPITALS' BENEFITS

Sustained economic growth has been the major driver of poverty reduction and human development. However, sustaining economic growth under the existing model has become a serious concern for future well-being. Growth has come at the expense of the unsustainable use of resources and substantial negative impacts on the environment. The progress made in tackling global poverty and development is now threatened by the consequences of negative environmental impacts. Climate change, biodiversity loss, the unsustainable management of water resources, and the health impacts of pollution and hazardous chemicals, are among the most urgent challenges for both OECD and non-OECD countries (OECD, 2008). Population growth and demands for increases in global socioeconomic statuses have heightened the need for a rapid transition to greener and more sustainable models of growth.

In the context of natural landscapes, different initiatives have attempted to combine natural resource management, climate change, social inclusion, and economic development as a way of moving away from the traditional model, based solely on economic drivers. Fortunately, some of these initiatives have been able to demonstrate positive synergies between healthy ecosystems, social inclusion, and productivity improvement. More so, interventions that consider social, human, and natural aspects, in addition to financial capital, have been reported to outweigh the benefits of a single economic approach.

Let us take the example of agricultural practices and initiatives that aim to improve the integration of agricultural development with challenges currently faced within the sector. Agriculture is a high-risk business, especially in the developing world where farmers face unfavourable conditions such as degraded land and a lack of access to high quality inputs for production. Furthermore, climate change has placed a new and increased stress on the management of natural resources required for food production. As a way of achieving food security and broader development goals under a changing climate, and increasing food demands, the concept of Climate-Smart Agriculture (CSA) has been developed as an answer to sustainably increase productivity, enhance resilience, and reduce, or remove, greenhouse gases (GHGs). A collaborative effort by CIAT[1], CCAFS[2], the World Bank, and DFID[3], has identified more than 1,700 unique combinations of production systems, regions, and technologies in the realm of potential CSA practices. However, only a few of these have demonstrated synergies between the pillars of productivity, adaptation, and mitigation. Based on a climate-smart assessment score, certain CSA practices and technologies proved to have combined benefits expressed in increased yield and income, enhanced water quality and use efficiency, improved soil health, and greater knowledge for climate risk management and diversification. They also showed a positive impact in gender inclusion, as well as carbon sequestration, and an improvement in nutrient use efficiency (Baedeker, Grosjean, & Girvetz, 2018). These increases in benefits, derived from the application of certain CSA practices, can be considered a result of an increase in capital stocks or assets. However, these increases in benefits not only come from access to new technological assets, but also from the increase in human and social assets (knowledge and inclusiveness), along with increased natural assets. In other words, an increase in economic, natural, social, and human capital.

In the fishery sector, community-based fishery management (CBFM) has been one of the most promising approaches for securing sustainable small-scale fisheries as a response to a perceived decline in marine resources. CBFM emerged in the 1980s as an alternative to government-led or private protection approaches to marine resource management. This approach is characterized by leaving the resource management authority to local communities, allowing local fishery governance, and often involving community partnership with governmental and non-governmental institutions. Three observed CBFM outcomes have been documented in published literature: 1) sustained resource management institutions; 2) equity in decision-making; and 3) increased marine biomass inside the management areas. Yet, empirical evidence suggests that outcomes from CBFM for people and ecosystems are mixed, with an inadequate understanding of the factors that influence successful CBFM outcomes. As an effort to understand the drivers that influence CBFM outcomes, Blythe et al. (2017) used Elinor Ostrom's social-ecological systems (SES) framework for post-hoc diagnosis in an eight-year CBFM project in five Solomon Island villages. Results suggest that successful CBFM outcomes were facilitated by effective information sharing, harvesting rules that merge traditional and contemporary practices, strong leadership, and resource monitoring. The study highlights that successful outcomes were characterized by the implementation of fishing restrictions in resource management plans, the inclusion of new voices in resource management, and an increase in the catch rates within the managed areas, suggesting increases in marine biomass (Blythe & et al., 2017). In other words, benefits from improved social and human resources were not only

1 International Center for Tropical Agriculture.

2 CGIAR Research Program on Climate Change, Agriculture and Food Security.

3 UK's Government's Department for International Development.

reflected in an improved governance system, they were also reflected by an increase in marine resources supporting people's economic activities. CBFM shows potential as an intervention of social and human capital, facilitating inclusive institutions by effective information sharing, harmoniously merging traditional and contemporary practices, and enhancing participation and leadership.

Deforestation and forest degradation caused by illegal logging, especially timber in tropical forests, as well as subsistence agriculture and urbanization, have posed serious threats to future well-being and sustainability. Putra, et al. (2018) investigated community-based sustainable forest management (CBSFM) certification systems implemented in the Kedung Keris Village, Indonesia, as a mechanism to prevent negative outcomes associated with land use change in forested areas and a way to improve the income of farmers through the sustainable management of forests. The research showed that CBSFM facilitated both ecological and socio-economic benefits to the small forest holders (SFHs) in the Kedung Keris Village, as they were able to perform a more appropriate investment (capacity building, seedling procurement, land preparation, maintenance cost, etc.) for sustainable management through CBSFM. As a result, timber prices increased between 10.68%-14.09% and the annual revenue exhibited a continuous rise. Meanwhile, the CBSFM system also brought other benefits, such as improved quality and quantity of water supply, erosion and flood control, and an increase in biodiversity. Furthermore, CBSFM not only improved the knowledge of SFHs in tree measurement, silviculture, timber marketing, erosion control, and other forest management activities; it also created awareness regarding the sustainable management of forests and increased gender equality in the decision-making process. As the case shows, CBSFM has the potential to bring monetary and non-monetary benefits from improved social and human assets as well as support people's economic activities from an increase in natural resources.

As heavy forest exploitation causes severe depletion of natural capital and degrades forest ecosystem services, balancing the provision of forest products and the management of forest ecosystem services (regulating, supporting, and cultural services) is becoming one of the major challenges in forest farming communities. Zheng, et al. (2019) report results of two different scenarios in the Ecosystem Function Conservation Area of Hainan Island, where the expansion of rubber plantations has caused a major loss of natural forests. One scenario looked at monoculture rubber plantations [Business as Usual (BaU)] and the other scenario was focused on intercropped rubber plantations (Green Intervention). By comparing both, the research found that utilizing intercropping in rubber plantations allows for greater economic income while improving ecosystem services. There was no significant difference in investment cost between monoculture rubber plantations ($149.40/ha-yr) and intercropped rubber plantations ($181.30/ha-yr); however, income from intercropped rubber plantations ($3,957/ha-yr) was more than double the income from monoculture rubber plantations ($1,696/ha-yr). Meanwhile, intercropping within plantations also contributed to decreases in splash soil erosion, increases of water use efficiency in drought seasons, improvement of water, soil and nutrient retention, improved flood mitigation, and increased biodiversity. Furthermore, adopting intercropping within plantations increased knowledge capacity (e.g. adopting additional marketable crops or other products), which allowed farmers to achieve a more stable income through crop diversification and risk management (Zheng, et al., 2019). Therefore, green interventions (capacity building) – in this case, intercropping within rubber plantations – not only generated extra economic income, but also improved natural capital.

For many developing nations, not only is coffee an integral part of people's lives, it is also an invaluable commodity of outstanding export importance. For coffee production regions, the quantity and quality of the coffee produced is highly influenced by pollination services. However, increases in tropical deforestation and forest degradation are disturbing pollination services, which poses a severe threat in maintaining sustainable coffee production. According to a study done in Valle General, Costa Rica, investment in conserving forest patches surrounding coffee plantations resulted in biodiversity conservation, as well as in better quantity and quality of coffee yields (Ricketts H. Taylor, 2004). Preserved tropical forest fragments within 1km distance from the coffee plantation increased pollination services to the plantations, which resulted in 20% higher coffee yields and reduced misshapen product (peaberries) by 27%. Furthermore, they found that over USD 60,000/year of additional income could be attributed to pollination services for one single farm (480ha), which was generated by investing in nearby forest fragments (46ha and 111ha). The experiment reflected that through green interventions – conservation of two major neighboring forest patches within 1km – income increased to $747.125/ha/year. On the other hand, farms deprived of the benefits of pollination (BaU) only acquired a revenue of $618.55/ha/year. Therefore, conservation investment on forest patches, or investment in what is defined as natural capital, created tangible monetary benefits.

Globally, agricultural intensification diminishes clusters of forest patches on farmlands, making them more vulnerable to infestations of pests. In coffee plantations, for example, pests such as the coffee berry borer beetle *(Hypothenemus hampei)*, became difficult to control, leading to increased costs regarding pest management, and reducing revenue from agriculture. Karp, et al. (2013) quantified bird-mediated pest management services from conserving forest elements on farmland by providing habitat for borer-consuming birds in southern Costa Rica. The study showed that additional annual revenue of USD 75-310/ha/year was generated as a result of maintaining forest patches on farmland, which supported predation through birds within the coffee plantation. Retaining forest patches increased bird-mediated pest control services by twofold, which saved on average 2-4% of coffee berries. Furthermore, coffee farmers benefited from 99% of the total pest-control services from forest patches blended with farmland (Karp, et al., 2013). The study presents forest conservation activities as an intervention that results in both, monetary and non-monetary benefits derived from improved natural capital. Ultimately, interventions following conservation activities provide a win-win for biodiversity and farmers' livelihoods.

The examples above present the case in which the improvement of resource or capital stocks has provided greater monetary and non-monetary benefits, proving that interventions that consider not only economic drivers, but also natural, social, and human aspects increase the total flow of benefits. Even more, comparing the increase of benefits with the resources required for the interventions, capitals' replenishment and improvement not only proves to have positive returns, it also provides greater and more attractive returns when comparing to BaU activities. In other words, interventions through these capitals supports Ekins (2000) statement about 'investing' in capitals, as they result in greater monetary and non-monetary benefits. The case studies presented in this section builds the importance of considering more than just economic resources or economic capital; they demonstrate how the improvement of natural, social, and human capital provides a greater flow of benefits, supporting their definition as capitals and the case for the investment in capitals.

2.4 CONNECTING GREEN GROWTH, CAPITALS, AND CAPITALS' BENEFITS

Following the goal of green growth and the four capitals that frame the key elements that ensure quality of life and material conditions, green growth at the landscape level aims to bring together natural, social, human, and economic capital benefits in order to support and shape current, and future, well-being. For this, green growth landscape interventions can be interpreted as a simultaneous increase in the stock of capitals in order to improve the benefits which they give rise to. Taking Ekins' (2000) definition of 'investment' as an addition to capital stocks, even with the limitation of monetizing all the benefits, green growth interventions can be considered as an investment in capitals, which bring together monetizable and non-monetizable benefits. Given the capacity to monetize some of these benefits, the profit obtained from an investment in capitals can be expressed as returns on investment.

Following this logic, and based on the nature of green growth interventions in landscapes, the 3Returns Framework builds on the consideration of landscape interventions as:

Investment in Natural Capital: resources allocated to increase the stocks of natural assets;

Investment in Social & Human Capital: resources allocated to increase cooperation within and among groups, individual and collective knowledge, skills, and competencies; while building/strengthening institutions for resource management, decision making, and social integration; and

Investment in Financial Capital: resources allocated to acquire or increase the assets needed in order to provide goods or services. (The financial capital is part of the economic capital).

Building the fundamentals of the 3Returns Framework, green growth interventions for landscapes would imply investing in natural, social & human, and financial capital, which in turn will result in an increase in benefits, while simultaneously leading to the preservation of the resources required for current and future well-being (economic, natural, social, and human capital stocks). It is important to highlight that the monetizable benefits from interventions support the computation of profitable (NPV) and efficiency (ROI) measures, while non-monetizable benefits, which are difficult or impossible to give a monetary value, reflect the changes in important aspects that allow for the support of green growth interventions.

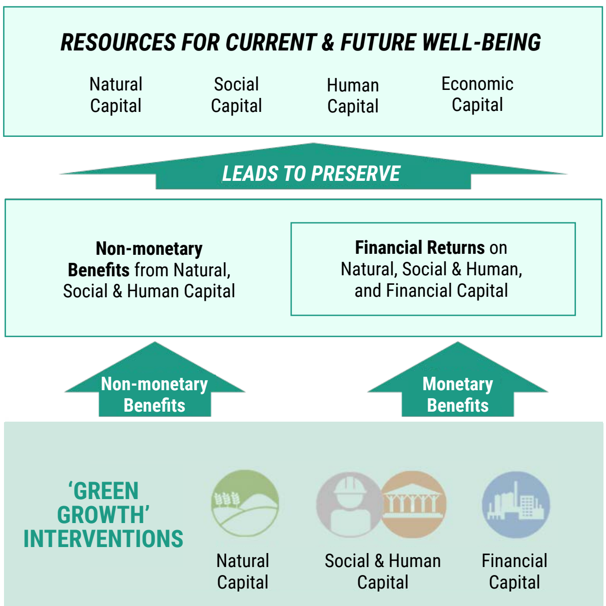

Figure 1. Green growth landscape intervention as an investment in capitals.

The 3Returns Framework has been designed with the goal to simultaneously serve multiple decision makers, including government entities, communities, and the private sector, directly and indirectly involved and that interact in a certain natural environment. Consequently, the fundamentals of the 3Returns Framework emphasize the importance of considering monetary and non-monetary benefits in the process of decision making. Overall, the identification of benefits allows stakeholders to determine if the benefits from investments outweigh the resources required to intervene, which is fundamental information when deciding upon a course of action. It also facilitates the identification of the most efficient interventions, based on the comparison of the resources required and the total benefits from a range of available options.

Showing financial returns and non-monetary benefits to private, public, national, and international financial institutions aims to enable the allocation of funding by demonstrating how green growth interventions can impact economic activities and improve long-term returns. Pinpointing monetary and non-monetary benefits to impact investors captures the attention of economic actors interested in sustainable, long-term, and impact investment projects. The identification of both types of benefits can also facilitate the development of responsible trade agreements between the commercial sector and the productive and extractive sectors. Securing the production and extraction of commodities in the long run decreases the risk from the supply side and promotes formal agreements.

Analyzing monetary benefits, but also non-monetary benefits, should be considered when developing market and policy instruments. Their consideration facilitates designing financial and regulatory frameworks for resource mobilization and risk reduction. Following the proposed capitals' assessment approach, the identification of valuable assets permits for designing insurance or other market-based systems. Furthermore, taking into consideration non-monetary benefits, allows for the understanding of the potential tradeoffs from certain market driven actions. The acknowledgment of monetary and non-monetary benefits is crucial for key public institutions (in charge of resource allocation and implementation of mechanisms for resource collection) when identifying efficient investment channels for securing capitals. It allows public institutions to identify the need for changing or implementing incentives to protect capitals, or to compensate for damages caused to them.

Besides the importance of accounting for monetary and non-monetary benefits for different stakeholders, the 3Returns Framework also presents a different approach when considering the expenditures for intended interventions. In the context of landscape interventions, expenses associated with sustainable production, restoration, landscape management, capacity building, etc., have historically been treated as additional operational expenses (OPEX) rather than an integrated and detailed section of the financial analyses. Additionally, the identification and characterization of capitals, as presented in this document, leads to the reconsideration of the categorization of certain expenses. In other words, the identification of benefits and the increase in benefits from investment in capitals requires the recategorization of certain operational expenses into capital expenses (CAPEX). This recategorization not only implies a new way of expressing expenditures, but also a new way of interpreting and analyzing certain financial indicators. For instance, ROI has classically been recorded as a consideration of only the physical assets required for providing products and services in a project. The ROI in the 3Returns Framework considers the investment in natural, social & human, and physical assets required for a functioning and sustainable project within a landscape. This new analysis and interpretation of this financial indicator also allows for the comparison of what would happen in a landscape without intervention as well as with differing interventions as investments in one or more capitals. In fact, following the 3Returns will allow for more clearly defining and identifying green growth interventions for sustainable landscapes.

CHAPTER 3

3.1 THE 3RETURNS FRAMEWORK, STEP-BY-STEP

The 3Returns Framework aims to provide stakeholders with guidance to define the appropriate scope needed to proceed with a landscape or project assessment following the fundamentals of the 3Returns Framework. Additionally, it presents the mechanisms to determine whether the benefits outweigh the required resources for potential interventions, going through recommended indicators and an analytical approach that supports identifying efficient actions and potential trade-offs from their application. The 3Returns Framework presents a range of recommended tools and results interpretation suggestions, considering the importance of each of them for different stakeholders.

An assessment, following the 3Returns Framework, aims to result in key information required for policy design, the design of innovative financial instruments, efficient resource allocation, and a baseline for project investment. Having this information available facilitates decision making towards a green growth model for sustainable landscapes. The table below summarizes the reasons, considering different stakeholders' interests, for utilizing the 3Returns Framework.

Table 1. Reasons for utilizing the 3Returns Framework for landscape assessment.[4]

Reasons for a 3Returns Assessment	Main Audience
Public/Policy Support	
Provide evidence and justification for the importance of conserving and properly managing capitals in a particular site	Government agencies, policy and decision makers, local stakeholders, businesses, donors
Foster local awareness of the capital benefits provided by a particular site	Local communities, indigenous and traditional people, local decision makers
Build support for restoration, conservation and sustainable development of multiple sites through increased understanding of their wide range of benefits	Government agencies and ministries, civil society
Link capitals' contributions to international or national sustainability goals and national policies (e.g. Sustainable Development Goals)	Government, international community
Site Management and Planning	
Support spatial and strategic conservation, restoration, and investment planning by identified areas of particular interest	Government agencies, conservation organizations, donors
Assess potential consequences of different sectoral (e.g. forestry, agriculture, livestock) decisions and policies on capitals' benefits	Government agencies and ministries, businesses, landowners, resource rights holders, local communities, multilateral financial institutions
Assess potential consequences of climate change, understanding capitals' implications and allowing for the analysis of resilience mechanisms	Government agencies and ministries, conservation organizations, landowners, Indigenous and traditional people, businesses, communities living in or near a site, site managers
Establish the baseline of capitals and capitals' benefits by a site enabling monitoring of changes and support management planning	Site managers and others responsible for monitoring sites
Reveal synergies and possible trade-offs between capitals and/or capitals and conservation and restoration objectives, identifying management options for the site and defining better objectives	Site managers, local stakeholders
Develop, implement and update management strategies for the site, building on the understanding of capitals' benefits	Site managers, local communities, Indigenous and traditional people, conservation organizations, businesses

4 Adapted from "Tools for measuring, modelling, and valuing ecosystem services: Guidance for Key Biodiversity Areas, natural World Heritages Sites, and protected areas", by Neugarten, R., et al., 2018, IUCN.

Funding and Investment	
Attract government and donor investment from other sectors concerned and interested with conservation, restoration, and sustainable development	Government ministries, development agencies and organizations
Assess the feasibility of economic activities' projections	Commercial banks, multilateral development banks
Support the development of new sustainable finance mechanisms for conservation of the sites (e.g. Payment for Ecosystem Services (PES) or carbon financing such as Reduced Emissions from Deforestation and Forest Degradation (REDD+))	Businesses, public and private investors, government agencies, conservation organizations, local communities
Assess compensation options and insurance mechanisms for conservation and restoration efforts	Government agencies, development agencies, landscape managers, communities living in or near the site
Knowledge Generation	
Inform research on green growth provided by sites locally, nationally, regionally, or globally	Academics, students, conservation organizations, research organizations
Inform research on capital accounting frameworks; synergies and trade-offs between capitals and sustainable development	Academics, students, conservation organizations, research organizations

The 3Returns Framework emphasizes the importance of considering interventions as an investment in capitals, and quantifying and monetizing the benefits of those actions, to the extent possible. For this, **the framework builds on**, and **puts into operation**, methodologies for natural capital accounting, social & human capital accounting, and Extended Cost-Benefit Analysis[5]. Considering the project level scope for landscapes' assessment, the 3Returns Framework has operationalized the guidance and concepts from the Natural Capital Protocol[6] and Social & Human Capital Protocol[7], decision making frameworks that enable organizations to identify, measure, and value the direct and indirect impacts and dependencies on capitals. (See Table 3 at the end of this chapter).

The 3Returns Framework also suggests tools, especially for measuring, modeling, and valuing ecosystem services[8]; and indicators that capture key elements when analyzing a transition towards green growth models[9].

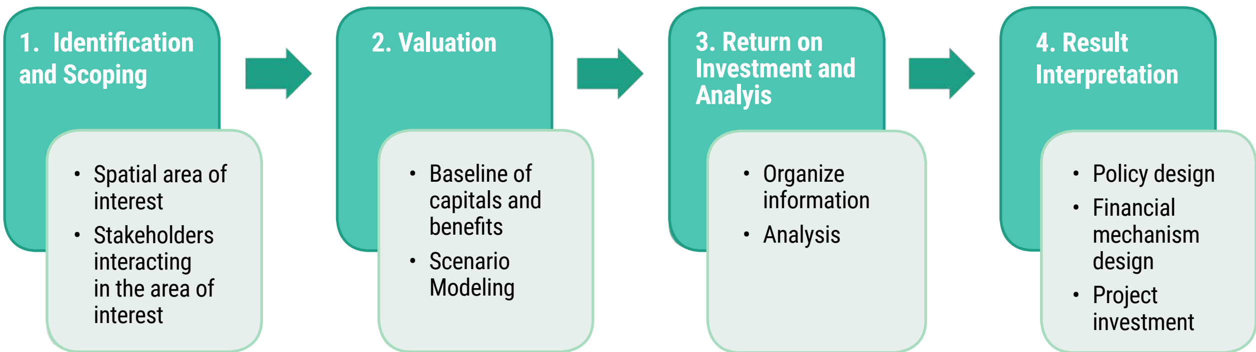

Figure 2. 3Returns Framework Stages

5 Green Growth Assessment & Extended Cost Benefit Analysis: https://gggi.org/site/assets/uploads/2019/01/FINAL-2018-eCBA-Handbook_EN.pdf.
6 Natural Capital Protocol: https://naturalcapitalcoalition.org/natural-capital-protocol.
7 Social and Human Capital Protocol: https://www.social-human-capital.org.
8 Tools for measuring, modeling, and valuing ecosystem services: https://portals.iucn.org/library/sites/library/files/documents/PAG-028-En.pdf.
9 GGGI Strategy 2030 – A Low-Carbon, Resilient World of Strong, Inclusive, and Sustainable Growth,

3.1.1 Identification and Scoping

The 3Returns Framework recognizes that the interactions of all of the capitals must take place within the constraints of the environmental boundaries of natural capital. Therefore, 3Returns assessments for differing ecological landscapes and targeted project assessments need to first, **define the spatial area** of interest. This is required in order to better quantify and assess the potential impacts of current practices and green interventions; as well as the stakeholders, resources, and institutions interacting in the precise location. Identifying the spatial area of interest and its boundaries is needed for quantitative and monetary valuation, assessment of degradation and improvement, and understanding how stakeholders are affected and benefited by their multiple interactions. Considering the 3Returns assessment approach, the 3Returns Framework takes the **spatial boundary only to the scope of the landscape or project level**. Yet, the specific scope will depend on the assessor's objectives and interests, value perspective, value-chain boundaries, and other determinant conditions.

Once the precise location has been defined, the clear **identification of stakeholders interacting in the area of interest** is the second step. The stakeholders involved may include a diverse range of actors, from government entities in charge of site management and control, to communities or private companies **directly** involved in the landscapes through ongoing livelihood and economic activities. Stakeholder identification defines the scope of the assessment, guides assessment of relevant capital changes and benefits, provides sources of data, and helps to validate available information and assessment results. It also facilitates the perception of ownership and ensures that the information produced during the assessment process will be accepted by the people, groups, or organizations that will ultimately be responsible for the management of the site. Involvement and relationship establishment with multiple stakeholders is crucial as potential implementable solutions may require their collaborative and inclusive participation.

Considering the interaction and complexity between capitals, stakeholders, and economic activities, **the 3Returns Framework strongly recommends to scope the assessment considering only the first two stages of the value chain, input, and production, from extractive and productive commodity-based sectors**. In other words, the recommended boundary when analyzing economic activities within an area of interest is the extraction and production stages of the primary sector of the economy (which includes agriculture, forestry, and fishing). The assessment may include other stages of the value chain, or secondary and tertiary economic sectors; however, the interaction, impact, and dependency of these activities on capitals should be carefully analyzed in order to consider the complexity of those interactions.

Once the scope of the assessment has been defined and the precise location, relevant stakeholders, and main livelihood and economic activities of interest have been identified, it is important to analyze, based on the spatial circumstances, the relevance of various issues affecting multiple activities and stakeholders. For this, it is necessary to **determine the impacts and dependencies on the capitals**. The following concepts have been taken and adapted from the Natural Capital Protocol and Social & Human Capital Protocol decision making frameworks.

Impact Driver: measurable quantity of a natural, social & human, and financial resource that is used as an input for an activity, or a measurable output of an activity/event.

Impact: persistent change, in the quantity or quality of capitals, that occurs as a consequence of an impact driver. A single impact driver may be associated with multiple impacts.

Impact Pathway: an impact pathway has three generic steps: the impact driver, the change in capitals caused by the impact driver (sometimes called outcomes), and the impacts that result from the change in capitals. An impact pathway describes how, as a result of a specific activity, a particular impact driver results in changes in capitals and how these changes impact different stakeholders.

Dependency Pathway: a dependency pathway shows how a particular activity depends upon specific features of capitals. It identifies, for example, how observed or potential changes in capitals affect the costs and benefits of productive and extractive economic systems.

Depending on the scope of the assessment, the extent of the impacts and dependencies needs to be taken into account, both in the present and the future context. Listing impacts and dependencies relevant to the assessment is necessary in order to focus on the valuation efforts. Since stakeholders may have different interests regarding the assessment, the following examples demonstrate how capital impacts and dependencies may be considered.

Natural capital impacts can include changes in land use, biodiversity, soil, water and air quality, degradation status, and erosion status, among others. Dependencies on natural capital may include general stakeholders' benefits (e.g. protection), production and extractive yields, and new or additional costs for these sectors and general stakeholders within a landscape. To investigate potential impacts and/or dependencies commonly analyzed, the Final Ecosystem Goods and Services Classification[10] provides a guidance to build the understanding

10 Final Ecosystem Goods and Services Classification System (FEGS-CS): https://www.epa.gov/eco-research/final-ecosystem-goods-and-services-classification-system.

of which potential impacts and dependencies are important to measure according to different stakeholders.

Social and human capital impacts can include creation or destruction of institutions, as well as changes in knowledge, capabilities, and cultural heritage. Dependencies of social and human capital include the availability of a skilled, engaged, responsible, healthy, and organized population, information sharing, and an inclusive environment.

Financial capital impacts include the increase in assets for providing goods and services. Dependencies on financial capital include yields and changes in production costs and prices.

To assess impacts and dependencies following the 3Returns Framework, it is required to map the activities against the identified impacts and dependencies. For this, relevant activities associated with the assessment scope need to be identified. Once mapping the activities is completed, which **impact driver and dependency** will be measured can be defined following a materiality assessment.

Box 1. Materiality and Materiality Assessment

An impact or dependency on a capital is **material** if consideration of its value, as part of the set of information used for decision making, has the potential to alter that decision. Consequently, a materiality assessment allows for distinguishing the relevance and significance of considering an impact driver and/or dependency. A materiality assessment can be based in the following criteria:

Operational – the extent to which capitals' impacts and/or dependencies may be significantly affected with or without the execution of an activity.

Legal and regulatory – the extent to which a legal process or implication may be caused by capitals' impacts and/or dependencies.

Financing – the extent to which the access of financing may be influenced by capitals' impacts and/or dependencies.

(Adapted from Natural Capital Coalition 2016 and Social & Human Capital Coalition 2019).

Besides the materiality assessment, it is also important to choose impact drivers and dependencies that meet the assessment needs and stakeholders' interests. Selecting the right ones requires careful consideration, as they may be used to track capitals' performance over time, or for comparison across different projects and scenarios. Their selection will also depend on data availability and the initial understanding of interactions within the scope of the assessment, which are a fundamental precursor to efficiently complete the assessment.

By the end of the **identification phase**, the assessor should have already defined the scope of the assessment by clearly identifying the spatial area of interest, the stakeholders to be considered, and a list of material impact drivers and dependencies associated with current activities and intended interventions. After considering data availability and gaps, a valuation process is required to define a baseline to which changes in capitals and their benefits will be able to be modeled and analyzed, reflecting the advantages of a green intervention.

Box 2. The Myanmar Mangrove 3Returns Restoration Case in Chapter 4 presents a clear example of the criteria utilized for defining the spatial area, stakeholders, impacts, and the dependencies in capitals.

The identification phase strictly depends on the landscape that is a part of the analysis; therefore, it is recommended that this phase is led by a clear and holistic understanding of the landscape situation and the main forces shaping changes in capitals.

3.1.2 Valuation

The second phase requires the **definition of a baseline for capitals and benefits** as a first step. Through this, the 3Returns assessment determines a starting point, or benchmark, to analyze potential changes in capitals' stocks and flows. Based on the baseline, changes in capitals attributed to different activities within the landscape can be compared. Therefore, an explicit baseline is recommended as it will enable the drawing of meaningful conclusions. Defining the baseline requires a process of capitals' valuation, determining the importance, worth, or usefulness of them within a particular context. Therefore, understanding the social, environmental, and economic context is essential to meaningfully estimate the value of capitals and their benefits.

The valuation process will depend on the ***identification*** stage, specifically on the scope of the assessment, and on the impact drivers and dependencies to be assessed. Despite the variability of the valuation process, based on selecting context specific determinants, the 3Returns valuation process requires incorporating two types of values. ***Social Value***, which will determine relevant outcomes for society in general; assessing the vulnerability to natural and social risks caused by human activities or caused by natural forces. And ***Economic Value***, which will determine how capitals' impacts affect, positively or negatively, the financial performance of economic activities.

Therefore, the selection of indicators to value capitals' stocks and flows requires the consideration of the need to reflect these two values during the valuation process. For this, each indicator may require an appropriate valuation technique in order to value capitals as "stocks", and the benefits that are derived from them. In physical terms, "stocks" refer to the total quantity and quality of assets at a given point in time, such as the volume of standing trees in a given area. In monetary terms, capital benefits refer to the monetary inflows, or savings inferred from capital stocks, such as the revenue from economic activities based on timber (***Economic Value***), or economic savings from flood protection from standing trees (***Social Value***). A quantitative valuation of capital stocks will facilitate a monetary valuation of capitals' benefits; however, not all quantitative capital stock valuation will be able to derive a monetary valuation of capitals' benefits.

Box 3. Valuation Technique

The valuation techniques applied will depend on the time and resources available. There may be trade-offs between different valuation techniques in terms of their precision, time, and cost. Furthermore, all valuation methods have their advantages and disadvantages and, generally speaking, a sequential, pragmatic approach for estimating capitals' stocks and benefits.

Based on key elements that capture the transition towards green growth models, and available tools, especially for measuring, modeling, and valuing ecosystem services; the 3Returns Framework recommends the following indicators to be quantified and monetized in order to essentially capture both, social, and economic value, while reflecting the impact of BaU activities and green interventions.

Quantitative Indicators:

Natural Capital and Economic Activity Indicators:

Land Use Area: quantify the estimated land use area in hectares based on the classification of Land Use, Irrigation and Agricultural Practices by the Food and Agriculture Organization of the United Nations[11]. This quantitative indicator will facilitate the monetary valuation process for quantifying social and economic values.

GHG emissions: quantify the GHG emission estimates in carbon dioxide equivalent terms (CO_2e). The 3Returns Framework recommends for this indicator the Ex-Ante Carbon-balance Tool[12]. This tool is an appraisal system developed by FAO which provides estimates of the impact of agriculture, forestry and fishery development projects, programmes and policies on the carbon-balance. The tool also allows comparison between impacts of potential interventions and a business-as-usual scenario. (See Annex 1).

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11 Land Use, Irrigation and Agricultural Practices – Definitions according to FAO category system. Published in FAOSTAT by FAO, last updated November 2017 (See *ANNEX 1*).

12 EX-Ante Carbon Balance Tool (EX-ACT): http://www.fao.org/tc/exact/ex-act-home/en/.

Social & Human Capital Indicators:

Jobs and green jobs: quantify the estimates of jobs and green jobs in terms of number of jobs (consider only full-time jobs or full-time equivalent jobs). The number of jobs is strongly linked with the valuation of economic activities as part of the operational expenditures. However, not all the jobs within the economic activities identified qualify as green jobs.[13] The quantification of both indicators becomes crucial as a measure for comparison between intervention and no intervention or between different interventions (See *Annex 1*).

Enhanced adaptation: quantify the estimated number of people supported to cope with the effects of climate change. For this indicator, only direct beneficiaries are recommended to be considered. Direct beneficiaries are defined as households or individuals that directly receive and/or shape the outcome of a given intervention (See *Annex 1*).

Participation in collective decision-making organizations: quantify the estimated percentage of people participating in a formal organization either created based on their economic activity, social condition, or both.

Monetary Indicators:

Economic value of productive and extractive sectors: monetize the estimated annual benefits and costs from productive sectors such as agriculture, aquaculture, livestock and forestry; and extractive sectors such as fishery. The quantification of land use area supports the monetization of economic activities if its complemented with production yields, commodity prices and costs of production.

Social and economic value of ecosystem services: monetize the estimated annual social value (e.g. hazard mitigation) and economic value (e.g. pesticide cost avoided) of ecosystem services. For valuing ecosystem services, the document 'Tools for measuring, modeling, and valuing ecosystem services: Guidance for Key Biodiversity Areas, natural World Heritage sites, and protected areas' prepared by OECD, categorizes two types of tools for valuing ecosystem services. The first type consists of written step-by-step tools which are guidance documents with specific measurement protocols, such as Toolkit for Ecosystem Service Site-based Assessment (TESSA) or the Protected Area Benefits Assessment Tool (PA-BAT). The second type are computer-based modeling tools, which are software or web-based tools that enable assessment of one or more sites. Considering the nature of the proposed 3Returns assessments, the computer-based modeling tools are recommended as they can incorporate scenarios, spatial assessment, and economic valuation of ecosystem services and integrate different ecological and economic models to understand and visualize ecosystem services values. For reference, Annex 2 presents the computer-based modeling tools included in the document prepared by the OECD.

Avoiding double counting is a key issue to consider when valuing in monetary terms. This can occur, for example, when intermediate costs or benefits, rather than only final costs or benefits, are assessed. For example, the value of some inputs may already be included in the price of a traded commodity. Therefore, recording both the benefits of the inputs and the commodity traded would be an example of double counting. (See Box 4). This same principle also applies when valuing and considering ecosystem services that affect economic activities. For example, when valuing pollination services, the attributable value of pollination can be already embedded in the value of the final crops produced (yield impact). Therefore, the value of pollination services should not be added to the value of the final crops. Finally, as a measure to avoid double counting the 3Returns Framework recommends organizing the information of the valuation stage following the Return on Investment Analysis structure presented in the following section. Table 15 in Chapter 4 presents an example of information from the baseline valuation process organized following this structure.

Box 4. The Myanmar Mangrove 3Returns Restoration Case in Chapter 4 includes an example of avoiding double counting.

When quantifying the economic activities related to mud crab commerce (one of the main commodities traded in the region), two main actors were identified: crab catchers and crab farmers or fatteners. Crab catchers were trading with crab fatteners (crablets and juveniles) and in markets (adult crabs), meanwhile crab fatteners were just trading in markets (adult crabs). Therefore, when quantifying the economic benefits of crab catchers, only the revenue received from markets was reported in the benefits section, as the revenue received from trading/sourcing crab farmers was already reported through the operational expenditures of the crab farmers. Consequently, benefits of both actors were expressed at the same market level considering the trade of adult crabs.

13 To classify a job as a 'Green Job' requires meeting the ***decent job*** criteria. Decent working should include one or more of the following: (a) adequate monthly wage, (b) work stability and security, (c) occupational hazard level involved, (d) decent working hours, and (e) availability of social protection scheme (e.g. social security). Work that uses child labor and bounded labor do not qualify for decent work. Example sectoral areas in AFOLU that have large green employment creation potential include the following: *Sustainable forestry activities* (tree plantation, forest certification, national voluntary certification) *sustainable production practices* (organic agriculture, bee-keeping, climate smart agricultural practices) *sustainable tourism* (ecotourism).

Scenario Modeling

Once the baseline has been defined and valued according to the indicators chosen, changes in capitals and benefits should be modeled to reflect different storylines describing a possible future. Scenario design and analysis allows stakeholders to understand various possibilities and outcomes between continuing operations as usual and having an intervention through the implementation of different activities, technologies, or through different actors. Considering the approach of the 3Returns, scenario design and analysis must incorporate the intervention and interrelated changes in capitals (natural, social & human, and financial), which allows for the analysis of changes in benefits and the identification of affected stakeholders. For this, **at least two scenarios** should be designed. Data and methods for assessing changes are required for designing and modeling changes in at least two situations:

1. Business as usual, i.e., no intervention
2. Green Growth, i.e., one, or multiple, interventions

Box 5. The Business as Usual Scenario

For some landscapes, it is expected to find some level of pre-existing investment in capitals, such as in production and extraction assets, restoration, or capacity building efforts. In these cases, the 3Returns Framework recommends analyzing them as BaU.

Other landscapes are expected to not have experienced any kind of investment in capitals. In these cases, the 3Returns Framework recommends analyzing these as BaU, but forewarns that the calculation of efficiency measures (i.e. ROI) will not be possible for the BaU and will only be part of the green growth scenario analysis.

The definition and valuation of the baseline, and the identification of relevant impact drivers and dependencies, allows defining the potential changes in natural, social & human, and financial capital and their impact on the benefits to which they give rise. At this point, several considerations, explained in the paragraphs below, should be taken into account when selecting and applying the methodologies to measure changes to the benefits of capitals as a result of impact drivers.

It is essential to note that for a single assessment, multiple modeling methodologies can be applied. Therefore, it is important to identify the required or desired outputs, given that different methods may involve different geographic scopes or use different indicators and metrics. Additionally, depending on the methodology, extreme observations (outliers) or attributed changes in capitals and benefits may be treated in different ways. While a range of methodologies can, and often must, be employed to assess impacts and dependencies, it is important to consider methodological differences and how they will affect the results.

In addition to methodological considerations when measuring changes in the state of capitals, clear distinction needs to be drawn between the multiple actors that contribute to capital changes and the impact drivers affecting the status of the capitals. Of course, these will depend on the materiality assessment done during the identification stage and the perspective of the assessor when conducting the analysis. However, at this point the consideration of actors and impact drivers should be clearly defined, allowing for the specification of the assumptions that will be considered when modeling and analyzing the defined scenarios.

The 3Returns Framework strongly emphasizes the importance and necessity to identify, analyze, and model changes in capitals associated with external factors. Scenario development must take into consideration important external factors (impact drivers) such as climate change and extreme weather events (e.g. flooding, droughts), either naturally produced or human-induced. Changes in capitals associated with climate change and extreme weather conditions result in direct and indirect impacts on commercial and subsistence practices. The consideration and analysis of these changes become crucial when providing adaptation and technological solutions. Understanding the magnitude of those impacts, and which stakeholders will be affected by such changes, increases the ability to assess risks and to respond based on the current resilient opportunities. Once potential external factors that may influence the state of capitals have been identified, determining the trend associated with these factors becomes an important step, especially where changes are non-linear, cumulative, or are approaching critical thresholds.

Once these considerations have been examined, the next action would be to conduct the measurement, or estimation, of capitals and changes in benefits associated with each impact driver and dependency through the methodologies selected. Where relevant, the outputs may include a likelihood estimation of change. For each factor identified, which could lead to significant changes in capitals, it is useful and informative to estimate the likelihood of that factor occurring. Various methods can be used to assess the likelihood of change, including a probability-based analysis, a multi-criteria analysis, and expert opinion and/or multi-stakeholder assessment. The likelihood assessment will influence the results of the 3Returns assessment; however, likelihood assessments are inherently uncertain and may be subjective. To account for this, a sensitivity analysis of the final results will support studying a range of alternative values, allowing the assessor to identify threshold levels of likelihood at which the assessment would lead to a different decision. This step is a useful method to justify the results of the assessment and substantiate decision making.

3.1.3 Return on Investment Analysis

For the Return on Investment Analysis, the 3Returns Framework presents a structure based on a cost-benefit analysis (CBA)[14], an extended Cost Benefit Analysis (eCBA)[15], and the interest of understanding how different impact drivers may affect the status of the capitals and the benefits derived from them. The Return on Investment Analysis organizes the information measured, estimated, and modeled in the previous stage, in a way that distinguishes monetary and non-monetary values while allowing the analysis of financial indicators that support decision making. The table below presents the Return on Investment Analysis structure, followed by the explanation of each component.

Table 2. Return on Investment Analysis.

Return on Investment Analysis	
Benefits	UNIT
Economic Activities Revenue	Monetary value
Ecosystem Services Benefits	Monetary value
Operational Expenditures (OPEX)	
Economic Activities OPEX	Monetary value
Public OPEX	Monetary value
Capital Expenditures (CAPEX)	
Investment in Natural Capital	Monetary value
Investment in Social & Human Capital	Monetary value
Investment in Financial Capital	Monetary value
Financial Indicators	
Net Present Value (NPV)	Present Value (PV) (Benefits – OPEX – CAPEX)
Benefit to Cost Ratio (BCR)	PV (Benefits) / PV (OPEX + CAPEX)
Return on Investment (ROI)	PV (Net Benefits) / PV (CAPEX)
Non-Monetary Benefits	
Natural Capital Non-Monetary Benefits	Quantitative value
S&H Capital Non-Monetary Benefits	Quantitative value
Capitals' Status	
Natural Capital	Quantitative value
Social & Human Capital	Quantitative value
Financial Capital	Monetary value

14 Following methods for environmental decision-making, the CBA is a method that quantifies the social impacts of policies in monetary terms (GGGI, 2018).

15 An eCBA is an economic appraisal tool that takes a broader view of benefits and costs accruing to all stakeholders, including social, environmental or economic aspects (GGGI, 2018).

Benefits

The Return on Investment Analysis allocates the revenue from economic activities and the benefits from ecosystem services under the Benefits component. Both, revenue from economic activities and benefits from ecosystem services will be affected either by the practices and potential interventions identified or by additionally identified external factors. The impacts will be reflected by an increase or decrease in the revenue or in the benefits from ecosystem services. Considering the importance of the values presented in this component and the results' interpretation in the subsequent stage, the 3Returns Framework recommends clearly identifying the consequences of impacts and dependencies for economic activities (***Economic Value***) and for the society (***Social Value***). **Consequences of impacts on economic activities, and economic activities dependencies** will include all benefits accruing economic activities from the activities per se and from changes in capitals. **Consequences of impacts on society, and society dependencies** will include all benefits accruing to all individuals, including communities and enterprises, that arise from changes in capitals resulting from impact drivers (including externalities). The figure below presents an example of how to identify different benefit values.

BENEFITS		
Economic Activities Revenue	Agriculture Revenue	Consequences of Impacts on Economic Activities and Economic Activites Dependencies
	Aquaculture Revenue	
	Forestry Revenue	
	Fishery Revenue	
Ecosystem Services Benefits	Wildlife Services (e.g. pollination and pest control)	
	Hazard Mitigation Services	Consequences of Impacts on Society and Society Dependencies
	Environmental and Aesthetic Quality Services	

Figure 3. Identifying consequences of impacts and dependencies in the benefits component.

Operational Expenditures (OPEX)

The Return on Investment Analysis identifies and categorizes two types of operational expenditures. One, directly related with the economic activities and needed to maintain operations, and the second one directly related with the maintenance, conservation, and protection of environmental goods[16]. The first one, or economic activities operational expenditures, includes for example input costs, labor costs, maintenance, permits, and transportation costs, among others. The second one, or public operational expenditures, includes for example the salaries of the public officers directly involved in the activities previously mentioned. Both operational expenditures categories will be affected either by the practices and potential interventions identified or by external factors also identified. Impacts will be reflected by an increase or decrease in the operational expenditures either for operating the economic activities or for maintaining, conserving, or protecting environmental goods.

Capital Expenditures (CAPEX)

The Return on Investment Analysis is based on the identification and classification of interventions as an investment in capitals in order to improve the benefits to which they give rise. Traditionally, intervention costs associated with sustainable production, restoration, and improvement in landscape management have been integral to financial analyses but treated as additional costs rather than investments with positive outcomes associated. Based on the nature of interventions in landscapes, the capital expenditures component identifies and classifies those specific resources related with benefits' improvement, as investments in natural capital, social & human capital, and financial capital.

Based on the definitions presented through the 3Returns Model, natural capital expenditures will include all those resources allocated to increase the stocks of natural assets. For instance, ecological restoration costs (the entire cost) will represent an investment in natural capital. Social & human capital expenditures will include all those resources allocated to increase cooperation within and among groups, individual and collective knowledge, skills, and competencies. For example, capacity building costs (the entire cost), both for common individuals and public servants in charge of environmental goods and public well-being, will represent an investment in social & human capital. Resources allocated in the development of institutions for resource management, decision making, and social integration will also represent an investment in social & human capital. Finally, financial capital expenditures will include all those resources allocated to acquire or increase the assets needed in order to provide goods or services. Those assets can be related to economic activities and their acquisition to provide goods or services; or related to the public sector in order to provide better services.

16 Environmental goods are a sub-category of public goods.

Box 6. CSA Practices Example

Taking the implementation of CSA practices for illustrating capitals' investment, the implementation of a production asset, for example solar irrigation systems, will represent an investment in financial and social & human capital. The financial capital investment will be reflected in the acquisition and implementation cost of the solar irrigation system, while the expenditures related to capacity building for system management will represent the social & human capital investment. Furthermore, the introduction of a complementary crop or commodity in the production stage will represent an investment in social & human capital based on the resources allocated for capacity building. The resources allocated for the secondary crop or commodity do not represent an investment in natural capital, as those resources are part of the input costs for operating the economic activity. Conversely, the investment in a surrounding forest with the main purpose of gaining ecosystem services will represent an investment in natural capital.

Financial Indicators

Following the fundamentals of a cost-benefit analysis, the calculation and interpretation of the NPV and the benefit to cost ratio (BCR) follows the same logic.

$$\textit{Net Present Value} = PV\,(\textit{Benefits} - \textit{OPEX} - \textit{CAPEX})$$

The NPV is the difference between the present value (PV) of inflows and the PV of outflows over a period of time. As in capital budgeting and investment planning, the NPV in this case analyzes the profitability of current practices and of a potential intervention. A positive NPV will indicate that the projected benefits exceed the anticipated expenditures in present monetary terms. Therefore, a positive NPV will reflect profitability while a negative NPV will reflect net losses.

$$\textit{Benefit to Cost Ratio}\ (BCR) = \frac{PV\,(\textit{Benefits})}{PV\,(\textit{OPEX} + \textit{CAPEX})}$$

The BCR is a complementary financial indicator that summarizes the overall relationship between the costs and benefits of current practices and potential interventions. It provides useful information specially when analyzing different potential interventions, being potential investments with high BCR the most preferred.

$$\textit{Return on Investment}\ (ROI) = \frac{PV\,(\textit{Benefits} - \textit{OPEX})}{PV\,(\textit{CAPEX})} = \frac{PV\,(\textit{Net Benefits})}{PV\,(\textit{CAPEX})}$$

Traditionally, the ROI indicator has been a performance measure used to evaluate and compare the efficiency of an investment. However, and considering the 3Returns Framework and capitals' investment, the ROI in this case provides valuable information when assessing interventions for sustainable landscapes. The ROI analyzes the resources stakeholders invest in a landscape, and the returns that stakeholders realize on those resources based on the net benefits they receive from the landscape and the institutions in it. Understanding the relationship between the net benefits against the resources invested in a landscape, considering the interlinked ecological, social, and economic impact, facilitates the support for a sustainable and profitable intervention, in other words, a green growth intervention. The ROI calculation must consider Net Benefits (benefits minus operational expenditures) in the numerator as a result of interdependency and because multiple impacts (either by practices, potential interventions or by external factors) will be reflected in an increase, or decrease, of the benefits and operational expenditures. As mentioned before, avoiding double counting is essential in order to reflect an accurate numerator.

For the three financial indicators calculation, when the scope of the assessment relates only to private costs or benefits to a business, a financial/commercial discount rate is used to express the future costs or benefits in PV terms. However, it is unusual that decisions affecting the capitals under consideration have purely private consequences. Therefore, it is appropriate to apply a discount rate that reflects the balance of preferences for consumption now versus preferences for consumption in the future among all different stakeholders.

Box 7. The Social Discount Rate (SDR)

The discount rate is central to any economic decision involving the use of resources in different periods of time. This is particularly relevant in the evaluation of policies and investment projects where the social consequences of incorrect or suboptimal decisions may be very significant for the long-term development. From the point of view of private investors, determining the adequate discount rate in a project is relatively easy (it should reflect the opportunity cost of the capital). On the other hand, the social discount rate should reflect the rate at which a group of individuals is willing to sacrifice present and future benefits and costs (measured for example in terms of wealth or consumption) (Campos & et al., 2015).

What is the optimal (social) discount rate to use in evaluating projects? The debate remains unsolved with an academic consensus still distant. However, choosing the appropriate discount rate is critical when analyzing a project. For instance, a higher discount rate favors projects with benefits that accrue earlier, whereas it tends to penalize those projects whose costs are higher at early stages and benefits mostly arise in the long run. Recommended SDR by multilateral institutions: The World Bank (10-12%), Inter-American Development Bank (12%), Asian Development Bank (10-12%), African Development Bank (10-12%), and European Bank for Reconstruction and Development (10%) (Campos & et al., 2015).

Consequently, it is recommended to apply a societal or social discount rate[17] for expressing future costs or benefits in PV terms. A sensitivity analysis is recommended to be applied for the discount rate, testing the sensitivity of results and conclusions using different discount rates.

Non-Monetary Benefits

Following the importance of capturing key elements that support a transition towards green growth models, the following non-monetary indicators are recommended to be considered and expressed through the Return on Investment Analysis. Regarding natural capital non-monetary benefits, it is recommended to quantify the cumulative GHG emissions for the scenarios regarding the time frame under analysis. Other non-monetary can be considered, for example the species diversity (depending on the scope of the assessment, e.g. tree species diversity) expressed for different scenarios and at the end of the time frame under analysis.

Regarding social & human non-monetary benefits, and based on the indicators suggested previously, it is recommended to quantify the number of total jobs and green jobs maintained for different scenarios until the end of the time frame under analysis. For the number of people supported to cope with the effects of climate change, it is recommended to quantify the total number of people supported under different scenarios during the time frame under analysis. Finally, for the participation in collective decision-making organizations it is recommended to quantify the estimated percentage of people participating in a formal organization in the different scenarios and at the end of the time frame under analysis.

Capitals' Status

The last section of the Return on Investment Analysis aims to support an overall comparable analysis based on capitals outputs as a result of no intervention and different potential interventions. Following the recommended indicators and information under analysis, the capital's status can be expressed through the following outputs:

- Natural Capital Status Indicator: The 3Returns Framework recommends quantifying the estimated land use area in hectares based on the classification of Land Use, Irrigation and Agricultural Practices by the Food and Agriculture Organization of the United Nations. The land use area should be quantified and expressed at the end of the time frame under analysis.

- Social & Human Capital Status Indicator: It is recommended to express in quantitative figures the number of people involved in capacity building programs (members or staff of the government, private sector actors, and population in general), and the number of people involved in decision making and integrative organizations. The social & human capital status result should be expressed as the total number of people reached during the time frame under analysis.

- Financial Capital Status: Will be expressed as the PV (monetary terms) of the capital expended in the acquisition of assets needed to provide goods or services. The financial capital status adds up to the overall economic capital status.

17 Social discount rates are almost always lower than normal financial or commercial discount rates as they attempt to reflect the well-being of future generations as well as generations alive today.

3.1.4 Results Interpretation

The information presented through the Return on Investment Analysis allows policy makers and investors to analyze benefits, costs, and trade-offs between different investment options based on an iterative selection of interventions considering investors', governmental institutions' and stakeholders' interest. Information presented through the different categories allows for public and policy support, site managing and planning, funding and investment, and knowledge generation purposes. When analyzing landscapes interventions, the information obtained is of key interest to government agencies, policy and decision makers, local communities, businesses, donors, conservation organizations, commercial banks, multilateral development banks, public and private investors, and research organizations, among others.

Going through the Return on Investment Analysis, the first two sections, benefits and operational expenditures, reflect the importance and interrelationship between economic and livelihood activities within the landscape boundaries in which these activities are carried out. Any input or output from an activity has a multi-stakeholder consequence, therefore information in these two categories aims to highlight the trade-offs between economic and social value. Policy and investment decision making should consider this information aiming to maximize the value of both, while also minimizing the trade-offs between them.

Categorizing different interventions as an investment in capitals through the capital expenditure section allows for an understanding of the nature of such interventions and their relationship to benefits and operational costs. Each potential intervention will represent an investment in one or several capitals at the same time. The information in this section allows for understanding the nature of potential interventions and their relationship with changes in benefits and operational expenditures. Therefore, this section complements the understanding for policy and investment decision making, allowing for the appreciation of what the key factors driving economic and social value are.

The non-monetary benefits and capitals' status complements the information mentioned in the previous sections, emphasizing key trade-offs from potential interventions and no action. The acknowledgement of non-monetary benefits and capital's status is of the utmost importance, specifically for seeking collective well-being through important aspects that are not often reflected in monetary values.

The interpretation of the financial indicators, NPV and BCR, follows the same understanding as any other financial analysis developed in order to define the profitability of an investment. However, and considering the investment approach in capitals, the interpretation of the ROI becomes relevant and crucial in understanding the efficiency of potential interventions, complementing the information from the NPV at the moment of policy and investment decision making.

The NPV has generally been used to decide whether to pursue an intervention or not, with the rule of thumb being to proceed if the NPV is greater than zero. When analyzing socio-economic systems in a landscape, it is expected, although not always[18], that the BaU scenario reflects a positive NPV. It is also expected that, depending on the nature of the actions, a potential intervention reflects a positive and greater NPV than the BaU scenario. Based on this, a range of potential interventions can be analyzed, taking as the most favourable the ones that show the greatest NPV. However, higher NPVs can be expected to be backed by greater investments (not always true), which can represent a risk, especially when considering the estimation of long-term benefits from landscapes. Additionally, even though the NPV from sustainable practices can be greater than the one from BaU practices, the fact that the NPV from BaU can be positive without investing in natural and social & human capitals hinders the motivation to move to a more sustainable model.

The ROI indicator takes another angle of analysis when considering potential interventions and resource allocation for improving benefits. Following the 3Returns Framework and capitals' investment approach, the ROI provides information about the efficiency of allocating resources against the net benefits received from them. It is expected to observe a positive and even greater ROI from the BaU scenario compared to potential green growth interventions when calculating the ROI for different scenarios in the short-term. This, as current practices mostly reflect an exploitation of resources without sufficient replenishment or reinvestment, driven by short-term benefits and not considering the long run. On the other hand, any potential intervention that would imply an investment in capitals is expected to reflect a lower ROI in the short-term considering the nature of interventions in a landscape. However, and depending on the activities under the BaU, if degradation and unsustainable practices are observed, it is expected that the relationship 'net benefits over investment' starts declining over time, reflecting a lack of capitals' replenishment for benefit creation. Conversely, the relationship between 'net benefits over investment' for potential green interventions is expected to increase in the long-term (at different rates depending on the interventions proposed), being the intervention with the greatest ROI the one implying the most efficient allocation of resources for benefit creation.

Combining all, NPV, ROI, investment size, and non-monetary benefits, supports decision making that leads the transition towards sustainable landscapes, securing current and future well-being. From the landscape perspective, decision making based only on NPV does not strongly support a transition from a more efficient, but unsustainable economic model, to a more sustainable, but less efficient model in the short-term. However, when considering the importance of capitals and the need to invest in them for benefit improvement, interventions that reflect an increasing ROI, even higher than the BaU scenario in the long-term, serves as the evidence for motivating a transition towards sustainable economic and livelihood models.

18 For instance, when analyzing contaminated and heavily degraded landscapes.

Finally, result-interpretation requires a collaborative and inclusive participation of all stakeholders involved, allowing them to identify collective and individual impacts and dependencies, and then deciding on the best strategy to follow. The 3Returns Framework has been designed to support innovative investment cases, to enhance the bankability of sustainable landscapes and restoration projects, and to encourage partnerships and collective action at scale, making not only governments responsible for investing in landscape management but unlocking capital from the private sector whom sees value in reduced environmental risks and long-term financial returns.

Table 3. How the 3Returns Framework operationalizes the Natural Capital Protocol and the Social & Human Capital Protocol for sustainable landscapes.[19]

Natural Capital and Social & Human Capital Protocol Steps	Questions to be Answered	Answering through the 3Returns Framework
01: Get started	Why conduct a Natural, Social, and Human Capital assessment?	Facilitate decision makers with the formulation and analysis of policies, financial instruments, allocation of resources, and the identification of best practices for sustainable landscapes interventions.
02: Define the objective	What is the objective of your assessment?	Assess green growth interventions for landscapes that promote efficient use of natural resources, minimization of environmental impacts, resilience in natural disasters, and encourage inclusive and equitable development while building strong economies.
03: Scope the assessment	What is an appropriate scope to meet your objective?	The 3Returns Framework takes the spatial boundary only to the scope of the landscape or project level; and recommends considering only the first two stages of the value chain, input and production, from extractive and productive commodity-based sectors.
04: Determine the impacts and/or dependencies	Which impacts and/or dependencies are material?	Natural capital impacts can include changes in land use, biodiversity, soil, water and air quality, degradation status, and erosion status, among others. Dependencies on natural capital may include general stakeholders' benefits (e.g. protection), production and extractive yields, and new or additional costs for these sectors and general stakeholders within a landscape. Social and human capital impacts can include creation or destruction of institutions, as well as changes in knowledge, capabilities, and cultural heritage. Dependencies of social and human capital include the availability of a skilled, engaged, responsible, healthy, and organized population, information sharing, and an inclusive environment. Financial capital impacts include the increase in assets for providing goods and services. Dependencies on financial capital include yields and changes in production costs and prices.

05: Measure impact drivers and/or dependencies	How can impact drivers and/or dependencies be measured?	Indicators recommended in the 3Returns Framework (minimum requirements):
		- Quantitative Indicators:
		  - Natural Capital and Economic Activity Indicators: Land use area and GHG emissions.
		  - Social & Human Capital Indicators: Jobs and green jobs, number of people under enhanced adaptation, and percentage of people participating in collective decision-making organizations.
		- Monetary Indicators:
		  - Economic value of productive and extractive sectors (annual benefits and annual operational expenses).
		  - Social and economic value of ecosystem services [social value (e.g. hazard mitigation) and economic value (e.g. pesticide cost avoided)]

19 Adapted from "Natural Capital Protocol" by the Natural Capital Coalition (2016), and "Social & Human Capital Protocol" by the Social & Human Capital Coalition (2019).

06: Measure changes in the state of natural, social, and human capital	What changes in the state and trends of natural, social, and human capital are related to the business impacts and/or dependencies?	For measuring changes in the state and trends of capitals, the 3Returns Framework recommends to analyze two scenarios, a business as usual scenario (i.e. no intervention – none or minimum investment in capitals), and a green growth scenario (i.e. one, or multiple interventions – investment in capitals).
07: Value impacts and/or dependencies	What is the value of the natural, social, and human capital impacts and/or dependencies of the business?	The 3Returns Framework valuation process incorporates two types of values. **Social Value**, which determines relevant outcomes for society in general; assessing the vulnerability to natural and social risks caused by human activities or caused by natural forces. And **Economic Value**, which determines how capitals' impacts affect, positively or negatively, the financial performance of economic activities. These values are expressed through the Return on Investment Analysis, which organizes monetary and non-monetary values in an easy and comprehensive way that allows for analysis.
08: Interpret and test the results	How can the assessment process and results be interpreted, validated, and verified?	The Return on Investment Analysis allows result interpretation through the calculation of financial indicators to analyze profitability (i.e. NPV) and efficiency (i.e. ROI), while presenting non-monetary benefits and capitals' impacts as outputs, which allows for comparison of different interventions. Results validation and verification is recommended to be done through stakeholder consultation.
09: Take actions	How will the results be applied and natural, social, and human capital integrated into existing processes?	Results from the 3Returns Framework aim to shape the development and design of policies and financial mechanisms while bringing collective and collaborative action from multiple stakeholder for investing in capitals in order to secure current and future well-being.

CHAPTER 4

4.1 MYANMAR MANGROVE 3RETURNS RESTORATION PILOT CASE

4.1.1. Introduction

The mangrove forests of the Ayeyarwady Delta have sustained one of the highest deforestation rates in Myanmar. The cause of this loss has been anthropogenic in nature, including agricultural land expansion and the harvesting of wood for fuel and construction purposes. The effects of deforestation have negatively affected the stock of natural resources in the Delta. They have also resulted in lowering the capacity of mangrove forests to effectively act as a buffer against waves and storm surges. To address this, the Government of Myanmar has set the objective of increasing the resilience of mangroves and coastal communities.

Conservation and restoration of coastal mangroves is a priority consistent with Myanmar's Nationally Determined Contribution commitments to the Paris Agreement in regard to the reduction in climate-associated vulnerability and the role of mangroves in carbon sequestration, also referred to as blue carbon. However, the conservation and restoration of mangroves requires substantial investment. This can be justified and stimulated if the benefits from mangroves are clearly known. Thus, the aim of this assessment was to characterize the monetary and non-monetary benefits of restoration and the improved management of mangroves in townships of the lower Ayeyarwady Delta. The objective was to identify green growth alternatives in order to enhance the well-being of the communities of the Ayeyarwady Delta. For this, the 3Returns Framework was applied, seeking to estimate monetary benefits, non-monetary benefits, and the returns on investment in environmental, social & human, and financial categories of different green growth options.

Benefits and costs were measured under a BaU scenario (with current levels of investment in restoration and rates of illegal mangrove use) and compared against scenarios where illegal use of mangroves is reduced, mangrove restoration is enhanced, and mangroves currently under government management are allocated to community forestry and village woodlots. The identification process, data collection, valuation, scenario modeling, and resulting interpretation is explained in the following sections framed by the 3Returns approach for landscape assessment.[20]

4.1.2. Identification and Scoping

Study Area

The study area focused in the lower Ayeyarwady Delta, comprising three townships: Pyapon, Bogale, and Labutta (Figure 4). The area selected is currently facing tremendous challenges in preventing mangrove loss, which is essential for climate mitigation and sustainable development. The townships in the project area have some of the largest remaining mangrove cover within Myanmar and their population is highly dependent on the mangrove resources for livelihood purposes. In this context, it was urgent to determine the investment and management options that can facilitate protection and restoration of the mangrove forests in this area.

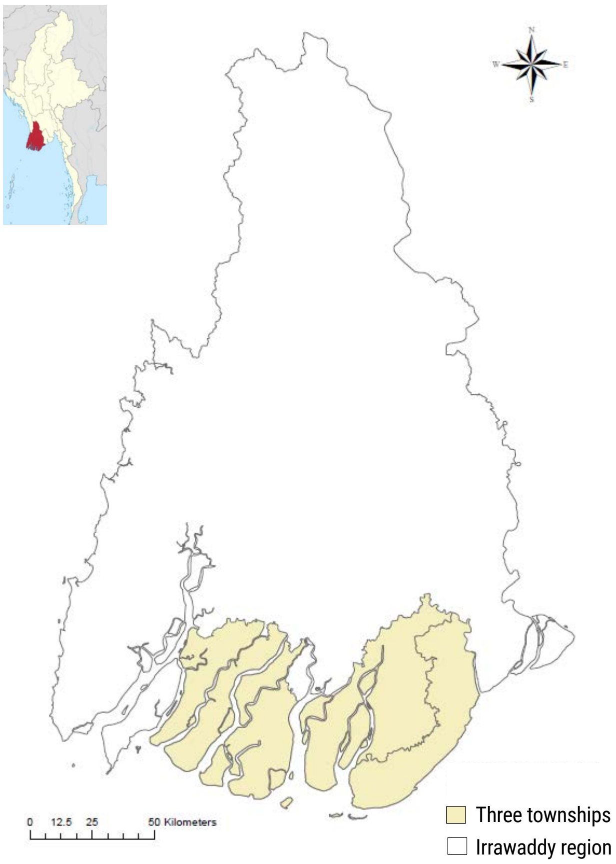

Figure 4. Study area in the lower Ayeyarwady Delta, Myanmar.

20 For detailed information about the Myanmar Mangrove 3Returns Restoration Case, see the full report 'Economic Appraisal of Ayeyarwady Delta Mangrove Forests' by the GGKP. (2020).

The management of the mangroves of the Ayeyarwady Delta is primarily the responsibility of the Department of Forestry, which has established the Myanmar Reforestation and Rehabilitation Plan (MRRP). In the study area, mangroves were identified in a range of areas with different management regimes:

- Mein-Ma-Hla Kyun Wildlife Sanctuary, which is referred to as National Park (NP), where extractive activities are not permitted.
- Reserve Forests (RF), which are areas where mangroves are managed by the Department of Forestry, including mangrove plantations. In these areas, extractive activities are not permitted unless the area is sub-classified as:
    - o Community forestry plots managed by Community Forestry User Groups (CFUGs), where the CFUG controls use of, and access to, the mangroves.
    - o Community forest lands which are common village woodlots (VW) where all community members have access to the mangroves.
- Private land.

Stakeholders

Based on survey information[21] collected from the study area, approximately 73% of families within the three townships were landless people. Livelihoods were mainly characterized by agricultural practices, and a high dependency on mangrove products such as fuelwood, mud crabs, and shrimp. Based on this information, key stakeholders were identified considering main mangrove products and main aquaculture and agricultural activities:

Table 4. Key stakeholders identified in the study area.

Product	Stakeholder	Activity
Fuelwood	Fuelwood Collectors	Extraction
	Middlemen	Commerce
	General Inhabitants	Consumption – Domestic Cooking
	Fishers	Consumption – Drying Fish
	Forest Department	Management, Control and Protection
Mud Crab	Crab Collectors	Extraction
	Crab Farmers	Production
	Middlemen	Commerce
	General Inhabitants	Consumption
	Department of Fishery	Management
Shrimp	Shrimp Collectors	Extraction (not main activity)
	Shrimp Farmers	Production
	Middlemen	Commerce
	General Inhabitants	Consumption
	Department of Fishery	Management
Fish	Fishermen	Extraction
	Fish Farmers	Production
	Middlemen	Commerce
	General Inhabitants	Consumption
	Department of Fishery	Management
Rice (Agriculture)	Rice Farmers	Production
	General Inhabitants	Consumption
	Middlemen	Commerce
	Department of Agriculture, Livestock and Irrigation	Management

21 Surveys for livelihoods, land tenure, and rights for ecosystem-based land use planning were conducted through interviews with stakeholders in the study area, based on guidance from The practical guidelines for socio-economic surveys by CIFOR – CIRAD (Liswanti, Shantiko et al. 2013). Detailed questions relating to mangrove aquaculture activities, crab catching, and fuelwood harvesting were also developed. This socio-economic research was approved by the Australian Human Research Ethics Committee at The University of Queensland (No. 2018000480).

Study Scope

A high accuracy land-use map and other data and information were collected and used for scoping the assessment. The total mangrove habitat within the three townships, including RFs and NPs, was 147,459 ha (Figure 5). This area is significantly larger than areas within RFs and NPs and has the potential for mangrove restoration associated with livelihood improvement for local people. However, the study did not use the total mangrove habitat in the three townships for the analysis as the legal and institutional frameworks for managing mangroves outside of RFs and NPs lack clarity. Until the legal frameworks for managing mangroves are clarified, green development projects will remain as high risk in these areas.

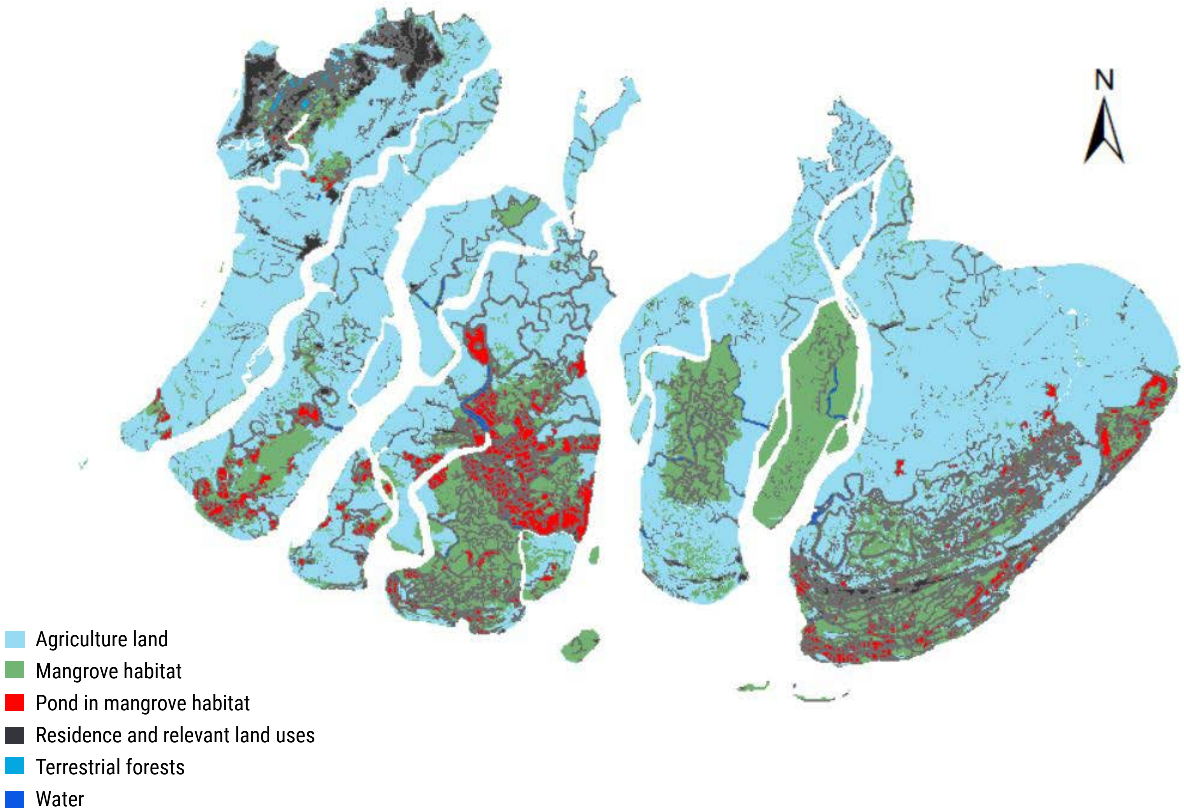

Figure 5. Detailed map of the study area.

Restricting the assessment to only RF and NP areas reduced the land area considered as mangrove land within the study area to about 85,432 ha (Figure 6). Satellite images[22] were ground-truthed and evaluated[23] to establish mangrove status and different land uses within the RFs and NPs throughout the three townships.

22 Planet Earth images were analyzed for producing maps (Planet team 2017). Results were validated by Google Earth and Spot 5 images. A semi-supervised image classification approach was used.

23 Plot coordinates were recorded with a hand-held Global Positioning System (GPS), and four photos were taken from the center of the plot at cardinal directions. Soil core samples were collected from over 300 plots in mangroves and alternative land uses for analyzes. Tree species, tree diameter, height, biomass, understory vegetation, and regeneration data was also collected for analysis.

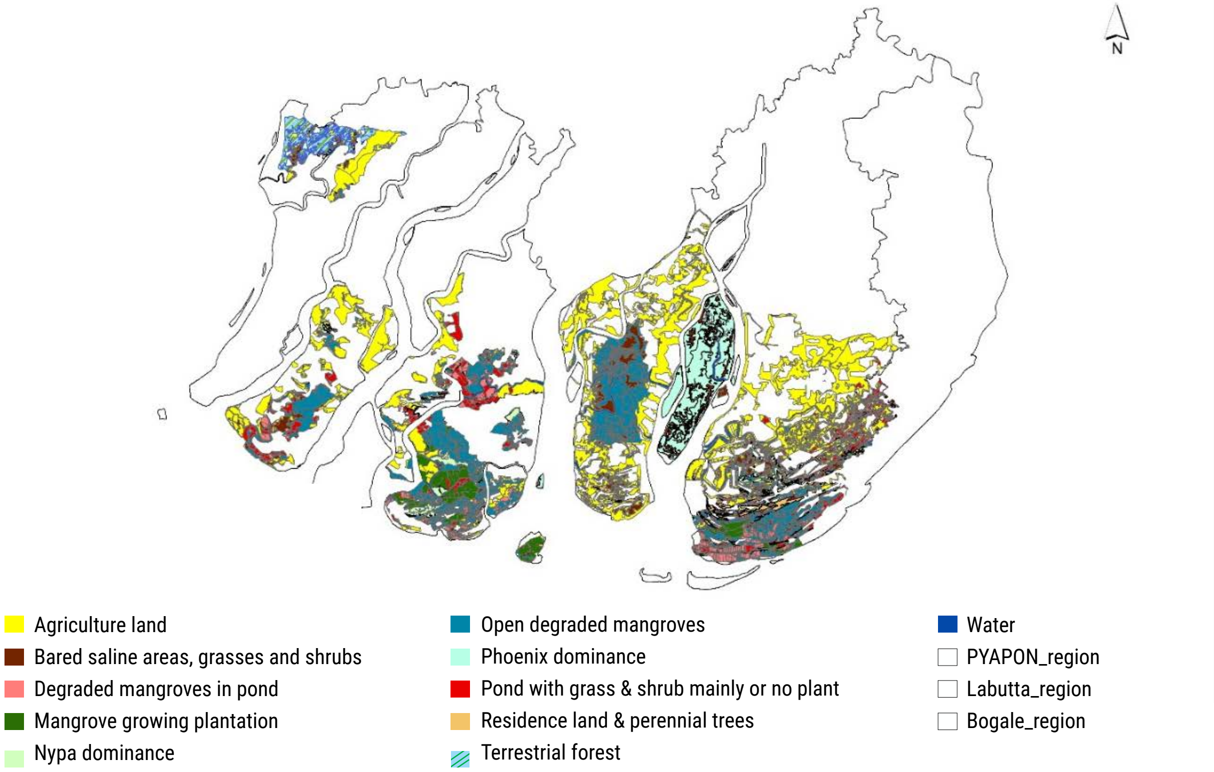

Figure 6. Mangrove forest status and land use map in Reserve Forest and National Park areas in the three townships.

Three products (fuelwood, crabs, and shrimp) were observed to be highly dependent on mangrove forests and were identified as the key commodities extracted and produced in RF and NP areas. Following the 3Returns Framework scoping recommendation, mangrove status, mangrove resource dependency, and the land use mapping in RF and NP areas, the study considered the following stakeholders:

Table 5. Key stakeholders selected for the Valuation Stage following the 3Returns Framework.

Product	Stakeholder	Activity
Fuelwood	Fuelwood Collectors	Extraction
	Forest Department (staff in field)	Control and Protection
Mud Crab	Crab Collectors	Extraction
	Crab Farmers	Production
Shrimp	Shrimp Farmers	Production
Rice (agriculture)	Rice Farmers	Production

4.1.3. Valuation

Defining a Baseline

Under the law, RF and NP areas are directly and fully under the control of the Forest Department. However, after several decades of encroachment onto mangrove areas, people have occupied large areas of mangroves and have established ponds within the mangroves. Based on satellite images and ground surveys, Table 6 presents the results of mangrove status assessment and land uses in RF and NP areas in the three townships in 2019.

Table 6. Mangrove status and land uses in RF and NP areas in the three townships (unit: hectares).

Land use and mangrove status	Bogale	Labutta	Pyapon	Total
1. Mangrove habitat	**28,424**	**34,548**	**22,461**	**85,432**
1.1 Open mangrove habitat	**28,191**	**26,146**	**13,550**	**67,887**
Mangrove plantation		4,293	1,177	5,470
Mangroves, main cover *Nypa*	795	3,653	2,471	6,919
Mangroves, main cover *Phoenix paludosa*	11,611	137		11,748
Secondary and restored mangrove	8,873	14,374	5,866	29,113
Young regenerating mangrove	761	1,019	208	1,988
Grass and shrubs with few regenerating mangrove trees	5,630	2,137	3,219	10,986
Unvegetated and saline wetland	521	533	609	1,664
1.2 Pond in mangrove habitat	**233**	**8,402**	**8,911**	**17,545**
Pond with grass and shrubs with few regenerating mangrove trees		293	1,699	1,992
Pond with mangrove trees	84	4		88
Pond with secondary and restored mangroves		964	3,097	4,062
Pond with young regenerating mangroves	12	1,931	677	2,620
Pond without mangroves	137	5,209	3,438	8,784
2. Agriculture land, other terrestrial land uses and water	**36,351**	**27,764**	**15,531**	**79,646**
Plantation forest		2,753		2,753
Natural forest		840		840
Agriculture land	31,734	20,452	10,599	62,785
Unvegetated land	45	8		53
Unvegetated land with sandy soil	11	225		236
Residents, offices, schools, pagodas	18	95	191	305
Perennial trees	694	194	2,000	2,888
Roads		8		8

To encourage improved land management within RFs, local farmers were encouraged to group together and submit applications for community forestry (CF) land certificates for mangroves around their homes and villages. CFUGs have the right to set up aquaculture ponds within their land areas as long as they comply with the rule that less than 10% of the land is water surface utilized for aquaculture purposes. Mangroves are required to be rehabilitated in the remaining areas. According to Forest Department data, by 2018, 69 CF certificates were issued to 1,606 members (households) in the Myaungmya Forest District. Most of the CF groups are located in Pyapon, Bogale and Labutta townships (60 CF groups). 7,895 ha of mangroves and mangrove land have been allocated to CFs; this represents approximately 11% of the total mangrove land area of RFs in the three townships. Interviews with different forestry authorities indicated that the Government does not limit the number of CF certificates for local communities. However, significant resources are needed to obtain these certificates, especially for the preparation of the Forest Management Plan (Form B). Thus, most CF certificates have been issued with significant support from Overseas Development Aid (ODA) projects such as RECOFTC,[24] JICA,[25] and FREDA.[26] Additionally, some Forest Department officers are skeptical about CF mangrove management and are reticent to discuss opportunities to allocate more mangroves to communities. In addition to CFUGs, villages are also allocated fuelwood plantations, called village woodlots. Only members of the villages have the right to harvest timber and fuelwood from village woodlots according to the villages' approved forest management plans. However, these areas are open to the public for the collection of non-timber forest products, notably the catching of crabs. Only 3% of mangrove habitat areas have been allocated to VWs. Table 7 summarizes population data and the distribution of the population collected for building the baseline for the assessment.

24 The Center for People and Forests.
25 Japanese International Cooperation Agency.
26 Forest Resource Environmental Development and Conservation Association.

Table 7. Population data following the scoping area for analysis.

Social Data	Number	Source
Number of households in villages living in RFs, NPs, and their 10 km buffer zone	134,731 households	Myanmar Information Management Unit (MIMU) data – national population census 2014 & RFs & NP map layer 2019 (assumption: mangrove fuelwood utilization zone)
Number of villages in RFs, NPs, and their 5 km buffer zone	550 villages	MIMU data – national population census 2014 & RFs & NP map layer 2019 (assumption: crab catching for livelihoods)
Number of villages in RFs, NPs, and their 1 km buffer zone	360 villages	MIMU data – national population census 2014 & RFs & NP map layer 2019 (assumption: fuelwood cutting for livelihoods)
Total CF user group mangrove areas in 2018	7,895 ha	Forest Department data (2019)

Economic Value

Fuelwood extraction, crab extraction and production, shrimp production, and rice production are the current major activities that are derived from mangrove areas, mangrove aquaculture systems and land use in the area of study. These activities were valued in order to determine how capitals' impacts will affect their financial performance.

One of the highest income generating activities came from mangrove aquaculture ponds where local farmers had established ponds in mangrove areas (Table 8). The typical practice consisted of farmers building walls around their mangrove area, digging ditches in a portion of the mangroves in order to make ponds, and then retaining mangroves in the remaining central area. These mangroves can be stressed due to changes in tidal inundation associated with building walls. In the current typical mangrove aquaculture system, farmers use polyculture systems that include crab, shrimp, and other fish cultured together. This polyculture diversifies products but has significant negative impacts on shrimp and crab production, which are the two major products of the system. Seabass is a popular product in the brackish waters of the Delta, but it is a major predator of crabs and shrimp, likely reducing survival rates and productivity. Thus, crabs and shrimp were considered as the key aquaculture products from ponds developed in mangrove areas.

Table 8. Mangrove aquaculture ponds operations.

Operation data	Value (2019)	Note
Income from mangrove ponds	MMK 14,787 million[27]	Annual estimation from CF mangrove areas (survey)
Pond operational costs	MMK 9,169 million	Estimation from survey data
Number of jobs from mangrove aquaculture farming	1,951 jobs	Estimation from survey data

Crab trapping and fattening are very profitable activities, with crab trappers supplying crab farmers and selling their products directly to township-level buyers depending on the size of the naturally available crabs. Surveys in 20 villages in the three townships indicated that there are 30 – 150 crab catchers in a village. On average, about 60 crab catchers in the villages catch crabs in the mangroves. Seventy-two percent of crab catchers were considered to be full-time catchers, where catching crab was their main source of income. The average income for a full-time crab catcher is approximately MMK 244,000 per month, while part-time catchers earn about MMK 171,000 per month, on average. The study assumed that landless people in the villages located within the RFs or within 5km buffer zone of RFs have livelihoods that mostly depend on mangrove resources. There are 550 villages within the RF areas and 5 km buffer zones. Overall, the study calculated that over 32,400 people and their families have livelihoods depending on crab catching in public mangroves in the Delta (Table 9). Their livelihoods are currently threatened by significant reductions in mangrove area and increases in pond areas where they cannot catch crabs.

27 USD 1.00 is equal to MMK 1,500.00.

Table 9. Crab catching from public mangroves within RF and NP in the three townships.

	Unit	Average amount	St Dev*
Number of households per village	Households	231	199
Number of full-time crab catchers per village	Person	43	32
Number of part-time crab catchers per village	Person	26	18
Average number of crabs caught per day by crab catchers	Crabs	20	4
Average weight of crabs caught per day by crab catchers	Kg	2.1	0.9
Average income of full-time crab catcher per month	MMK	237,000	62,000
Average income of part-time crab catcher per month	MMK	164,000	60,000
	Value (2019 – annual estimate)		
Income from free-open fishing in public mangroves	MMK 83,631 million		
Open fishing labor costs	MMK 46,703 million		
Number of jobs from crab catching on open mangroves (Full-time and full-time equivalent jobs)	32,400 jobs		

According to surveyed people, fuelwood collectors collect an equivalent amount of fuelwood to MMK 137,500 per month, of that amount typically 20% is self-consumed and 80% is sold to different actors in the value chain including local shops, middlemen, bamboo raft owners (for smoking fish), and traders. Surveys in 36 villages within RFs and in the buffer zone of RFs, indicated that a fuelwood collector can collect 15,000 – 45,000 kg of air-dry fuelwood per month and earn about MMK 144,000 – 201,000 (MMK 150 per air dry fuelwood viss). In one surveyed village, 43 fuelwood collectors (full time and part time) collected wood for sale. The study assumed that landless people from villages close to the RFs and the NP (probably no more than 1 km distant), cut mangroves within these areas to sell as firewood to support their livelihoods. In total, there are 360 villages within the RFs and the 1km buffer zone, and thus livelihoods of over 15,500 fuelwood collectors in three townships depend on illegal logging of mangroves in mangrove areas under the direct management of the Forest Department (Table 10). Most households in the RF and within the 10 km buffer zone use mangrove fuelwood for domestic cooking. On average, a household in this region uses about 700 – 800 kg of fuelwood per year for domestic cooking. Most households collect fuelwood from mangroves and their gardens to reduce costs. The average ratio of fuelwood from mangrove and other source is 65% to 35%. Thus, the study calculated that over 75,000,000 kg of mangrove fuelwood is collected and used annually in the delta for domestic cooking.

Table 10. Fuelwood logging from mangroves within RF and NP in the three townships.

	Unit	Average amount	St Dev*
Number of households per village	Households	252	225
Number of full-time fuelwood collectors per village	Fuelwood collector	17	15
Number of part-time fuelwood collectors per village	Fuelwood collector	26	21
Income earned per month for full-time collector	MMK	221,000	28,000
Income earned per month for part-time collector	MMK	145,000	42,000
Expenditure for fuelwood collecting per month (excluding labor cost) for full-time collector	MMK	32,000	12,000
+ Patrol payment (normally MMK 1,000 each time)	MMK	5,000	3,000
	Value (2019 – annual – estimate)		
Income from fuelwood cutting on open public mangrove	MMK 32,624 million		
Income from fuelwood cutting from village common woodlots	MMK 1,459 million		
Income from fuelwood cutting in mangrove aquaculture ponds	MMK 5,234 million		
Income from plantation clear cutting	0		
Open mangrove fuelwood collection operational costs	MMK 20,133 million		
Fuelwood collection operational costs for village woodlots	MMK 871 million		
Fuelwood collection operational cost for mangrove ponds	MMK 3,126 million		

Jobs from fuelwood collection on open mangroves (Unregulated)	15,500 jobs
Jobs from fuelwood cutting from mangrove aquaculture ponds	1,974 jobs
Jobs from sustainable fuelwood cutting from village common woodlots	550 jobs

Large areas within the government-managed mangrove RF boundaries have been converted from natural mangroves to rice fields. It was found that irrigation systems are not highly developed in the study area, and therefore, farmers usually grow only one rice crop per year with relatively low rates of productivity. Rice production operational information is presented in Table 11.

Table 11. Rice production operations.

Operation data	Value (2019 – annual)	Note
Average rice income per hectare per year	MMK 0.432 million	Estimated from surveys
Income from agriculture (rice production)	MMK 27,125 million	Assumption: all are rice – one crop per year
Rice cultivation operational costs	MMK 14,503	Estimated from surveys
Jobs from agriculture (rice cultivation)	15,696	Estimated from surveys

Social Value

Valuing ecosystem services reveals the importance of ecosystem functions as an essential component for devising management activities. Ecosystem services do not just generate products and raw materials, but also provide vital life support services that are critical to human well-being and the functioning of economies. The valuation of direct use ecosystem services (refer to Economic Value Section) was followed by the valuation of indirect use ecosystem services that affected the overall population of the study area. Through literature review, expert consultation, and baseline survey in the study area, carbon sequestration[28] and storm protection services were quantified and monetized.

Mangrove carbon stocks, which enable the calculation of the value of projects that avoid degradation of mangroves and associated emissions, and carbon sequestration of mangroves during restoration were obtained from plot survey data and the modeling of mangrove tree growth in the Delta. The study surveyed 328 mangrove sites in the study area. Data collection included variation in species, tree stocking density, growth, regeneration, and soil carbon. In over 40 sites, the data and samples were collected in different adjacent land uses in order to evaluate impacts of land use changes on carbon sequestration and other soil properties. The study also conducted an inventory of 215 mangrove plantations[29]. Values were expressed as megagrams (1 Mg = ton) of CO_2 equivalents per unit area per year which were converted to a value by assuming a carbon price per Mg of CO_2 (e.g. USD/ha per year). Multiplying the unit value by the area of land cover provided a total value of carbon sequestration at the landscape level, refer to Table 12.

28 Carbon sequestration services were monetized as part of the requirements of the overall GGGI program in Myanmar: 'Investment Case for Coastal Landscape Mangrove Restoration in Myanmar'.

29 Data collection included the source of investments in mangrove plantations, plantation species, age, investment cost norms, management practices (mainly based on community involvement), tree density, plantation type (mixed or monoculture), details of whether plantations were in or outside ponds, and location (by GPS coordinates). Additionally, distance to the closest water body was calculated and bioclimatic variables and total suspended matter in water bodies were obtained from secondary sources.

Table 12. Carbon sequestration ecosystem services.

Data	Value (2019 – annual)	Note
Natural mangrove	1,100 ha	An equation relating tree biomass and basal area was developed using survey data and secondary data available in the Ayeyarwady Delta.
Mangrove plantations	5,470 ha	
Degraded mangrove	56,537 ha	
Young regenerating mangrove	20 ha	
Average annual tree biomass growth of natural mangrove and plantations	6.2 Mg/ha/year	Eq. Biomass = $2.6453*G^{1.1255}$
Average tree biomass growth of degraded mangrove	2.6 Mg/ha/year	(R^2 = 0.9894)
Average tree biomass growth of young regenerating mangrove	1.9 Mg/ha/year	
Total biomass	187,768 Mg	From the equation, biomass was estimated for different species from their basal area growth rate (G).
Carbon sequestration from mangroves annually[30]	68,911 Mg of CO_2 equivalents	Estimated from survey and modeling (Total in study area)
Carbon price	USD 10 Mg	Estimation from ongoing carbon sequestration projects
Income from biomass carbon sequestration	MMK 1,034 million	Conversion rate USD 1 = MMK 1,500
Carbon marketing and relevant costs	MMK 52 million	Estimation from ongoing carbon sequestration projects (5% of carbon value)

Coastal protection services at the landscape level were determined based on secondary data and literature from studies in Myanmar and nearby countries. The assessment of coastal protection was not spatially explicit, as data was not sufficiently detailed to estimate coastal protection at the landscape level. The study found an estimated value for storm protection ranging between **USD 1,120 – 1,369 ha^{-1} $year^{-1}$** based on the results of Barbier (2007) and Estoque et al. (2018)[31]. The study estimated the total value of storm protection by multiplying the area of mangrove (only 'healthy mangrove' area[32]) with the value per hectare (USD 1,369 ha^{-1} $year^{-1}$), please refer to Table 13.

Table 13. Coastal protection ecosystem service.

Data	Value (2019 – annual)	Note
Healthy natural mangrove	1,100 ha	Assumption: stocking >2,000 trees/ha and tree volume >50m^3/ha
Mangrove plantation	5,470 ha	Assumption: stocking >2,000 trees/ha and tree volume >50m^3/ha
Coastal protection value	USD 1,369 ha-1 year-1	For healthy mangrove
Value of coastal protection service	MMK 13,491 million	Estimated

30 Total biomass was converted to carbon sequestration using a conversion factor from the IPCC Wetland Supplement (2013) - *Total biomass x 20% x 0.5 C x 3.67 CO_2* - Only 20% biomass stored on the mangrove stands, other biomass is continuously collected for fuelwood, mainly from existing natural and plantation mangroves.

31 Estoque et al. (2018) estimated coastal protection value of mangroves in Myanmar using avoided expenditures on physical reclamation and replenishment, obtaining a value of USD 1,369 ha^{-1} $year^{-1}$.

32 Assumption: only strictly protected mangrove plantation and natural mangroves were used for valuing coastal protection due to its healthy status. Healthy mangrove area: natural mangroves and plantations which have stocking > 2,000 trees per hectare and tree volume > 50m^3 per hectare.

Besides Economic and Social Value, and given the importance that the Forest Department has in managing and controlling RF and NP areas, data was collected regarding gov ernment operational expenditure for field management and control. Additional jobs related to mangrove restoration and protection activities were quantified as well (Table 14). Finally, based on data collected from the study area, species biodiversity of CF mangrove areas was reported through the Shannon Diversity Index at 0.195 for 2019.

Table 14. Government operational expenditure for control and protection of RF and NP areas in the three townships.

Operation data	Value (2019)	Note
Current government forestry staff	60	Estimated from 3 townships
Government costs for 1 staff – on average per month	MMK 500,000	Estimated from staff salary and other costs, survey 2019
Forest Department staff operational expenses (annual)	MMK 360 million	Estimated from salaries and other operational costs
Jobs related to mangrove restoration and protection	900 jobs	Estimated and equivalent to full time job (including nursery, planting, tending, monitoring)

Table 15 summarizes the valuation process and baseline defined in order to model potential interventions and management options following the Return on Investment Analysis structure.

Table 15. Capitals and benefits baseline.

	2019
Benefits (monetary)	millions MMK
Value of fuelwood cutting in open public mangrove	32,624
Value of fuelwood cutting from VW	1,459
Value of aquaculture	14,787
Value of fuelwood cut in mangrove aquaculture ponds	5,234
Value of clear-cutting surplus plantation area	0
Value of free-open fishing in public mangroves (crab catching)	83,631
Value of agriculture (rice production)	27,123
Value of biomass carbon sequestration	1,034
Value of coastal protection	13,491
Operational expenditure (OPEX)	millions MMK
Forest Department staff operational expenditure	360
Mangrove aquaculture pond operational costs	9,169
Rice cultivation operational costs	14,503
Fuelwood collection costs in mangroves	20,133
Fuelwood collection costs in VW	871
Fuelwood collection costs within mangrove ponds	3,126
Fishing labor costs	46,703
Other operational expenditures (carbon marketing)	52
Non-Monetary Benefits	Unit
Cumulative biomass carbon sequestration (Mg of CO_2 equivalents)	68,911
Total number of jobs from livelihoods and restoration activities within RFs and NP (# of jobs)	68,971
Green Jobs (# of jobs)[33]	33,300
CF tree species diversity (Shannon index)	0.195
Capitals' Status	Unit
Natural Capital - healthy mangrove areas (natural mangroves and plantations which have stocking > 2,000 trees/ha and tree volume > 50m3/ha) (ha)	6,570
Social & Human Capital - people involved in community forestry and capacity building	8,038

33 Estimated based on total jobs quantified and decent job criteria (survey data collection).

Scenario Modeling

Management of mangroves largely depends on the institutional arrangements within countries. In Myanmar, the political reforms over the last decade, which followed 50 years of economic and political isolation, have affected the forest management strategies. The study developed a range of mangrove management scenarios in order to assess and compare the potential outcomes of different management strategies. The scenarios include a BaU, a scenario where the current MRRP is fully enforced (MRRP+), and a range of scenarios that assess increased allocation of mangroves to CF, either through increasing the area allocated to CFUGs or through increase in area of VW. These two CF arrangements differ in the access that they provide for landless people in the study area for fishing and collecting wood within the mangroves. A range of other improvements for forest management and aquaculture were also included. The different scenarios are described in detail below, also illustrating the activities, impacts, and expected outcomes from each scenario.

Climate change, including sea level rise in scenario modeling

Following the 3Returns Framework, which strongly emphasizes the importance and necessity to identify, analyze, and model changes in capitals associated with external factors, the study focused on increases in sea level as they are expected with a high level of confidence (IPCC, 2019). Sea level rise (SLR) is a global risk to nations with low elevation coastal land due to impacts from increased inundation, storm surge, erosion, and saltwater intrusion (Nicholls and Cazenave, 2010). In addition, the effects of SLR are predicted to be particularly negative for developing nations (Dasgupta et al., 2011), with negative economic consequences especially noted for rice production (Chen et al., 2012). SLR is also expected to increase the damage caused by storm surges (Fritz et al., 2009). Mangroves provide coastal protection from storms and other waves (Hochard et al., 2019), yet they are also at risk from SLR if increases in tidal inundation and erosion exceed rates of accretion of shores, which can result in mangrove losses (Lovelock et al., 2015).

Detailed modeling of the impacts of SLR requires accurate digital elevation models as well as knowledge of sediment supply, wave exposure, and vertical and horizontal accretion of shorelines (Minderhoud et al., 2019). Without detailed site level data and modeling, projections of the impact of SLR are likely to have significant errors. Therefore, in order to estimate effects of SLR on the mangroves of the Ayeyarwady Delta, the study used recent analyses from global models instead of detailed spatial analyses for which data was unavailable and which would require more substantial research efforts. Recent global models indicate that SLR may have a positive effect on carbon sequestration in mangroves and saltmarshes (Rogers et al., 2019)and that impacts on the cover of coastal wetlands can be positive if coastal squeeze is limited (Schuerch et al., 2018).

The model of Schuerch et al. (2018) is based on the Dynamic and Interactive Vulnerability Assessment (DIVA) model, which assessed the impacts of SLR on segments of the global coastline that are 30-50 km in length. DIVA modeled coastal segments are assigned parameters describing local rates of SLR, the geomorphology, and human population density. The study used the SLR scenario of Representative Concentration Pathway 8.5 (0.6 – 0.8 m by 2100, IPCC 2018) and two coastal squeeze scenarios – high and low.[34] Results indicated that in the high coastal squeeze scenario, mangrove losses of 1,200 km^2, which is approximately 15 km^2 per year (0.29% per year) could occur. In the low coastal squeeze scenario, mangrove area may increase by 2,200 km^2 or at 27.5 km^2 per year (0.54% per year), please refer to Table 16.

Table 16. Scenarios of mangrove cover change with sea level rise.

	Coastal Squeeze Scenarios	
	High coastal squeeze – low adaptation (P5)	Low coastal squeeze – high adaptation (P300)
Initial cover (km^2)	5,100	5,100
Cover 2100 (km^2)	3,900	7,300
Change in mangrove cover (km^2)	-1,200	2,200
% Change	-24%	43%

Management of the effects of climate change and saltwater intrusion in Myanmar include development of high temperature and salt tolerant rice varieties and modified agricultural practices as for example irrigation based on lunar calendar (low tides) and double cropping (Thein 2015). However, these may not be sufficient to counteract the effects of SLR (Deb et al. 2016). Although the impacts of climate change are likely to vary, models for Bangladesh suggest an approximate 33% reduction in rice yields by 2100 (Karim et al. 2012), which expressed in annual terms represents a reduction in production of 0.4% per year. This reduction rate was applied for rice cropping in mangrove RFs in the three research townships. Changes in agricultural productivity are likely to vary spatially and may be non-linear; however, there are insufficient analyses to provide spatially explicit changes in agricultural production with climate change for the Ayeyarwady Delta.

34 High coastal squeeze – low adaptation, where landward migration of mangroves is prevented at population densities of 5-20 persons/km^2; and Low coastal squeeze – high adaptation, where landward migration of mangroves is prevented at 300 persons/km^2.

The Business as Usual Scenario

i) All rice fields and aquaculture ponds converted from mangroves remain in the present converted condition;

ii) 11% of mangroves are allocated to communities (based on CF certificates) and are managed by the local through CFUGs for timber, non-timber forest products, and aquaculture; 3% of mangroves allocated to villages as VW by 2019;[35]

iii) Approved forest management plan for CFUGs allows thinning every 3 - 5 years;

iv) Law enforcement in RFs and mangrove management remain at current levels;

v) Mangrove restoration in the three townships through development of plantations by the government and other donors' projects/ programs is approximately 1,130 ha annually;

vi) Climate change impact on rice productivity results in declines of 0.4% productivity per year due to saline water intrusion. Mangrove expands landward by 0.5% per year with SLR.

Table 17. Description of impact drivers, impacts, impact consequences, and dependencies in the BaU scenario on the study area.

Impact drivers	Expected impact on study area	Impact consequences and dependencies
Law enforcement on mangrove management	Weak law enforcement; continuous and repeatedly illegal logging of fuelwood and timber from mangroves; and mangrove resources are degraded	- Mangrove forest structure and dynamics are degraded. Dominance of unwanted species which limits recovery of mangroves - Mangrove biomass carbon and timber loss. Mangrove biomass productivity significantly reduced - Reduce habitat for wildlife, especially birds and mammals - Conflict between meeting needs of local landless people and Government's target to maintain and improve mangrove forests - Limited outcome for Government mangrove rehabilitation program because of illegal logging and unregulated management activities
Community Forestry and mangrove aquaculture practices	Intensive fuelwood harvesting for cash and more intensive farming is likely preferred	- Simple forest structure comprised of pioneer, fast growing species. Only young trees remain in the mangrove stands - Extensive aquaculture productivity directly linked to pond surface area; thus, CF farmers tend to keep less trees and dig more ponds if possible, reducing mangrove area - Water levels are kept high most of the time in the ponds resulting in unsuitable hydrological regimes for mangroves - Rapid cash return for mangrove aquaculture pond owners from fuelwood and aquaculture contributions to livelihoods
Mangrove restoration	Limited mangrove restoration given limited government budget; some unsuitable plantation establishment techniques	- Mangrove restoration achieves only about 2/3 of the target set by the MRRP program - Unsuitable plantation establishment techniques have negative ecological impacts (e.g., burning vegetation before planting) - Low investment in capacity building within local Forest Department staff - Healthy seedlings from nursery contribute to the higher survival rate of planted trees
Management of village common woodlot (VW)	Ineffective management due to insufficient capacity building and low investment	- Micro institutional village frameworks are not sufficiently strengthened through capacity building and investment - Illegal logging still occurs in the VW areas - People have free access to mangroves for catching crabs
Sea level rise	Soil acidification and saline water intrusion	- Soil which was previously mangrove habitat has been acidified and has become toxic resulting in low or very low rice productivity - Saline water intrusion in low elevation rice fields. Farmers have no, or little, rice harvest in about 10 % of the rice area. On average, rice yields reduced by 0.4 % per year.

Negative impact **Mild positive/negative impact** **Positive impact expected**

35 The current annual rate of increase in areas of CFUGs and VWs were used as estimates of the annual increase in CFs over time.

Scenario 1: MRRP+

This scenario describes a case where government law enforcement is improved in Non-CF areas and CF management is improved.

i) All rice field and aquaculture ponds converted from RF's mangroves remain in their present condition;
ii) 11% of mangroves allocated to communities (based on CF certificates and community plantations without certificates) and are managed by the local community; 3% of mangroves allocated to villages as CF's common VWs by 2019.[36]
iii) Forest management plan for CF users allows for thinning every 3 - 5 years (unchanged);
iv) Improved law enforcement as the government sees fit, decreased illegal logging compared to BaU scenario (reduced by 85%);
v) Mangrove rehabilitation in three townships is 1,820 ha annually as the government sees fit, but the successful area is only 1,000 ha annually due to limited involvement of communities in plantation management and therefore some illegal fuelwood collection occurs;
vi) Climate change impact on rice productivity results in declines of 0.4% productivity per year due to saline water intrusion. Mangroves expand landward by 0.5% per year with SLR.

Table 18. Description of impact drivers, impacts, imact consequences, and dependencies associated with Scenario 1 in the study area.

Impact drivers	Expected impact on study area	Impact consequences and dependencies
Law enforcement	Law enforcement improved for RFs, NP and CFUGs; less illegal logging of mangroves and reduced thinning time of CF mangroves	- Decreased illegal logging of mangroves helps to recover mangrove areas and their quality - Increased forest quality in mangroves of CFUGs - Increased habitat for fish, crabs, and additional wildlife - Reduced illegal logging, at the expense of livelihood losses for fuelwood collectors - Increased disputes between local landless people and Forest Department authorities over mangrove protection
CF mangrove aquaculture practices	Higher compliance with approved CF management plans	- Increased quality of mangroves within the CFUG ponds - Increased value of ecosystem services and timber production of CF mangroves - Increased resilience and sustainability of extensive mangrove aquaculture - Increased income for CF pond owners - Decreased crab and shrimp productivity due to increases in the forest canopy resulting in declines of open water surface area - Decreased cash return for CF farmers in the first few years when they need income to cover capital and operational investment for the ponds (extreme cash shortage is a major problem for the poor in Myanmar)
Mangrove restoration	Investment meets MRRP targets	- Achieve mangrove restoration targets set by the MRRP program - Unsuitable plantation establishment techniques have negative ecological impacts (e.g. burning vegetation prior to planting) - Healthy seedlings from nurseries contribute to the higher survival rate of planted trees
Management of common village woodlots	Higher law enforcement in VW Increased area and quality of access to public mangroves	- Micro institutional village frameworks are not sufficiently strengthened through capacity building and investment - Illegal logging continues, but less occurs in the VW areas - All people have free access to mangroves for crab catching - Income from crab catching and fuelwood collection in open access mangroves and VWs is increased
Sea level rise	Soil acidification and saltwater intrusion	- Soils in areas that were previously mangroves are affected by acidification and become toxic. This results in low or very low rice productivity - Saline water intrusion in low elevation rice field. Farmers have no or little rice harvest from about 10% of rice area. On average, rice yields reduced by 0.4% per year.

Negative impact expected **Unknown or mild positive/negative impact expected** **Positive impact expected**

36 Increase of CFUG and VW area to 2026 as planned by national MRRP.

Scenario 2: MRRP + VW/CFUG

Scenario 2 presents the case in which there is an increased area of mangroves allocated equally to CFUG and VW. Mangrove restoration and improved aquaculture techniques are also implemented.

i) 25% of RF area is allocated for communities with certificates under CFUGs;
ii) 25% of RF area is allocated for communities with certificates under VW;
iii) Plantation establishment of 1,820 ha per year, but the successful area is 1,500 ha;
iv) At least 50% of funding for restoration allocated to CF areas;
v) All unvegetated, saline land rehabilitated;
vi) CF Forest management plan changed[37] to thinning every 5-6 years leaving 200–400 maternal trees per hectare, thereby improving coastal protection, blue carbon sequestration, and biodiversity;
vii) Existing mangrove aquaculture ponds (crabs and shrimp) remain in the landscape but production techniques are improved;
viii) Additional aquaculture is introduced into CFUG areas in the project area;
ix) Climate change impact on rice productivity results in declines of 0.4% productivity per year due to saline water intrusion. Mangroves expand landward by 0.5% per year with SLR.

Scenario 3: MRRP + CFUG

This scenario describes the case of an enhanced allocation of mangrove area to CFUGs, mangrove restoration, and improved aquaculture practices.

i) 3% of RF area allocated for communities under VW and no change in this area;
ii) 47% of RF area is allocated for communities under CFUG by 2026, reaching 50% of RF area for VWs and CFUGs;
iii) Plantation establishment of 1,820 ha per year, but the successful area is 1,500 ha;
iv) At least 50% of funding for restoration is allocated to CF areas;
v) All unvegetated, saline land rehabilitated;
vi) CF Forest management plan changed to thinning every 5-6 years, leaving 200–400 maternal trees per hectare, thereby improving coastal protection, blue carbon sequestration and biodiversity;
vii) Existing mangrove aquaculture ponds (crabs and shrimp) remain in the landscape but production techniques are improved;
viii) Additional aquaculture is introduced into CFUGs in the project area;
ix) Climate change impact on rice productivity results in declines of 0.4% productivity per year due to saline water intrusion. Mangrove expands landward by 0.5% per year with SLR.

Scenario 4: MRRP + VW

This scenario describes the case of an enhanced allocation to community VW, mangrove restoration and improved aquaculture.

i) 11% of RF area allocated for CF with certificates under CFUGs with no increase in CFUG area;
ii) 39% of RF area is allocated for communities with certificates under VW by 2026, reaching a total of 50% RF area allocated to CFUGs and VWs;
iii) Plantation establishment of 1,820 ha per year, but the successful area is 1,500 ha;
iv) At least 50% of funding for restoration is allocated to CF areas;
v) Forest management plan changed to thinning every 5-6 years, leaving 200–400 maternal trees per hectare, thereby improving coastal protection, blue carbon sequestration and biodiversity;
vi) Existing mangrove aquaculture ponds for crab and shrimp remain in the landscape but production techniques are improved;
vii) Additional mangrove friendly aquaculture is introduced into project area within CFUG areas;
viii) Climate change impact on rice productivity results in declines of 0.4% productivity per year due to saline water intrusion. Mangrove expand landward by 0.5% per year with SLR.

37 The existing forest management plan for community certified mangroves allow heavy thinning and clear cutting which is the primary cause for mangroves degradation. A new forest management plan is proposed to meet both local mangrove product needs and ecosystem services.

Table 19. Description of impact drivers, impacts, impact consequences and dependencies on the study area for Scenarios 2, 3, and 4.

Impact drivers	Expected impact on study area	Impact consequences and dependencies
Law enforcement	Law enforcement improved for RF, NP and CFUGs. Less illegal logging from mangroves and reduce thinning time of CF mangroves	- Decreased illegal logging of mangroves leads to recovery of mangrove areas and increased quality - Increased forest quality in CFUGs and VWs mangroves - Increased habitat for fish, crabs, and additional wildlife, particularly in public RFs and NP mangroves - Reduced illegal logging at the expense of livelihoods of fuelwood collectors, particularly in Scenario 3 - Increased disputes between local landless people and Forest Department authorities over mangrove protection, particularly in Scenario 3.
CF mangrove aquaculture practices	Forest management plan changed towards more sustainable actions	- Increased quality of mangroves within the CFUGs ponds - Value of ecosystem services and timber production of CF mangroves are improved - Large maternal trees are protected and provide essential habitat for wildlife - Maternal trees provide seeds for natural regeneration - Increased resilience and sustainability of extensive mangrove aquaculture - Higher economic return from larger timber size classes to meet future high demand for logs in the Delta - Decreased crab and shrimp productivity due to the increase in forest canopy and declines in open water surface area - Lower cash return for CF farmers in the first few years when they are in need of income to cover capital and operational investment for the ponds (extreme cash shortage is a major problem for the poor in Myanmar)
Mangrove restoration	Investment meets MRRP targets Potential additional investments from additional investors	- Mangrove restoration achieves targets set by the MRRP program - Increased mangrove restoration rate due to increased investment - Unsuitable plantation establishment techniques have negative ecological impacts (e.g. burning vegetation prior to planting) in government mangrove rehabilitation projects - Healthy seedlings from nurseries contribute to the higher survival rate of planted trees
Micro-institutional strengthen for VWs	Significant new areas allocate to villages as common woodlots, many new VWs established Increase area and quality of open access public mangroves	- Micro institutional village frameworks strengthened through capacity building and investment - Illegal logging reduced in the VW areas - People have free access to VW for crab catching, particularly in Scenario 2 - Creation of additional income for crab catching and fuelwood collection on open access mangroves and VWs
Rehabilitation of ponds without mangrove	50% of ponds without mangrove will be restored	- Increased mangrove area for ecosystem services - Increased resilience and sustainability of extensive aquaculture ponds - Investment from the government, donors, and pond owners is required
Capacity building	Decreased vulnerability to climate and socioeconomic shocks Aquaculture practices improved	- Resilient ecosystems are more sustainable and provide less volatile income - Decreased impacts of climate and socioeconomic perturbations on ecosystems and communities - Increased income for CF pond owners
Sea level rise	Soil acidification and saline water intrusion	- Soils which were previously mangroves are affected by acidification and become toxic, resulting in low or very low rice productivity - Saline water intrusion in low elevation rice fields. Farmers have no or little rice harvest in about 10% of rice area. On average, rice yields reduced by 0.4% per year.

Negative impact expected **Unknown or mild positive/negative impact expected** **Positive impact expected**

The scenarios presented above were modeled through 2026, which is the date that the current MRRP program of the Myanmar Government finishes. In order to analyze changes in capitals, benefits, and the overall impact of different interventions, the analysis was conducted over longer time periods extending through 2079 (60 years from data collection and baseline – 2019). Considering the complexity of the landscape environment, uncertainties are high with such projections. Annex 3 includes additional data and assumptions used for modeling the scenarios proposed.

4.1.4. Return on Investment Analysis and Conclusions

Following the 3Returns Framework, the scenarios were modeled according to the impact drivers, impacts, and dependencies described above. Interventions such as mangrove restoration and planting, capacity building, mangrove pond establishment, and concrete gates for improving aquaculture were analyzed as an investment of capitals given their impact over the benefits and costs considered. The analysis and results of this process were presented through the Return on Investment Analysis, which allowed conducting financial analyses and comparing across scenarios. Monetized results are presented in PV terms, using a discount rate of 10%.[38] Please refer to Table 20.

38 This rate was between the commercial rate, 12 – 15%, and social rate of 8% in Myanmar.

Table 20. Results of the Return on Investment Analysis for different intervention scenarios to 2026 following the 3Returns Framework.

Relevant Actions	BaU	Scenario 1 MRRP+	Scenario 2 MRRP+CFUG/VW	Scenario 3 MRRP+CFUG	Scenario 4 MRRP+VW
Aquaculture	Remain in the same condition	Remain in the same condition	Production techniques improved	Production techniques improved	Production techniques improved
Rice	Remain in the same condition	Remain in the same condition	Remain in the same condition	Remain in the same condition	Remain in the same condition
Community Forest User Group (CFUG)	Rate as current practice	Rate as planned by national MRRP plan	25% to 2026	47% to 2026	11% to 2026
Village Common Woodlot (VW)	Rate as current practice	Rate as planned by national MRRP plan	25% to 2026	3% to 2026	39% to 2026
Community Forest Management Plan	Thinning 2 years and clear cutting	Thinning 3-5 years, no clear cutting	Thinning 5 years, no clear cutting, and keeping (300) maternal trees	Thinning 5 years, no clear cutting, and keeping (300) maternal trees	Thinning 5 years, no clear cutting, and keeping (300) maternal trees
Law Enforcement	Law enforcement remains the same	Improved enforcement to reduce illegal logging	Forest managements is enforced to increase the area of CF	Forest managements is enforced to increase the area of CF	Forest managements is enforced to increase the area of CF
Restoration Effort	300 hectares of successful mangrove plantations annually	1,000 ha of successful mangrove rehabilitation under implementation target (under MRRP plan)	1,500 ha of successful mangrove rehabilitation under implementation target	1,500 ha of successful mangrove rehabilitation under implementation target	1,500 ha of successful mangrove rehabilitation under implementation target
Benefit (monetary) ***millions MMK in PV***					
Value of fuelwood cutting in open public mangrove	153,035	72,036	72,036	72,036	72,036
Value of fuelwood cutting from VW	10,970	15,241	32,243	7,846	47,774
Value of aquaculture	82,907	82,907	144,611	225,023	93,840
Value of fuelwood cut in mangrove aquaculture ponds	29,347	29,593	43,827	68,224	28,423
Value of clear-cutting surplus plantation area	0	0	0	0	0
Value of free-open fishing in public mangroves	430,965	444,065	423,261	387,605	445,775
Value of agriculture (rice production)	142,961	142,961	142,961	142,961	142,961
Value of biomass carbon sequestration	5,706	16,391	18,111	18,111	18,111
Value of coastal protection	81,851	137,806	170,721	170,721	170,721

Relevant Actions	BaU	Scenario 1 MRRP+	Scenario 2 MRRP+CFUG/VW	Scenario 3 MRRP+CFUG	Scenario 4 MRRP+VW
Operational expenditure (OPEX) *millions MMK in PV*					
Forest Department staff operational expenditure	1,979	4,983	2,805	2,805	2,805
Mangrove aquaculture pond operational costs	53,024	53,007	78,898	123,244	50,893
Rice cultivation operational costs	79,742	79,742	79,742	79,742	79,742
Fuelwood collection costs in mangroves	97,227	45,176	45,176	45,176	45,176
Fuelwood collection costs in VW	6,786	9,459	20,102	4,830	29,824
Fuelwood collection costs within mangrove ponds	18,080	18,232	27,143	42,415	17,498
Open fishing labor costs	247,887	255,553	243,377	222,508	256,556
Other operational expenditures (carbon marketing)	285	820	906	906	906
Capital expenditure (CAPEX) *millions MMK in PV*					
Mangrove restoration by planting NC	18,639	30,020	30,020	30,020	30,020
Capacity building (CF & forestry staff) S&HC	907	1,347	1,814	1,814	1,814
Mangrove pond establishment costs FC	1,006	1,006	9,322	23,576	0
Concrete gates for improving aquaculture FC	0	0	26,155	46,416	9,539
Financial Indicators					
PV Total Benefits	937,741	941,000	1,047,771	1,092,526	1,019,641
PV Operational Expenditures	505,010	466,972	498,148	521,625	483,400
PV Capital Expenditures	20,552	32,373	67,312	101,827	41,374
NPV	**412,179**	**441,655**	**482,311**	**469,074**	**494,867**
BCR	**1.78**	**1.88**	**1.85**	**1.75**	**1.94**
ROI	**21.06**	**14.64**	**8.17**	**5.61**	**12.96**
NPV *in million USD*					
PV Total Benefits (million USD)	625	627	699	728	680
PV Operational Expenditures (million USD)	337	311	332	348	322
PV Capital Expenditures (million USD)	14	22	45	68	28
NPV (million USD)	**275**	**294**	**322**	**313**	**330**

Relevant Actions	BaU	Scenario 1 MRRP+	Scenario 2 MRRP+CFUG/VW	Scenario 3 MRRP+CFUG	Scenario 4 MRRP+VW
Non-Monetary Benefits					
Cumulative biomass carbon sequestration (after deduction of fuelwood cutting)	573,586	1,682,620	1,883,445	1,883,445	1,883,445
Green jobs maintained	30,898	39,912	44,569	41,407	46,582
Total number of jobs from livelihoods and restoration activities within RFs and NP maintained	65,008	58,308	62,965	59,803	64,978
CF tree species diversity (Shannon Index)	0.195	0.588	0.588	0.588	0.588
Capitals' Status					
Natural Capital - healthy mangrove areas (natural mangroves and plantations which have stocking > 2,000 trees/ha and tree volume > 50 m3/ha)	8,670	20,570	27,570	27,570	27,570
Social & Human Capital - people involved in community forestry and capacity building	11,818	15,958	38,656	23,987	48,618
Financial Capital - ponds and concrete gates (millions MMK in PV)	1,006	1,006	35,477	69,992	9,539

In general, improved and decentralized mangrove management increases the NPV of resources in the landscape within RF and NP areas in the Delta. Values between 2019 to 2026 increased from USD 275 million in the BaU scenario to USD 329 million for Scenario 4, which allocates most of CF mangroves to villages as VW and included enhanced CF management and production. Highly decentralized mangrove management would provide 1.2 times the monetized benefits from mangrove resources compared to the BaU scenario by 2026, with even greater monetized benefits evident over longer time frames.

Allocation of a larger area of mangroves for CFUGs, as has been practiced in Myanmar for the last two decades, would contribute to improved livelihoods of families in the region. However, increases in the area of CFUGs would be at the expense of the jobs and livelihoods of many other landless people who collect crabs from the mangroves. Thus, it was suggested that the Myanmar Government and investors should support community forestry in VWs where all community members are permitted to catch crabs under the current fishery regulations.

The analysis found that the mangroves in RF and NP areas in the three townships provide jobs for several tens of thousands of landless people in the delta. The study estimated that over 200,000 people's livelihoods depend significantly on mangrove resources. Overall, natural resources and economic activities from mangroves provide over 60 thousands jobs for people in the Delta. Currently, most of the jobs are from harvesting natural mangrove resources, such as crab catching and fuelwood collection. Many current jobs are not sustainable, or environmentally friendly, as they lead to over exploitation of natural resources. Intensive and frequent unplanned logging and crab catching under weak law enforcement has resulted in deforestation and degradation of natural resources in mangrove areas in the Delta. The analysis indicated that more investment in CFs, especially developing VWs and capacity building, would result in a higher proportion of green jobs associated with mangrove resources. Green jobs from sustainable crab catching, fuelwood cutting from CF village woodlots, and mangrove restoration increase from about 31,000 in the BaU scenario to about 46,500 jobs in Scenario 4 (MRRP+VW) by 2026.

Other essential indicators of green growth are improved under green investment scenarios (Scenarios 2–4). The areas of healthy mangroves and plantations (natural capital), increased from only about 9,000 hectares (mainly plantations) in the BaU to over 27,500 hectares in the intervention scenarios 2, 3 and 4. Cumulative carbon sequestration in mangroves from 2019 to 2026, which accounts for half of total biomass growth of mangroves in the Delta, increased from just over 573,000 Mg CO_2 in BaU to over 1,883,000 Mg CO_2 in Scenario 4. Additionally, species biodiversity of CF mangroves, reported using the Shannon Diversity Index, increased from 0.195 to 0.588, if CFUG pond owners and VW managers keep at least 300 maternal trees of 3 different species on their land.

Extending the analysis until 2079, the modeling results revealed that proposed interventions have significantly higher impacts on the NPV, natural capital, social & human capital, cumulative biomass carbon sequestration, number of jobs, and number of green jobs. In the longer term the ROI of green scenarios (2, 3, and 4) increased over time while the BaU's ROI declines. The analysis suggested that conventional and current BaU practices are not sustainable as they reflect a decrease in benefits when there is limited reinvestment or replenishment of key capitals. After 50 years (by 2069), the ROI of Scenario 4 exceeds the ROI of BaU (Figure 7). Allocation of a greater area of mangroves for local communities CF participation and capacity building, especially under VW, increases the social & human capital in coastal communities in RFs and NPs in the Delta. While the total number of jobs in all scenarios is similar to the BaU, the proportion of green jobs is much higher under Scenarios 2, 3, and 4 (70-80% of all jobs) (Figure 8).

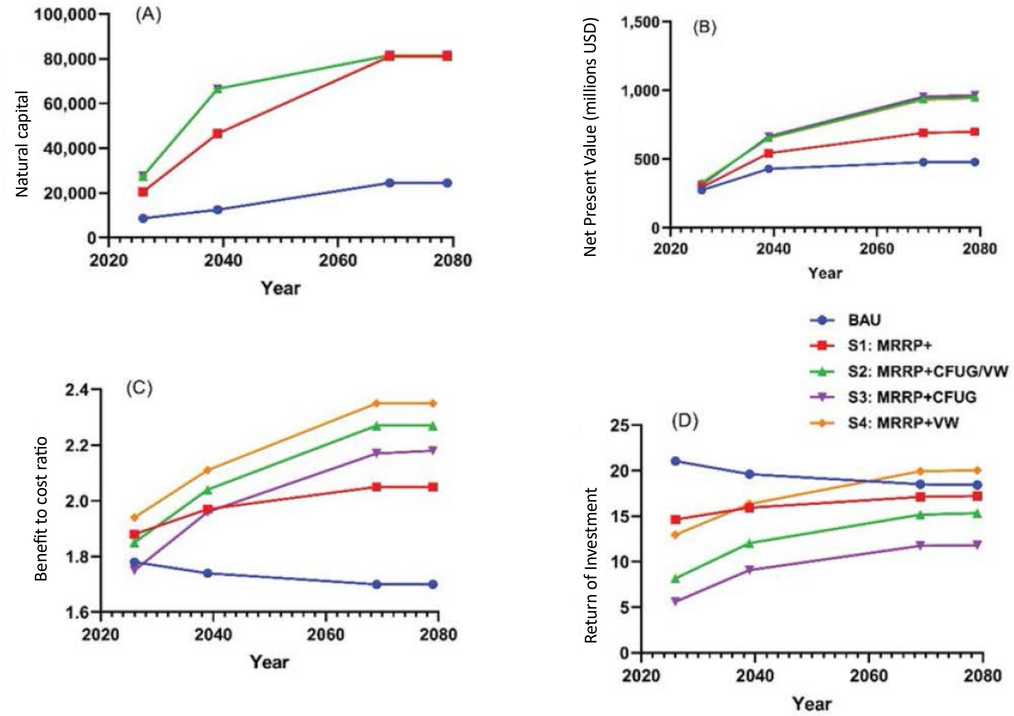

Figure 7. Changes of key financial indicators of different scenarios over time. (A) Natural capital; (B) NPV; (C) Benefit to cost ratio; and (D) Return on investment ratio.[39]

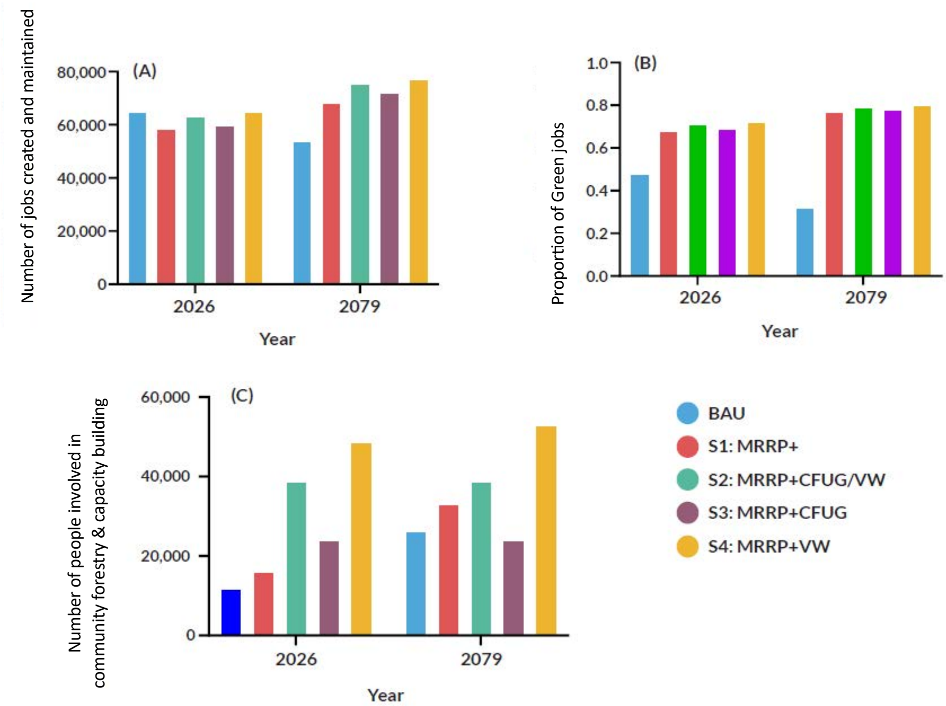

Figure 8. Changes of other key indicators of different scenarios over time. (A) Number of jobs created and maintained; (B) Number of green jobs created and maintained; and (C) Number of people involved in CF and capacity building.[40]

In conclusion, mangroves in the Delta provide vital livelihood resources and supportive services for thousands of people. Over 70% of people within RF and NP areas and buffer zones are landless people; therefore, it is crucial that mangrove management strategies and plans incorporate not only improved mangrove management, but also the prioritization of mechanisms and policies that take into consideration the impacts on these people. The analysis of different green investment scenarios indicates that decentralized mangrove management and increased investment in VWs, which still allows landless people to harvest non-timber forest products, achieves the highest NPV compared to the other scenarios by 2026. Scenario 4 also shows the greatest efficiency when analyzing benefits against investment in the long run. When considering non-monetary benefits and capitals' outputs, decentralized mangrove management through VWs presents the best scenario compared to the other green scenarios and the least trade-offs when compared to BaU (total number of jobs maintained).

Decentralization of mangrove management through CF represents a greater investment required in all green scenarios. In the case of VWs, this greater investment comes from increasing mangrove restoration by planting (natural capital investment); capacity building for community and forestry staff for implementing CF, improving mangrove management practices, and sustainable natural resource production/exploitation (social & human capital investment); and improving aquaculture practices through the investment in concrete gates for better water and pond management (financial capital investment). The study conducted in the Delta indicated that significant CF areas have not been successfully managed given lack of capacity building and support. Even more, most CF areas reported to have received little support after CF certificates were granted to the communities. Therefore, certifying is not enough, social & human capital investment is required and crucial for managing resources in a sustainable manner.

Currently, mangrove aquaculture is a lucrative farming practice for CF pond owners that depends mostly on the status of natural capital. The analysis showed that mangrove aquaculture in the Delta has low productivity and is highly volatile due to the dependency on wild caught larvae. Additionally, advanced mangrove aquaculture techniques such as the use of concrete gates and control of pond water quality and diseases, techniques that have been developed and applied in neighboring countries (e.g. Bangladesh, Thailand, and Viet Nam), are still not implemented in Myanmar. An investment in production infrastructure (financial capital investment) and capacity building for improving sustainable aquaculture that is compatible with mangrove restoration and land-use planning to minimize climate risks (social & human capital investment), are needed for improving this significant income-generating activity. Unfortunately, people in remote rural coastal areas in the Ayeyarwady Delta have limited resources and do not count with the capital for investing in improving their economic activities. Informal loans are the only option for most of the people, even for communities that have already received CF certificates. The analysis of this economic activity serves as the motivation for improving access to formal financial resources, thereby allowing farmers to access fairly priced and manageable loans from financial institutions.

CHAPTER 5

5.1 3RETURNS FRAMEWORK KEY POINTS AND LESSONS LEARNED

The 3Returns Framework is not a new methodology for capitals' accounting or for valuing ecosystem services; conversely, the 3Returns Framework builds on, and puts into operation, already existing capital accounting frameworks and tools for valuing ecosystem services. The overall motivation of this framework is to introduce a systematic approach for assessing interventions towards sustainable landscapes. For this, the 3Returns Framework presents a new approach based on the recognition of capitals, capitals' benefits, and interventions as an investment in capitals, which allow for the computation of efficiency measures (i.e. ROI) that, when combined with profitable measures and non-monetary benefits, serve as a practical method for decision making.

The assessment conducted in Myanmar following the 3Returns approach provided the support of the 3Returns Framework as a useful method that leads decision making towards sustainable landscapes. The calculation of an efficiency measure (i.e. ROI) proved to be a valuable point in order to determine which green intervention can be recommended, considering that the NPV was quite similar when analyzing different green scenarios. Additionally, the calculation of the ROI for the BaU also contributed to the understanding of the importance and necessity of reinvesting in capitals in order to continue enjoying the benefits that they provide, something difficult to conclude from the NPV in this case. Green interventions as expressed through the 3Returns Framework (through natural, social & human, and financial capital investment) proved to be informative, especially when considering how different interventions will affect the benefits and operational costs of economic activities, and the potential trade-offs from these interventions.

Among the **benefits of applying the 3Returns Framework**, the method resulted in key information needed for analyzing policy impacts and the identification of efficient ways of allocating resources in order to improve the benefits and status of stakeholders in the area of interest. Having this information available facilitated discussion among decision makers and their understanding of the implications of different interventions with potential trade-offs that can harm the implementation of them. Results from the assessment also allowed decision makers to understand the potential implication of climate change, the need for improved mangrove management practices in order to increase ecosystem services, and the identification of sectors that can be developed together with mangrove restoration efforts. The experience in Myanmar showed that the results from the 3Returns assessment were not only of interest to multiple government agencies and policy decision makers, but also from a multilateral development bank which expressed its intention to replicate the analysis in order to mobilize resources for development purposes. Additionally, the 3Returns assessment proved to be an effective example of how to combine and operationalize multiple available tools for policy impact and decision making, especially of natural capital accounting frameworks and ecosystem services valuation tools.

For **scaling and replicating** landscape assessments following the 3Returns Framework, the indicators recommended in this document have been selected in order to reflect and capture essential economic, social, and environmental dimensions when evaluating a potential intervention. Therefore, in order to replicate and scale landscape assessments following this framework, the indicators suggested should serve as the minimum requirement when analyzing a transition towards green growth models. By following the indicators suggested, the framework also accomplishes its goal to simultaneously serve multiple stakeholders, including government entities, communities, and the private sector. Additional indicators can be integrated as an effort to increase the understanding of impacts on capitals or for analyzing specific policy or financial mechanisms.

A **multi-stakeholder process is crucial**. Considering the complexity of the interactions between stakeholders, resources, and institutions within a spatial area, the 3Returns Framework strongly recommends the involvement of multiple stakeholders when assessing a landscape. Even though the assessment can be driven by a strong governmental or private angle, the analysis should consider the diverse range of actors involved in the area of interest.

The pilot study conducted in Myanmar provided the importance and usefulness of considering capitals when analyzing interventions towards sustainable landscapes and confirmed the value of the ROI for supporting decision making. The method presented through this document aims to contribute with the fundamentals for green growth landscape assessments. Furthermore, the 3Returns Framework aims to support countries, project developers, and stakeholders in meeting the Sustainable Development Goals; achieving commitments towards climate change, land degradation neutrality, and biodiversity; realizing national plans and strategies for economic growth; mobilizing resources for the execution of Nationally Determined Contributions; and other green growth targets.

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ANNEX 1: INDICATORS AND DATA REQUIREMENTS

The table below expands the information about the indicators and provides a recommendation on the data required to analyze a project following the 3Returns Framework.

Indicator: Land Use Area
According to the classification of Land Use, Irrigation and Agricultural Practices by the Food and Agriculture Organization of the United Nations

Land	Definition	Data Collection
6601 Land area	Country area excluding area under inland waters and coastal waters.	Area in hectares
6602 Agriculture	The total of areas under "Land under temporary crops", "Land under temporary meadows and pastures", "Land with temporary fallow", "Land under permanent crops", "Land under permanent meadows and pastures", and "Land under protective cover".	Area in hectares
6610 Agricultural land	Land used for cultivation of crops and animal husbandry. The total of areas under "Cropland" and "Permanent meadows and pastures."	Area in hectares
6620 Cropland	Land used for cultivation of crops. The total of areas under "Arable land" and "Permanent crops".	Area in hectares
6621 Arable land	The total of areas under temporary crops, temporary meadows and pastures, and land with temporary fallow. Arable land does not include land that is potentially cultivable but is not normally cultivated.	Area in hectares
6630 Land under temporary crops	Land used for crops with a less-than-one-year growing cycle, which must be newly sown or planted for further production after the harvest. Some crops that remain in the field for more than one year may also be considered as temporary crops e.g., asparagus, strawberries, pineapples, bananas and sugar cane. Multiple-cropped areas are counted only once.	Area in hectares
6633 Land under temporary meadows and pastures	Land temporarily cultivated with herbaceous forage crops for mowing or pasture. A period of less than five years is used to differentiate between temporary and permanent meadows and pastures.	Area in hectares
6640 Land with temporary fallow	Land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. This land may be in the form sown for the exclusive production of green manure. Land remaining fallow for too long may acquire characteristics requiring it to be reclassified, as for instance "Permanent meadows and pastures" if used for grazing or haying.	Area in hectares
6650 Land under permanent crops	Land cultivated with long-term crops which do not have to be replanted for several years (such as cocoa and coffee), land under trees and shrubs producing flowers (such as roses and jasmine), and nurseries (except those for forest trees, which should be classified under "Forestry"). Permanent meadows and pastures are excluded from land under permanent crops.	Area in hectares
6655 Land under permanent meadows and pastures	Land used permanently (five years or more) to grow herbaceous forage crops through cultivation or naturally (wild prairie or grazing land). Permanent meadows and pastures on which trees and shrubs are grown should be recorded under this heading only if the growing of forage crops is the most important use of the area.	Area in hectares

6656 Permanent meadows and pastures - Cultivated	Land under "Permanent meadows and pastures" that is managed and cultivated.	Area in hectares
6659 Permanent meadows and pastures - Naturally growing	Land under "Permanent meadows and pastures" that is naturally growing.	Area in hectares
6775 Land under protective cover	Land used for agriculture occupied by dwellings on farms, etc.: dwellings, operating buildings (hangars, barns, cellars, greenhouses, silos), buildings for animal production (stables, cowsheds, pig sheds, sheep pens, poultry yards), family gardens, farmyards. Excludes buildings for agro-food manufacture and buildings in rural areas for exclusive residential purpose.	Area in hectares
6663 Forestry	Land used for forestry. Excludes land that is predominantly under agricultural or urban use.	Area in hectares
6661 Forest Land	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 per cent, or trees able to reach these thresholds in situ. Excludes land that is predominantly under agricultural or urban land use, and land that is predominantly used for maintenance and restoration of environmental function.	Area in hectares
6662 Other wooded land	Land not classified as "Forest land", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 per cent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 per cent. Includes areas with bamboo and palms provided that land use, height and canopy-cover criteria are met. Excludes land that is predominantly under agricultural or urban land use, and land that is predominantly used for maintenance and restoration of environmental function.	Area in hectares
6670 Other land	Land area not classified as "Agriculture and" "Forestry". It includes the System of Integrated Environmental and Economic Accounting (SEEA) categories "Land used for aquaculture," "Built-up and related areas, "Land Use for maintenance and restoration of environmental functions," "Other uses of land not elsewhere classified," and "Land not in use."	Area in hectares

Indicator: GHG emissions
EX-Ante Carbon-balance Tool (EXACT) Data Requirements

EX-ACT modules to fill	Main Impact Area	Data Requirements
Land Use Change Module	Reduced CO_2 emissions Carbon Sequestration Decrease carbon stock	- Forest type and size - Area deforested - Final land use after conversion - Burning during conversion - Type of current land use - Type of future forest - Type of future land use

Crop Production Module	Reduced CO_2 emissions Reduced emissions of non-CO_2 gas and offsite CO_2 Carbon sequestration Increased emissions of CO_2 non-CO_2 and offsite Decreased carbon stock	- Current and future planted crop area (by type of crop) - Crop management practices - Practices of residue burning? - Specifications of water management practices - Type of organic amendment
Grassland and Livestock Module	Reduced emissions of non-CO_2 gas and offsite CO_2 Carbon sequestration Increased emissions of CO_2 non-CO_2 and offsite	- Current and future grassland area by state of degradation - Practices of grassland burning - Type and number of livestock - Feeding and breeding practices
Management and degradation Module	Reduced CO_2 emissions Reduced emissions of non-CO_2 gas and offsite CO_2 Carbon sequestration Decreased carbon stock	- Dynamic of forest degradation/ rehabilitation by forest type and size - Vegetation type and size concerned by drainage of organic soils, % of ditches relative to the surface area - Occurrence of forest fires - Area affected by rewetting - Area affected by peat extraction, height of the extraction - Area affected by fire, occurrence & intensity of fire
Coastal wetlands Module	Carbon sequestration Decreased carbon stock	- Vegetation type and % of the start surface area affected by extraction - % of the start surface area affected by drainage - Vegetation type and area affected by rewetting - % of nominal biomass restored
Inputs & Investment Module	Reduced CO_2 emissions Increased emissions of CO_2 non-CO_2 and offsite	- Quantity of agricultural inputs by type - Size of area with newly established irrigation (by type) - Quantity of electricity, liquid and gaseous fuel, and wood consumed - Size of area with infrastructures and buildings (by type)

Fishery & Aquaculture Module	Reduced CO_2 emissions Increased emissions of CO_2 non-CO_2 and offsite	- Species categories and associated fishing gear - % of the catch preserved with on board refrigerant - Management practices what will affect the fuel use intensity (FUI) - Annual total catch (fishery) - % of the catch preserved on ice produced ashore - Annual production (aquaculture) - Quantity of feed use

Indicator: Jobs and green jobs
Technical definitions and data collection

Technical Definitions and Considerations	- Job: direct employment from activities and interventions in certain sectors. - Full-time equivalent (FTE): is an employee's scheduled hours divided by employees' hours for a full-time workweek. (e.g. if an employee works 20 hours where work-week is defined as 35 hours, FTE would be 20/35=0.57). An FTE job-year is full-time employment for one person for one year. Where country specific working hours is not known for estimating FTE, a standard 2,080 hour of employment/year can be assumed. - Green job refers to the employment created from green growth interventions and include employment in the environmental services and goods sector. A job to be classified as 'Green Job' requires meeting the decent job criteria. Decent working should include one or more of the following: (a) adequate monthly wage, (b) work stability and security, (c) occupational hazard level involved, (d) decent working hours, and (e) availability of social protection scheme (e.g. social security). Work that uses child labor and bounded labor do not qualify for decent work. Example sectoral areas in agriculture, forestry, and other land uses (AFOLU) that have large green employment creation potential include the following: Sustainable forestry activities – tree plantation, forest certification, national voluntary certification; sustainable production practices – organic agriculture, bee-keeping, climate smart agricultural practices; sustainable tourism – ecotourism.	
Data collection	Jobs	Number of full-time or full-time equivalent jobs
	Green Jobs	Number of full-time or full-time equivalent jobs

Indicator: Enhanced Adaptation
Data collection for estimating the number of people supported to cope with the effects of climate change

Number of direct beneficiaries	- Number of people (including government officials) who directly participate in training or a capacity development program that reduces their vulnerability to the effects of climate change. - Number of people receiving benefits from sustainable and climate resilient interventions such as climate smart agricultural approaches. - Number of people protected from the effects of climate change from nature-based green infrastructure approaches. - Number of people beneficiaries of disaster risk reduction (DRR) projects. - Number of people directly involved in climate-information and early warning systems, and zoning of risk areas to reduce their exposure to climate change.

ANNEX 2: COMPUTER-BASED MODELING TOOLS FOR VALUING ES.[41]

Tool name and website	Acronym	Tool description
Artificial Intelligence for Ecosystem Services (ES) aries.integratedmodeling.org	ARIES	ARIES is an ecosystem services modeling platform. ARIES' underlying software, k.LAB, is designed for integrated socioeconomic- environmental modeling, which includes ES. ARIES can accommodate a range of different users and user needs, including scenarios, spatial assessment and economic valuation of ES, optimization of payments for ecosystem services programs, and spatial policy planning. Using ARIES currently requires modeling skills and Geographic Information Systems (GIS).
Co$ting Nature v.3 www.policysupport.org/ costingnature	C$N	C$N is web-based tool for spatially analyzing ES and assessing the impacts of human interventions such as land use change scenarios. It provides a globally or locally relative index of service provision that can be used for ES assessment, conservation prioritization, analysis of co-benefits, pressures, and threats. Version 3 includes economic/ monetary valuation. Using C$N does not require modeling skills or GIS.
Integrated Valuation of Ecosystem Services and Tradeoffs 3.4.2 www.naturalcapitalproject.org/ invest/	InVEST	InVEST is a suite of software models for mapping and quantifying ES in biophysical or economic terms under different scenarios (e.g., policy or management options). InVEST models are based on simple, generalized production functions and require commonly available input data. Using InVEST requires GIS but not modeling skills.
Multiscale Integrated Models of Ecosystem Services www.afordablefutures.com	MIMES	MIMES is an analytical framework designed to integrate different ecological and economic models to understand and visualize ES values. MIMES relies on SIMILE software and each MIMES application is customized to a specific socio-ecological system. Using MIMES requires modeling skills and GIS.
Social Values for Ecosystem Services solves.cr.usgs.gov	SolVES	SolVES is an ArcGIS-dependent application that allows the user to identify, assess and map the perceived social values that people attribute to cultural ES, such as aesthetic or recreational values. Combining spatial and points-allocation responses from surveys (which can be undertaken in person, online or through mailing), it produces points-based social-values metric and raster maps of social value intensities. Using SolVES requires GIS.
WaterWorld v.2 www.policysupport.org/ waterworld	WW	WW is a web-based tool for modeling hydrological services associated with specific activities under current conditions and under scenarios for land use, land management and climate change. It provides quantitative biophysical results or relative indices that can be used to understand hydrological ecosystem services, water resources and water risk factors. Using WW does not require GIS or modeling skills.

41 Adapted from "Tools for measuring, modelling, and valuing ecosystem services: Guidance for Key Biodiversity Areas, natural World Heritages Sites, and protected areas", by Neugarten, R., & et al., 2018, IUCN.

ANNEX 3: ADDITIONAL DATA AND ASSUMPTIONS FOR SCENARIO MODELING

Climate change and sea level rise scenarios		
Rice productivity decreases annually	0.4%	Rice productivity decreases due to saline water intrusion and climate change.
High coastal squeeze – low adaptation	-0.29% per year	Mangrove habitat declines at 0.29% per year.
Low coastal squeeze – high adaptation	0.54% per year	Mangrove habitat increase 0.54% per year, this results in decline in the area of rice fields, which is the land-use with second lowest elevation.
General assumptions for all scenarios		
Operational and capital cost rates increase per year	1%	Our assumption is that the cost rate will increase 1% per year due to inflation and other factors.
Income rate is stable	0 increase or decrease rate	We applied a conservative assumption that the income rate is stable during the investment period.
Discount rate	10%	10% . This rate is between the commercial rate, 12 – 15%, and social rate of 8%.
Tree biomass growth per year from plantations and natural mangroves in healthy condition (Mg)	6.2 Mg ha^{-1} $year^{-1}$	Project inventory. Assumption: natural forest growth rate is similar to plantations with same tree basal area.
Tree biomass growth per year from young regen-erating mangroves (Mg)	1.9 Mg ha^{-1} $year^{-1}$	Project inventory. Assumption: natural forest growth rate is similar to plantations with same tree basal area.
Tree biomass growth per hectare per year in degraded mangroves (Mg)	2.6 Mg ha^{-1} $year^{-1}$	Project inventory. Assumption: natural forest growth rate is similar to plantations with same tree basal area.
Average tree biomass/ha of degraded mangroves in RFs (Mg ha^{-1})	0	Similar in BaU and all other scenarios.
Increase of average biomass per ha of mangrove plantations, young rehabilitated mangroves and healthy natural mangroves in Scenario 1, 2, 3, and 4 (Mg ha^{-1} $year^{-1}$)	1 Mg ha^{-1} $year^{-1}$	Due to improvement of mangrove forests in Scenario 1, 2, 3 and 4, the average biomass per hectare of three types of man-groves: established plantations, young rehabilitated mangroves and healthy natural mangroves increase 1 Mg ha^{-1} $year^{-1}$.
Average increase in tree biomass per hectare per year (Mg ha^{-1} yr^{-1}) of degraded mangrove	0	No change in degraded mangroves.

Average increase in tree biomass growth rate per hectare per year (%) of healthy mangrove, established plantations and young rehabilitated mangroves in Scenario 1, 2, 3, and 4	1% increase per year	Due to improvement of mangrove forests in Scenario 1, 2, 3 and 4, the biomass growth rates is improved.
Average increase in tree biomass per hectare per year (Mg ha^{-1} yr^{-1}) of young regenerating mangrove (increase annually in Scenario 1, 2, 3, and 4)	1% increase per year	Due to improvement of mangrove forests, its productivity is improved.
Plantation harvest annually	Surplus planting area	Assumptions: A maximum of 40,000 ha of mangrove plantations and 40,000 ha of healthy natural mangroves are planned in the RFs and NP in three townships in both the non and low coastal squeeze scenarios (Table 16). In high coastal squeeze scenario, the maximum area of mangrove plantations and healthy natural mangroves is 30,000 ha due to a decrease in mangrove habitat. We assumed that any surplus planting would result in harvesting the same amount of mature plantation for timber and fuelwood.
Scenario Assumptions		
BaU Scenarios		
Number of Community Forest user group (CFUG) increase per year (01 CFUG equal to 40 households and 134 ha of mangrove allocated – average number)	1 CFUG	No ongoing investment to help establish CF user groups. CFUGs and VWs area reach about 35% of total RF area.
300 ha of VWs increase annually, equal VW area for 1 village.	300 ha	CFUGs and VWs area reach about 35% of total RF area.
Agriculture and other non-mangrove habitat	79,646 ha	Assumption: unchanged.
Degraded mangrove area	56,537 ha	Assumption: unchanged due to continuous unregulated fuelwood logging.
Mangrove plantation annual increase in area	300 ha	Assumption and estimated: with more investment from MRRP program, it is expected 300 ha of plantation will be in good condition annually.
Shrub, grasses, and bare saline land reduced yearly	500 ha	Assumption and estimated: Mangrove rehabilitation MRRP program and efforts of pond owners.
Government law enforcement staff	No change	Assumption: unchanged.
Public and CF mangrove reduced due to increase of CFUGs	estimation	Estimation from current trend.
Jobs from CF aquaculture farm	Survey data	Estimated from survey data.
Jobs from crab catching in public RFs and NP mangroves	Estimated and lost 1% a year due to declining crab resources	Gradually reduced due to decrease of open access public mangrove (CFUGs increase) and 1% of jobs lost annually due to declines in crab resources.
Unregulated jobs from fuelwood collection in public RFs and NP mangroves	Estimated	Gradually reduced due to decrease of open access public mangrove (CFUGs increase).

Scenario 1 MRRP+ (Government law enforcement in Non-CF areas and CF management improved)		
Number of Community Forest user group (CFUG) increase per year (1 CFUG equal to 40 households and 134 ha of mangrove allocated – average number)	1 CFUG	No ongoing investment to help establish CF user groups. CFUGs and VWs area reach about 35% of total RF area.
Increase in village's common woodlot (VW) annually	689 ha	Estimated based on MRRP plan: 689 ha of established plantation allocated to local villages. CFUGs and VWs area reach about 35% of total RF area.
Agriculture and other non-mangrove habitat	79,646 ha	Assumption: unchanged.
Annual increase in healthy mangrove	1,000 ha	Assumption: law enforcement improvement contributes to increased healthy mangrove areas.
Annual increase in mangrove plantation	1,000 ha	MRRP plan 1,820 ha per year, but successful area over the long-term is expected to be 1,000 ha only.
Shrub, grass and bare saline land decreases annually	1,500 ha	Due to new planting and improved law enforcement.
Other young rehabilitated mangroves (in ponds or outside ponds)	Increased	Increased due to law enforcement.
Common mangrove areas lost for public crab catching and fuelwood collection due to allocation to CFUGs	Estimated	Estimated from CFUGs area increase.
Capacity building (training and pilot model development)	1.5 times of BaU	It is expected that if the Government adhere to the MRRP capacity building is 1.5 times than BaU.
Law enforcement force strengthened	3 times of BaU	High pressure on livelihoods and fuelwood consumptions require significant increase of government authorities for law enforcement for mangrove protection.
Illegal fuelwood harvesting reduced	85%	With substantial investment of the Government in mangrove law enforcement, the illegal fuelwood cutting is expected to be reduced by 85%, which results in a reduction of 85% wood harvesting jobs.
Jobs from crab catching in public RFs and NP mangroves	Estimated	Gradually reduced due to decrease of access to public mangrove (CFUGs increase).
Unregulated jobs from fuelwood collection in public RFs and NP mangroves	Estimated	Reduced due to decrease of open access public mangrove (CFUGs increase) and improved law enforcement, 85% in 3 years and then a decrease of 100 jobs annually.
Biomass for carbon sequestration	50% of biomass growth	Assumption: 50% of biomass growth is for fuelwood and 50% is for carbon sequestration – remaining in the stand.
Jobs from crab catching in public RFs and NP mangroves	Estimated	Reduced due to decrease of access to public mangrove (CFUGs increase).
Scenario 2 MRRP + VW/CFUG (balanced between CFUG and VWs)		
Agriculture and other non-mangrove habitat	79,646 ha	Assumption: unchanged.
Annual increase in healthy mangrove	1,500 ha	Assumption: law enforcement improved and changed forest management plan contribute to increase in healthy mangrove areas.

Annual increase in mangrove plantation	1,500 ha	Actual planting target is 1,820 ha but estimated about 1,500 ha will reach canopy closed plantations and will not be further degraded.
Shrub, grass and bare saline land reduced yearly	3,000 ha	Due to new planting, improved law enforcement and improved forest management plan.
Increase in young rehabilitated mangroves (in ponds or outside ponds)	500 ha	Increased due to improved law enforcement and new planting.
Common mangrove areas lost for public crab catching and fuelwood collection due to allocation to CF user groups	Estimated	Estimated from increase in CFUGs area.
CFUG area increased annually to 2026	1,460 ha	Increase of 1,460 ha of CFUG annually to 2026 to reach about 25% of RFs area. Total CFUGs and VWs area will be 50% of RF area by 2026.
Increase in village's common woodlot (VW) annually	2,273 ha	Increase 2,273 ha of VWs annually to 2026 to reach 25% of RFs area. Total CFUGs and VWs area will be 50% of RF area by 2026.
Capacity building (training and development of pilot projects)	2 times of BaU	Significant increase of capacity building is needed for the success of community of forestry.
Law enforcement force strengthened	1.5 times of BaU	50% of RF allocated to CFUGs and VWs and these communities manage/protect their mangroves by themselves. Thus, investment in law enforcement is lower than Scenario 1.
Biomass for carbon sequestration	50% of biomass growth	Assumption: 50% of biomass growth is for fuelwood and 50% is for carbon sequestration – remaining in the stand.
Jobs from crab catching in public RFs and NP mangroves	Estimated	Reduced due to decrease of public access mangrove (CFUGs increase).
Unregulated jobs from fuelwood collection in public RFs and NP mangroves	Estimated	Reduced due to decrease of public access mangrove (CFUGs increase) and improved law enforcement.
Aquaculture pond increased productivity (shrimp and crabs)	40%	Introduced best practices: e.g. gates; removed unwanted species.
Aquaculture pond fish income	Almost zero	Removed unwanted fish species to improve shrimp and crab productivity.
Scenario 3 Enhanced MRRP + CFUG		
Agriculture and other non-mangrove habitat	79,646 ha	Assumption: unchanged.
Annual increase in healthy mangrove	1,500 ha	Assumption: law enforcement improvement and changed forest management plan contribute to increase in healthy mangrove areas.
Annual increase in mangrove plantation	1,500 ha	Actual planting target is 1,820 ha but estimated about 1,500 ha will reach closed canopy plantations and will not be further degraded.
Annual reduction in shrub, grass and bare saline land	3,000 ha	Due to new planting, improved law enforcement and improved forest management plan.
Annual increase in young rehabilitated mangroves (in ponds or outside ponds)	500 ha	Increased due to law enforcement.
Annual increase in area allocated to CFUGs	3,733 ha	To reach target of 50% of mangroves allocated to VWs and CFUGs by 2026.

Annual increase in village's common woodlot (VW)	0 ha	Area remains 2,200 ha (the same as 2019).
Common mangrove areas lost for public crab catching and fuelwood collection due to allocation to CFUGs	Estimated	Estimated from CFUGs area increase.
Capacity building (training and development of pilot projects)	2 times of BaU	Significant increase of capacity building is needed for the success of community forestry.
Law enforcement force strengthening	1.5 times of BaU	50% of RF is allocated to CFUGs and VWs and these communities manage/protect their own mangroves. Thus, investment in law enforcement is lower than Scenario 1
Biomass for carbon sequestration	50% of biomass growth	Assumption: 50% of biomass growth is for fuelwood and 50 % is for carbon sequestration – remaining in the stand.
Number of jobs from crab catching in public RFs and NP mangroves	Estimated	Reduced due to decrease of open access public mangrove (CFUGs increase).
Number of unregulated jobs from fuelwood collection in public RFs and NP mangroves	Estimated	Reduced due to decrease of open access public mangrove (CFUGs increase) and improved law enforcement.
Increase in aquaculture pond productivity (shrimp and crabs)	40%	Introduced best practices: e.g. gates; removed unwanted species.
Aquaculture pond fish income	Almost zero	Removed unwanted fish species to improve shrimp and crab productivity.
Scenario 4 Enhanced MRRP + VW		
Agriculture and other non-mangrove habitat	79,646 ha	Assumption: unchanged.
Annual increase in healthy mangrove	1,500 ha	Assumption: law enforcement improvement and forest management plan change contribute to increase healthy mangrove areas.
Annual increase in mangrove plantation	1,500 ha	Actual planting target is 1,820 ha but estimated about 1,500 ha will reach the stage of closed canopy plantations and won't be further degraded.
Annual reduction in shrub, grass and bare saline land	3,000 ha	Due to new planting, improved law enforcement and improved forest management plan.
Other young rehabilitation mangroves (in ponds or outside ponds)	500 ha	Increased due to law enforcement.
Annual increase in area allocated to CF user groups (CFUG)	0	CFUG remain the same (about 11% - 7,895 hectares of RFs area).
Annual increase in village's common woodlot (VW)	3,720 ha	To reach target 50% of mangroves allocated VW and CFUG by 2026.
Common mangrove areas lost for public crab catching and fuelwood collection due to allocation to CFUGs	Estimated	Estimated from CFUGs area increase.

Capacity building (training and development of pilot projects)	2 times of BaU	Significant increase of capacity building is needed for the success of community forestry.
Law enforcement force strengthening	1.5 times of BaU	50% of RF is allocated to CFUGs and VWs and these communities manage/protect their own mangroves. Thus, investment in law enforcement is lower than Scenario 1
Biomass for carbon sequestration	50% of biomass growth	Assumption: 50% of biomass growth is for fuelwood and 50% is for carbon sequestration – remaining in the stand.
Number of jobs from crab catching in public RFs and NP mangroves	Estimated	Reduced due to decrease of public access mangrove (CFUGs increase).
Number of unregulated jobs from fuelwood collection in public RFs and NP mangroves	Estimated	Reduced due to decrease of public access mangrove (CFUGs increase) and improved law enforcement.
Increase in aquaculture pond productivity (shrimp and crabs)	40%	Introduced best practices: e.g. gates; removed unwanted species.
Income from aquaculture of fish	Estimated as zero	Removed unwanted fish species for improving shrimp and crab productivity.

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