BARRIER ANALYSIS AND ENABLING FRAMEWORK OF ADAPTATION AND MITIGATION TECHNOLOGIES FOR SOLOMON ISLANDS

TNA TECHNOLOGY NEEDS ASSESSMENT

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BARRIER ANALYSIS AND ENABLING FRAMEWORK OF ADAPTATION AND MITIGATION TECHNOLOGIES FOR SOLOMON ISLANDS

REPORT II

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This document is an output of the Technology Needs Assessment (TNA) project of the Solomon Islands, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Program (UNEP) and the UNEP DTU Partnership (UDP) in collaboration with the University of the South Pacific (USP). The present report is the output of a fully country-led process. The views and information contained herein are a product of the TNA team led by the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM), Solomon Islands.

Foreword

The Solomon Islands' high vulnerability to adverse impacts of climate change, extreme climatic events, and sea level rise, including coastal soil erosion at various locations across its rural communities, means that the country is in dire need of innovative technologies to lessen damage to life, property, natural eco-systems, and its economy. I am confident that the Technology Needs Assessment (TNA) process initiated by the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) in partnership with the UNEP Copenhagen Climate Centre (UNEP CCC) and University of the South Pacific (USP) will play an influential role in increasing resilience against climate change vulnerabilities through transfer and diffusion of prioritized technologies in prioritized sectors including coastal erosion and relocation for adaptation. The TNA process will also play a role in the transfer and diffusion of prioritized technologies within renewable energy and forest conservation for the mitigation sector. I am pleased to note that the process of prioritizing sectors and identifying technologies was carried out transparently, collectively, and country-driven by relevant stakeholders. I am so moved by the stakeholders' enthusiasm and cooperative spirit through phase I of the TNA project despite the impact of the Covid 19 pandemic. It was highly consultative and involved several stakeholders and experts from the government, private sector, and non-government organizations.

Furthermore, I firmly believe that implementing both adaptation and mitigation technologies prioritized in the TNA report Phase-I will help the country build resilience and mitigate the impacts of climate change. I want to thank the members of the TNA National Team my colleagues within our Ministry, and experts of each Technical Working Group for their invaluable contributions to preparing this Report.

Lastly, I also thankfully acknowledge the contributions of the national consultants and other experts of USP, UNEP CCC and the Asian Institute for Technology (AIT) for their constant support and guidance in implementing the TNA project.

Dr Melchior Mataki
Permanent Secretary, Ministry of Environment, Climate Change, Disaster Management and Meteorology

List of Abbreviations

AFOLU	:	Agriculture, Forestry and Land Use
BAU	:	Business As Usual
CES	:	Coastal Erosion Sector
COP 14	:	The Fourteenth Conference of the Parties
DLI	:	Distribution Logistics Infrastructure
DTU	:	Technical University of Denmark
EEZ	:	Economic Exclusive Zone
ENSO	:	El Nino Southern Oscillation
EV	:	Electric Vehicle
FAO	:	Food and Agriculture
FRL	:	forest reference level
GCF	:	Green Climate Fund
GEF	:	Global Environment Facility
GEF	:	Global Environment Facility
GHG	:	Green House Gas
HDI	:	Human Development Index
HFLD	:	High Forest Cover Low Deforestation
ICZM	:	Integrated Coastal Zone Management
INC	:	Initial National Communication
IPCCC	:	International Panel on Climate Change
MDPAC	:	Ministry Development, Planning and Aid Coordination,
MECDM	:	Ministry of Environment, Climate Change, Disaster Management and Meteorology
MoFR	:	Ministry of Forestry and Research
MoFT	:	Ministry of Finance and Treasury
MPGIS	:	Ministry of Provincial Government Institutional Strengthening
MRD	:	Ministry of Rural Development
MTDP	:	Medium-Term Development Plan
MTTAP	:	Medium-Term Transport Action Plan
NAMA	:	Nationally Appropriate Mitigation Actions
NAP	:	National Adaptation Plan
NAPA	:	National Adaptation Plan of Action
NbS	:	Nature-based Solutions
NC	:	National Communication
NCCP	:	National Climate Change Policy
NDC	:	National Determine Contribution
NDMO	:	National Disaster Management Office.
NDMP	:	National Disaster Management Plan.
NDS	:	National Development Strategy
NGO	:	Non-Government Organisation
PMCI	:	Project Management, Coordination, and Implementation Unit
REDD	:	Reducing Emissions from Deforestation and Forest Degradation
SIG	:	Solomon Islands Government
SINEPSP	:	Solomon Islands National Energy Policy and Strategic Plan
SITAM	:	Solomon Islands Transport Asset Management System
SIWA	:	Solomon Islands Water Authority
SLR	:	Sea Level Rise
SOE	:	State-Owned Enterprise

STIIP	:	Sustainable Transport Infrastructure Improvement Program
TFS	:	Technology Factsheets
TNA	:	Technical Needs Assessment
UDP	:	UNEP-DTU Partnership
UNDP	:	United Nations Development Program
UNEP	:	United Nations Environment Program
UNFCCC	:	United Nations Framework Convention on Climate Change
USP	:	University of the South Pacific
V&A	:	Vulnerability and Adaptation

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EXECUTIVE SUMMARY

The Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) undertook a joint multi-country project entitled "Technology Needs Assessment (TNA) - Phase II" with funding from the Global Environment Facility (GEF). This report is the continuation and second output of the TNA process that builds on the first outcome of the TNA report, which aimed to identify and prioritize both mitigation and adaptation technologies for selected sectors.

Solomon Islands will submit the Barrier Analysis and Enabling Framework (BAEF) as the second deliverable to complete the TNA process, providing a comprehensive assessment of barriers and an enabling framework for the identified technologies. The chosen technologies within the respective sectors were selected on the basis of outcomes of the technology needs assessment for mitigation and adaptation, as well as synergizing national development across the various sectors to exploit the co-benefits from the selected technologies and enhance overall climate resiliency in Solomon Islands. For coastal erosion, the identified technologies include Nature-based and integrated coastal zone management, while the relocation sector focuses on climate change relocation policy and permanent location. The mitigation working group had set technology priorities for the sustainable road transportation sector (including drainage and landscape) and electric out board motors (E-OBM), while the technologies prioritized for the forestry sector are Multi-Propose National Forest Inventory (M-NFI) and establish a network of terrestrial protected areas (N-TPA). There is alignment with the approach taken under the TNA regarding prioritization of nationally determined contribution (NDC), and climate risk sectors for mitigation and adaptation respectively, drawing on the NDC and completed vulnerability and climate risk studies.

The BAEF report identifies and summarizes potential barriers to the deployment and diffusion of identified adaptation technologies for coastal erosion and relocation. Additionally, the report highlights prioritized mitigation technologies in the transportation and forestry sectors. The entire process of identifying technology barriers and implementing measures drew from various sources, including literature reviews, stakeholder meetings, bilateral discussions, the mitigation expert working group, and input from technology experts. Adaptation and mitigation consultant also seek reference to the TNA barrier analysis guideline , resources, information, and templates provided by specialists UNEP-DTU Partnership and USP during and after regional capacity building workshops.

Coastal Erosion Sector

The technology implementation barrier for Sea Wall Nature-based Solutions (NbS) and integrated coastal erosion are identified. Economic and financial variables are high capital and maintenance costs, limited financial allocation by the national government, inadequate donor, and loan funding. Policy, legal, and regulatory barriers identified were lack of sound and robust cross-sectorial policies, resource protection, development, and management, and ineffective and meaningless current policies. Lack of public information and awareness about the existence and usefulness of the technology because the information is not sufficient and effective, is part of the barrier to information and awareness variable. Limited institutional capacities, especially at the national level, in integrating climate change risks in development planning is identified as the barrier to institutional and organisational capacity and limited human skills and maintenance, especially at the local level.

To overcome the barriers for sea wall nature-based solutions (NbS), several measures have been identified, including: a**) Financing Requirement** – High capital cost is evidenced with the two technologies prioritized. Thus, we need to ensure that some of these project ideas are incorporated into the national planning and programming of the country. b) **Skills and Institutional Capacity Development** – There is also a need to train environmental engineers and planners to incorporate skills on NbS and ICZM into their designing and planning of such infrastructure. To re-affirm this, the Environment and Conservation Division within the MECDM requires all NbS and other development projects in the country complies with the national Environment Impact Assessment (EIA) and c) **Operation and Maintenance Capacity**- The effectiveness of NbS and ICZM relies on the maintenance and sustainability of these structures and establishments.

Relocation Sector

Some barriers of technologies implementation for relocation sectors have been identified by the adaptation consultant and the working group such as: high capital cost with relocation initiatives, limited financial allocation by national government and international donor not funding relocation initiatives for the economic and financial factors; The policy. Legal and regulatory factors identify the barrier related to lack of sound and robust policies and guidelines to coordinate all forms of relocation in the country, and when there are policies, they are ineffective, meaningless and not relocation focused; Lack of public information and awareness about the existence and usefulness of the technology is part of information and awareness factor; while Solomon Islands also facing the barrier on institutional and organisational capacity such as limited institutional capacities especially at national level in integrating climate change risks in development planning and possible relocation initiatives and limited human skills and maintenance specially at local level.

Based on the analysis, barriers in the relocation sector may be overcome through actions such as: Ensuring adequate financial mechanism is available to support relocation implementation, ensure mainstreaming of climate change considerations into relevant sectoral policies, plans and strategies, strengthening research, training, and technologies awareness – rising among stakeholders, strengthening institutional capacities at national and subnational levels and designing and implementing practical pilot demonstration projects

Transportation Sector

The Solomon Islands' transportation sector is facing a multitude of challenges in implementing green technology. The mitigation consultant and working group have conducted a thorough analysis of the sector, identifying key barriers and challenges that must be addressed to achieve a sustainable and green transportation system.

One of the primary challenges is economic and financial barriers. The high cost of investment, operation, and management is a significant hindrance to the implementation of green technology in the transportation sector. Additionally, the limited financial allocation from the government further limits the adoption of green technologies.

The technical regulations on green infrastructure and electric outboard motors are yet to be implemented in the country, making it difficult to adopt green technology in the transportation sector. The lack of a tax policy to support the implementation of green transportation systems is also a significant challenge. Furthermore, the lack of awareness and understanding of the benefits of green technology in the community has contributed to public pessimism towards

green infrastructure and transportation. The unclear enforcement system and the shortage of power supply for electric outboard motors further compound this.

Organizational barriers also pose a significant challenge to implementing green infrastructure and transportation systems. Private and public developers and lenders perceive low-impact developments to be as expensive as traditional infrastructure and technology. Additionally, limited institutional capacities at the national and local government levels further hinder the implementation of green infrastructure and transportation systems. There is no specific division responsible for green infrastructure and green transportation systems at the national or local government level.

Technical and technological barriers are also prevalent in the transportation sector. Inadequate technical expertise in maintenance for green infrastructure and green transportation systems and the lack of research related to developing these systems using locally available and affordable materials are classified as significant obstacles.

To overcome these challenges, a prioritization of technologies in the transportation sector is necessary. Technical guidelines dedicated to policies for green infrastructure and transportation systems must be developed. Cross-sectoral governments must work together to secure alternative funding to support the implementation of green infrastructure in the form of sustainable roads and green transportation systems for electric outboard motors. A precise tax system formulation is required to support the implementation of green infrastructure in the form of sustainable roads and green transportation systems for electric outboard motors. Finally, a special division in the Ministry of Infrastructure and Development (MID) must be established to oversee the green infrastructure and transportation system, with collaboration from private sectors and local municipalities for operational and maintenance processes. This will ensure the development of a sustainable and efficient green transportation system in the Solomon Islands.

Forestry Sector

The Forestry sector in the Solomon Islands is a critical sector that plays a strategic role in the country's economy. However, the sector faces numerous challenges that hinder its growth and development. One of the primary challenges facing the sector is related to economic and financial factors. High costs associated with preparing primary data for both the National Forest Inventory (NFI) and Network for Terrestrial Protected Areas (N-TPAs) are a significant barrier, along with operational and management expenses, which further exacerbate the problem. The government's limited financial allocation makes it challenging to address these issues. Additionally, the absence of derivative technical policies that can provide guidance for conducting NFI and TPAs poses a considerable challenge.

Policy, legal, and regulatory barriers also exist, with no clear guidance available for forest area data collection from government or community organisations. This lack of guidance hinders the sector's growth and development. Institutional and organizational factors also pose significant barriers, including the complexity and length of administrative procedures for creating N-TPAs, obtaining funding, and developing a regulatory framework. The lack of decision-making or legal prerogatives due to a lack of synchronization further hinders effective management.

Human resources capacity is identified as a critical factor, with appropriate capacity building essential for promoting management effectiveness in N-TPAs and NFI. Technical and human skill barriers exist, and capacity building measures should be implemented to ensure that the sector has the right human resources to drive growth and development.

Infrastructure and technology barriers also exist, including a lack of communication services necessary for data management, particularly the internet network. The differing and potentially conflicting views of the socio-economic and ecological costs and benefits pose significant challenges. Additionally, the lack of compensation measures and awareness among the public and local stakeholders on the role and objectives of N-TPAs pose sociocultural and awareness barriers.

To overcome these challenges, enabling frameworks have been identified that can help the sector overcome these obstacles. These include the development of technical guidelines for NFI and N-TPAs, increased access to financial resources, exploration of donor funding opportunities, allocation of special funds for implementing NFI, and maintaining communication and coordination between stakeholders.

Strengthening the regulatory framework to support decision-making or legal prerogatives in N-TPAs and ensuring that all stakeholders are involved in management and decision-making is also critical. Providing training on forest ecology and socio-economic issues in schools, universities, professionals, and the community is essential to have sufficient trained support personnel. Promoting continuous training among various professions and encouraging actors to work towards implementing shared goals is also important.

In conclusion, the Forestry sector in the Solomon Islands faces several challenges, but with the right enabling frameworks in place, it can overcome these barriers and achieve its full potential.

CHAPTER 1
ADAPTATION TECHNOLOGIES FOR COASTAL EROSION SECTOR

1.1 Preliminary targets for technology transfer and diffusion in Coastal Erosion Sector.

1.1.1 Introduction

Accelerating land degradation and soil erosion due to the impact of climate change has negative impacts on coastal communities across the Pacific (Wairiu, 2017)[1]. In the Solomon Islands this trend is prevalent at various locations across the country (Lane, 2006)[2]. The negative impacts include coastal erosion, washing away of sediments into coastal waters, affecting food production, poor water quality, coastal fisheries/reefs, and tourism (Pioch et al., 2011)[3]; wastewater, leachates and untreated sewage that negatively impact food security, infrastructure, human health, and coastal corals and fisheries; serious health and environmental issues linked to solid waste management in general at various locations in the country (National Waste Management and Pollution Strategy 2017-2026)[4].

Existing literature has confirmed the multiple negative impacts that climate change and increasing population pressure on land and ecosystem systems have on current and future island populations (Pelling & Uitto, 2001; Stephenson, et al 2010)5 [6]. With such a backdrop, the Solomon Islands Government through the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) has recommended that the Technology Need Assessment (TNA) process focus on developing technologies under the "Coastal erosion sector (CES) under this project (Solomon Islands NTA Report,2022)[7].

1.1.2 Prioritized Technologies

In the initial phase of TNA, with input from climate change Adaptation Expert Working Group members and stakeholders, six adaptation technologies were identified in the CES. Ultimately, two technologies were prioritized through a multi-criteria assessment (MCA) process due to their significance in reducing community vulnerability to the severe impacts of climate change.

The study has adopted a Multi-Criteria Analysis (MCA) in prioritizing potential technologies. MCA is one of the main decision-making tools that aims to determine the best alternative by considering more than one criterion in the selection process. MCA has manifold tools and methods that can be applied in different fields, from finance to engineering design. The prioritized technologies are in Table 1 below.

1 Wairiu, M. (2017). Land degradation and sustainable land management practices in Pacific Island Countries. Regional Environmental Change, 17, 1053-1064.

2 Lane, M. B. (2006). Towards integrated coastal management in Solomon Islands: Identifying strategic issues for governance reform. Ocean & Coastal Management, 49(7-8), 421-441.

3 Pioch, S., Kilfoyle, K., Levrel, H., & Spieler, R. (2011). Green marine construction. Journal of Coastal Research, (61), 257-268.

4 National waste Management and Pollution Control Strategy, 2017-2026, MECDM Honiara, Solomon Islands.

5 Stephenson, J., Newman, K., & Mayhew, S. (2010). Population dynamics and climate change: what are the links. Journal of Public Health, 32(2), 150-156.

6 Stephenson, J., Newman, K., & Mayhew, S. (2010). Population dynamics and climate change: what are the links. Journal of Public Health, 32(2), 150-156.

7 TNA Report (2022), Prioritization of Technologies, Ministry of Environment, Climate Change, Disaster Management & Meteorology, Honiara, Solomon Islands.

Table 1 Prioritized technologies for Coastal Erosion Sector

No:	**Prioritized Technologies**	**Ranked**
1	Climate Trust fund	3
2	Coastal Vegetation restoration	6
3	Integrated coastal zone management.	**2**
4	Sandbags	5
5	Sea wall- nature based solution	**1**
6	Sea wall-hardware	4

1.1.3 Level of experience with the technology

The Solomon Islands government has some levels of experienced with most of the listed technologies above in table 1, some of which are in use at various locations across the country, with associated levels of challenges related to ease of deployment and quick spread to other communities. To ensure sustainability of these technologies post-implementation, Phase II of the TNA process establishes preliminary targets for the transfer and diffusion, focusing initially on the first two prioritized technologies in the sector.

Figure 1 Replanting of mangrove forest as a form of NbS against sea level rise across the vulnerable communities.
(Source: Cam.ac.uk, 2023)

1.1.4 Objectives of the Prioritized technologies

The following objectives have been established to make a positive impact and drive change using prioritized technologies:

1. Obtain funding to establish and implement nature-based solution applications in at least 20 identified communities nationwide within the next five years. This will help to promote sustainable development by utilizing eco-friendly technologies that support the conservation of natural resources.
2. Implement integrated coastal zone management (ICZM) at selected sites nationwide by 2028. This will ensure that coastal zones are managed sustainably while also promoting economic growth and protecting the marine ecosystem.

3. Introduce coastal vegetation restoration programs at 20 selected sites and involve stakeholders in the TNA Process in locally managed marine areas by 2026. This will involve planting vegetation such as mangroves, which will stabilize the shoreline and provide habitats for marine life. By involving stakeholders in the process, we can ensure that the restoration programs are tailored to the specific needs of each community, and that they are sustainable in the long run. These objectives will help to create a positive impact on the environment and promote sustainable development.

1.1.5 Stakeholders Participation in the TNA Process

It is acknowledged that to achieve the preliminary targets of transfer and diffusion of technologies in coastal erosion sector, the relevant stakeholders must get involved and play active roles in the successful implementation of the identified technologies. The important stakeholders include coastal sectors related policy makers, experts, relevant authorities such as MECDM[8], Ministry of Lands Housing and Survey (MLHS), Ministry of Provincial government and Institutional Strengthening (MPGIS). Other players include technology dealers, technicians, and experts in water sector. The implementers include Non-Government Organizations (NGO) and Community Based Organizations (CBO) focusing on communities, advocacy groups of women, youth, marginalized members in the communities, village leaders active at local and national levels.

According to Roberts (2011)[9],' stakeholder analysis can also help a project or programme identify, the interests of all stakeholders who may affect or be affected by the programme/project; potential conflicts or risks that could jeopardize the initiative; Opportunities and relationships that can be built on during implementation.

1.1.6 Different stages of the TNA project Implementation.

The **figure 2** below summarizes the TNA project implementation in the Solomon Islands.

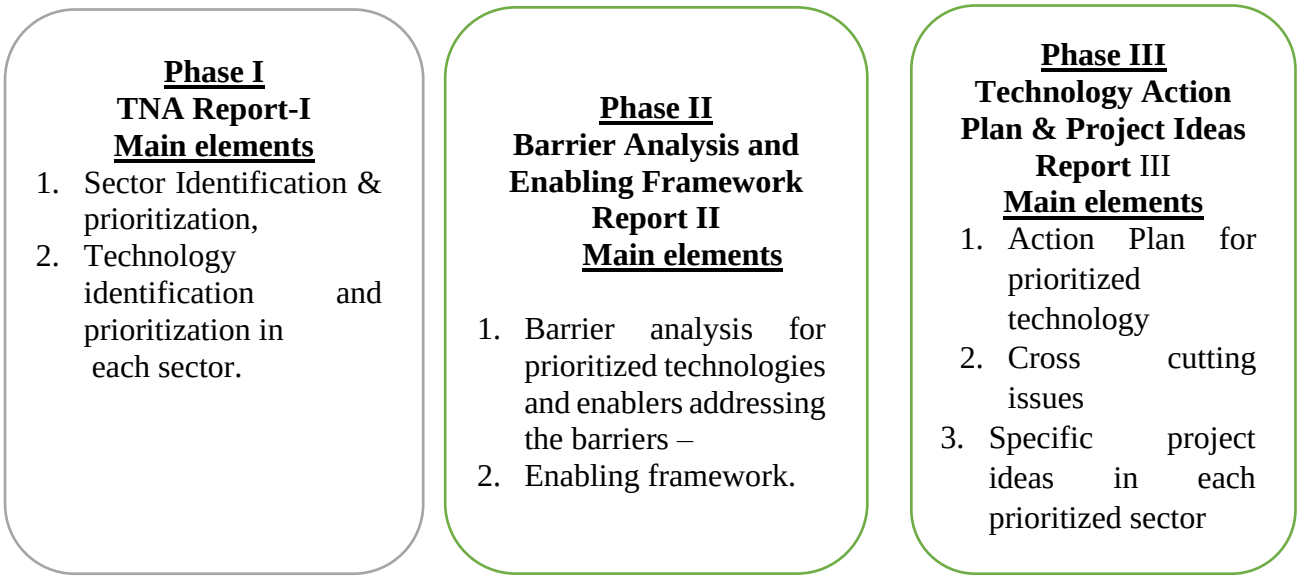

Figure 2 Different stages of TNA project implementation in Solomon Islands

8 MECDM- is the Principal Ministry of the TNA project in the Solomon Islands

9 Roberts, P. (2011). Effective project management: Identify and manage risks plan and budget keep projects under control. Kogan Page Publishers.

1.2. Methodology

This document reports the output of the Phase II of the TNA process for Adaptation and Mitigation for Solomon Islands. The paper primarily covers the barriers analysis and transfusion, enabling framework and key measures collectively identified to overcome the barriers. For each prioritized technology identified, a systematic approach of describing and analyzing each technology related barrier and identification of enabling framework was adopted. The following keys steps were undertaken as part of the process.

TNA Phase II Process:

a) Identifying of preliminary targets for technology development and diffusion at the sectoral scale.
b) Describing of technologies identified. Provision of its potential adaptation benefits. Determine and categorize whether such technology is a market or public good with some description of its status across the country.
c) Identifying of key measures for overcoming the barriers, possible linkage between different technology barriers within a sector and device a technology enabling framework would help overcome potential barriers while creating a supporting environment for the development and successful diffusion of the selected technologies.

1.2.1 Desktop Reviews

The consultants undertook an extensive literature review of existing country reports and articles around coastal erosion, relocation for adaptation and forestry and transportation sector for mitigation. Bilge & Dumitraş (2012) emphasize the critical role of desktop reviews in understanding researched topics. Thus, the report undertook literature review to understand the context of the selected adaptation and mitigation sectors in the country. Some of the documents studied include, NBSAP (2014)[10], Solomon Islands Ridge to Reef Islands Diagnostic Analysis Report (2021)[11], The National Development Strategy (2016-2035), This process has helped to formulate and finalize the Second Phase of the TNA report.

1.2.2 Validation Consultation meetings

After the desktop review process, a series of workshops and bilateral meetings were held by both the Adaptation and Mitigation consultants with respective Technical Working Groups. These series of meeting were critical to verify and validate the ideas captured through the desktop review and the preliminary meetings whether they are correctly reflected in the final report.

10 National Biodiversity Strategic Action Plan (2014). MECDM, Honiara, Solomon Islands
11 Pacific International Waters Ridge to Reef Regional Project, Pacific Community (SPC), Suva, Fiji

Table 2 Methods followed in the barrier analysis and enabling framework

	MAIN STAGES OF ANALYSIS	METHODS AND TOOLS
1	Identification of Stakeholders	• Phase 1 of TNA process
2	Identification of Potential barriers	• Literature Review, consultation meetings and brainstorming
3	Analysis of barriers	• Use of logic thinking problem tree design, expert opinions, and consultations
4	Measures developed to overcome barriers	• Translating barriers into measures using solution tree during Technical Working Group consultations
5	Screening and validation of important barriers and measures	• Validation through extensive consultation during TWG consultations
6	Preparation of the BAEF Report (Draft)	• TNA Adaptation & Mitigation consultations drafted report
7	Final Report	• First CCC/USP expert reviewed and then MECDM/NTASC approval of the report.

1.2.3 The TNA Project Steering Committee

The TNA Project Steering Committee consists mainly of senior staff within the Principal Ministry, the MECDM, which oversees climate change and resilience activities across the country. It then extends to other relevant line ministries such as the Ministry of Lands Housing and Survey (MLHS), Ministry of Fisheries and Marine Resources (MFMR), Ministry of Forestry and Research (MFR) and Private Sector representatives through Solomon Islands Chamber of Commerce (SICCI) and NGOs. In their deliberations, the committee agreed that the TNA process should focus only on the four sub-sectors under the Adaptation and Mitigation (Coastal erosion, relocation, transport, and forestry sectors) respectively.

1.3 Barrier Analysis and possible enabling measure for Nature Based Solution (NbS) Sea wall.

1.3.1 General description of Nature based Solution (Sea wall)

Vulnerable coastal communities across the country resort to various forms of adaptation strategies when deciding to build barriers and other forms of re-enforcements against sea level rise or coastal erosion (Leal Filho et al., 2020)[12]. Companies and individuals often use hard materials such as concrete cement and pillars as barriers to contain coastal erosion without considering the potential environmental impacts of these barriers. According to Schipper (2020)[13] this kind of adaptation is referred to as Maladaptation because it may address a specific identified problem in the short term as it may prevent erosion of the soil but at the same also create another in the longer term. For example, building sea walls with hard concrete may destroy the habitat of many living organisms under the sea or along the riverbank.

12 Leal Filho, W., Ha'apio, M. O., Lütz, J. M., & Li, C. (2020). Climate change adaptation as a development challenge to small Island states: A case study from the Solomon Islands. Environmental Science & Policy, 107, 179-187.

13 Schipper, E. L. F. (2020). Maladaptation: when adaptation to climate change goes very wrong. One Earth, 3(4), 409-414.

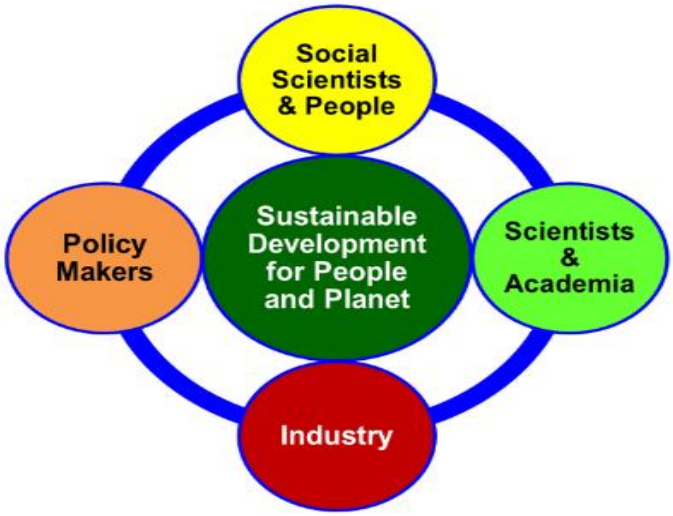

Figure 3 The stakeholders of Nature Based Solution Technology (Source: Bhore, S.J., 2016)

1.3.2 Types of Nature-based Solution (Sea wall)

Nature-based solutions are actions to protect, sustainably manage, or restore natural ecosystems, that address societal challenges such as climate change, human health, food and water security, and disaster risk reduction effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (Seddon et al., 2021)[14]. Implementing nature-based solutions in sea wall construction involves utilizing vegetation to build flood barriers, safeguarding infrastructure along coastal areas and riverbanks. These flood barriers to protect critical infrastructure include levees, dikes, and seawalls. Below is a NbS technology adopted from Fiji Islands.

Figure 4 Example of Nature based Solution (sea wall) in Fiji Islands (Source: Elenoa Turagaiviu, 2022)

14 Seddon, N., Smith, A., Smith, P., Key, I., Chausson, A., Girardin, C., ... & Turner, B. (2021). Getting the message right on nature-based solutions to climate change. Global change biology, 27(8), 1518-1546.

1.3.3 Technology status in Solomon Islands

Nature based Solution Nature-based solutions have a long history as adaptations used by rural villages and communities to build resilience (Kabisch et al., 2016)[15]. The communities planted mangroves forest and coconut trees along the coastal areas as form of barrier against sea level rise and as fortress against strong winds and cyclones. According to Albert et al., (2017)[16] mangroves, coral and sea grass ecosystem respond to sea level rise. This study supports with an earlier finding that emphasizes the critical role of mangroves in shoreline protection and buffering against sea level rise. Thus, this technology is not new across the country; however, it just needs to be designed properly to yield maximum benefit to the communities.

The current status of Nature-based Solutions (NbS) technology in Solomon Islands is encouraging, as the country has already established the institutional capacity required to implement NBS successfully. This involves identifying relevant expertise, funding mechanisms, coordination mechanisms, and partnerships for NBS implementation. To ensure that the implementation of NBS proceeds smoothly, the local university, Solomon Islands National University, has joined forces with Royal Melbourne Institute of Technology and University of Melbourne to conduct research on various aspects of NBS. The research conducted includes assessing the effectiveness of NBS interventions, exploring technological innovations for ecosystem restoration and management, and developing knowledge exchange platforms for sharing best practices and lessons learned (https://www.researchgate.net/publication/358045464_Nature_based_Solutions_Climate_Resilient_Honiara).

Community engagement is an essential component of NBS implementation in Solomon Islands. The country assesses community awareness, knowledge, and capacity to implement NBS practices. Additionally, the country evaluates the presence of mechanisms for community consultation, empowerment, and co-management of natural resources.

Solomon Islands recognizes the importance of having policies, regulations, and frameworks that support the adoption and implementation of NBS. The country has established national strategies for climate change adaptation and mitigation, biodiversity conservation, sustainable land management, and disaster risk reduction that incorporate NBS principles. However, the country needs to continue evaluating the presence of these policies to ensure they are effective in supporting NBS implementation.

1.3.4 Technology category and market characteristics

The NbS technology can be categorized as non-market public goods when established at a community level and requires national or provincial governments' support to develop and manage such technology implementation. In several contexts, such technology could be a private good, if it is established for recreational or tourism investments objectives. However, for this purpose the technology is categorized as public good because of the intention to benefit the whole communities or villages.

15 Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., ... & Bonn, A. (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. Ecology and society, 21(2).

16 Albert, S., Saunders, M. I., Roelfsema, C. M., Leon, J. X., Johnstone, E., Mackenzie, J. R., ... & Woodroffe, C. D. (2017). Winners and losers as mangrove, coral and seagrass ecosystems respond to sea-level rise in Solomon Islands. Environmental Research Letters, 12(9), 094009.

1.4. Identification of Barriers for The Nature Base Solution Technology

According to Chan et al., (2017)[17], barriers are the factors that prevent the smooth implementation of any project. In this study, barriers include:

a) High capital cost,
b) Insufficient legal and regulatory framework for NbS technology implementation,
c) Lack of incentives for community ownership and participation,
d) High level of land dispute,
e) Inadequate information on societal benefit of technology,
f) Limited institutional capacity and management skills of responsible authority

1.4.1 Screening and prioritization of identified barriers

After compiling the potential barriers list, it was presented to the coastal erosion sector technical working group (CESTWG) to screen the list and identify the essential barriers that need to be addressed for technology transfer and diffusion to take place, as well as the non-essential barriers that were to be ignored (see annex 3). Barrier analysis tools such as the starter problem and solution trees were used to speed up prioritizing of barriers through consensus among the CESTWG. Through this process, the final list of barriers was identified and briefly discussed below.

1.4.2 Economic and financial barriers

a. **Capital cost -** Capital costs are fixed, one-time expenses incurred on the purchase of land, buildings, construction, and equipment used in the production of goods or in the rendering of services (Savas & Savas, 2000). In other words, it is the total cost needed to bring a project to a commercially operable status. In this technology, the capital cost involves the expenses related to setting up the NbS (sea wall) at the selected sites. Subsequently, the maintenance cost, categorized as a public good, covers the ongoing development, operation, and maintenance, all of which fall within the same public budget.
b. **Maintenance cost** – As the technology is classified as a public good, its development, operation and maintenance would also remain under the same public budget. Having said that, Nature Based solution is not a new concept across the country; nevertheless, many communities do not invest in this technology because of the capital cost and reinforcement or maintenance cost it may incur in the long term. Communities along the coastline areas have been anticipating if this is the kind of assistance that should be factored within the national government development budget.

Table 3 Expenses related to building a single NbS technology

Main costs of Producing NbS technology USD$		
Activites	Detail	Costs
Structures- Rocks	If need to shifted from other areas	300,000
Earth Works-	Depending on the size of the sea wall	100,000
Planing of Vegestation	Introduction native trees if not available	100,000
Logistics	Transport costs	100,000
Total cost		**600,000**

17 Chan, A. P., Darko, A., Ameyaw, E. E., & Owusu-Manu, D. G. (2017). Barriers affecting the adoption of green building technologies. Journal of Management in Engineering, 33(3), 04016057.

c. Inherited risk of the NbS Sea wall

Inherited risks are the costs associated with maintenance and repairs during the implementation of the NbS project idea, including the reinforcement of natural barriers and the maintenance of the NbS sea wall over the years. However, these nature-based solutions present additional challenges such as addressing knowledge gaps, managing trade-offs, implementing successful actions, dealing with natural elements, and financing projects. Concerns also arise regarding their reliability and cost-effectiveness when compared to engineered alternatives, as well as their resilience to climate change, as highlighted by Sowińska-Świerkosz & García (2022)."

1.4.3 Non-Financial Barriers

a. Policy, legal, and Regulatory

In-effective NbS policy – National Biodiversity Strategic Action Plan (2016-2020)[18]**-** This policy document has been formulated to oversee and regulate biodiversity conservation efforts throughout the country. Although it may not explicitly outline the objectives of Nature-based Solutions (NbS), it does promote, and support various critical activities aimed at protecting the environment and fostering its growth. The biodiversity within the Solomon Island's geographical and political boundaries faces constant pressure from habitat destruction, overexploitation, waste, invasive species, and climate change (Kereseka, 2021)[19]. Capacity constraints emanating from the absence of biodiversity values, institutional constraints including weak environment impact assessment enforcement on coastal resources, inadequate financing, and a lack of scientific information are consequently undermining effort to lessen these pressures on biodiversity (Lam & McDonald, 2006)[20].

b. Technical Level

Limited local capacity- According to Ferreira et al., (2021),[21] despite local knowledge around NbS, designing a modern nature-based solution structure requires qualified and experienced environmental and ecological engineers focused on engineering applications to land and water resources, air and soil quality, land-use management, ecosystem services, ecological restoration, and waste management. In the Solomon Islands most villages at both local and national levels lack access to these modern specialized skills. Since the country is still developing, more focus on the infrastructure development. However, due to the lack of expertise in the community and nationally, the idea of addressing the problem had to be delayed because an international expertise is needed and getting one had to go through a lot of processes for approvals and permits before actually having them on site. On the other hand, having an expertise in the community or nationally would reduce the cost of bring them from abroad, or rather than waiting for someone from abroad, the national expertise is already close to the site and can assist the community with much less waiting time and no need of international permits which takes time.

18 NBSAP (2016-2020). Environment Division, Ministry of Environment, Climate Change, Disaster Management & Meteorology, Honiara , Solomon Islands

19 Kereseka, J. (2021). Solomon Islands Ridge to Reef Island Diagnostic Analysis Report.

20 Lam, M., & McDonald, J. (2006) National Capacity Self-Assessment Stock Take Report Convention on Biological Diversity.

21 Ferreira, C. S. S., Potočki, K., Kapović-Solomun, M., & Kalantari, Z. (2021). Nature-based solutions for flood mitigation and resilience in urban areas. In Nature-Based Solutions for Flood Mitigation: Environmental and Socio-Economic Aspects (pp. 59-78). Cham: Springer International Publishing.

c. Social, cultural, and behavioural

Land tenure- Most lands in the Islands are customary or tribal owned (Sullivan 2018)[22], making development, especially for community benefits, challenging. To address this complexity, there must be a greater level of civic education for community members to support and buy into NbS implementation at the local levels.

Ownership question- There is often a limitation in communal properties or structures for public uses. The question of public or state ownership and funding usually generates a "no care" attitude towards such investments. Usually, if a community member destroys such property, there is weak, or no penalty imposed on the culprit.

Perception of such technology- Generally, projects funded under aid money are public assets or properties leading to the belief that such funding assistance are short-term oriented and there shouldn't be concern about building capacity for future generations' benefits (Wallace, 2010)[23].

d. Information and awareness

Potential benefits of the technology- There is limited knowledge and awareness of the potential benefits that NbS technology could have on the coastal community and their surrounding environment. Additionally, Nature-based solutions are often designed to bring benefits to both people and nature. For example, planting native forests in watersheds can help naturally filter water supplies and buffer flooding, while building NbS sea wall can help provide biodiversity habitat and restore ecosystems.

Limited awareness of climate change and hazardous events- There may be some awareness of the impact of climate change on coastal communities, but little can be directly linked with societal challenges through the protection, sustainable management, and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being at the local level.

Need for community cooperation through participation- There is often little awareness of the need for community engagement and cooperation to achieve community harmony and collaboration for the public good. According to Head (2007) [24]when such awareness is available, the terms will be accepted by the communities.

1.5 Identified measures.

This section discusses the necessary measures to overcome identified barriers in implementing NbS technology across the country This study has employed the problem tree solution as it's key approach and analysis. According to Madu et al., (2018)[25] conducting a problem tree/solution provides a means to review the existing understanding of the underlying causes to a specific problem and how it can be overcome. Moreover, by employing the problem tree solution, the study efficiently filters out the effects from the root causes of the problems, enabling the allocation of resources toward addressing the identified underlying issues. The method involved a series of bilateral consultations with key stakeholders, which proved critical

22 Sullivan, M. (2018). Recognition of customary land in the Solomon Islands: status, issues and options.

23 Wallace, H. (2010). The Solomon Islands: conflict and capacity. In Challenging Capacity Building: Comparative Perspectives (pp. 133-155). London: Palgrave Macmillan UK.

24 Head, B. W. (2007). Community engagement: participation on whose terms? Australian journal of political science, 42(3), 441-454.

25 Madu, I., Adesope, O., & Ogueri, E. (2018). Application of problem tree analysis in solving poverty related issues. Glob. Approaches Ext. Pract.(GAEP), 13, 62-69.

in identifying the measures necessary to overcome and eliminate the identified barriers. The stakeholders list included refer to **annexes 2.**

1.5.1 Economic and financial measures

a) **High initial and capital cost** – To compensate for the high capital cost in relation to the establishment of NbS (sea wall) technology, the national government may consider providing incentives (tax waivers and duties) through the Customs and Excise division to communities and individuals who have participated in importation of equipment for such establishments.

b**) High maintenance cost –** The communities may have to meet some of the maintenance and improvement cost of the technology. This means they must maintain structures and replant trees or replenish rocks or sand if there is damage to the ecosystems.

c) Inherited risk – replenishment of the vegetation surrounding the NbS implementation site must be carried out through the routine maintenance of the technology. This is to ensure that there is long-term sustainability with the project.

1.5. 2 non-financial measures

Commonly observed across the Small Islands Development states (SIDS) particularly in poor and developing countries, the existence of non-financial technology management practices is primary reactive due to a limited understanding of the technological, socio-economic, and institutional aspect of its implementation, management, and diffusion. For example, non-financial barriers to the implementation of Nature-based Solutions (NbS) technology necessitate the development and adoption of the following measures:

a. Policy, legal and regulatory

Ineffective NbS policy – Besides the NBSAP which is a very broad document on biodiversity and environment management, there needs to be a specific policy developed for the purpose of coastal communities NbS (Seawall) technology implementation in the country. The national or provincial government must assist the communities with such initiatives to be effective.

Legal framework – The national government should establish a legal framework that safeguards and encourages the participation of local communities in these initiatives. This ensures that the development of such initiatives complies with relevant environmental impact assessment and does not harm the surrounding ecology prior to implementation.

Regulatory – Communities who participate in these initiatives should have the ability to report any violation of regulations and rules related to NbS (seawall) technology to the relevant authorities.

b. Technical Level

Weak Research Capacity – The national government, through the MECDM, must collaborate with regional and international organizations with experience in similar projects across the region. For example, the Asian Development Bank (ADB) has assisted the Fiji Ministry of Waterways in implementing NbS coastal area seawall constructions projects in more than 10 communities across the country. Regional organizations possess strong analytical tools to determine the design and structure of NbS tailored to specific communities.

Limited local capacity – According to the CESWTG discussions, participants have indicated that there are many qualified civil engineers in the country but there is a

shortage of ecological and environmental engineers to design NbS technologies that suit the local context.

c. Social, cultural, and behavioural issues

Ownership – Local communities must have a sense of ownership of NbS (seawall) technology on the ground for long-term success. It is through this ownership that the communities actively participating in the project can guarantee its sustained success over time.

Perception of such technology – Civic education must be extended to community members to transform their perception about such projects. The goal is to transform their view of these projects from mere infrastructures to community gifts. Efforts should be directed toward fostering acceptance and emphasizing the long-term benefits for all involved.

d. Information and awareness

Potential benefits of such technology – Civic education about NbS seawalls should be disseminated to coastal communities, highlighting the integrative strategies to reduce climate risks and the additional benefits, such as climate regulation, recreation, health, tourism, food, and drinking water.

Limited awareness of climate change – The MECDM, through the climate change division, must play its role in educating the rural communities about building NbS structures as part of protecting their shores against sea level rise and impact of climate change. Civic education will enhance knowledge about climate change's effects and how coastal communities can build resilience in the face of extreme events.

1.6 Barrier Analysis and possible enabling measures for Integrated coastal zone management.

1.6.1 General description of Integrated coastal zone management technology

Since the last decade, integrated coastal zone management (ICZM) has been widely considered as a viable alternative to conventional sectoral management (Thia-Eng ,1993)[26].In the Solomon Islands, some of the vulnerable communities have also adopted different forms of adaptation approaches including coastal zone management technologies, to minimize sea-level rise and coastal erosion at diverse locations across the country. ICZM is a resource management system following an integrative, holistic approach and an interactive planning process to address complex management issues in the coastal area (Garmendia, et al., 2010)[27].

26 Thia-Eng, C. (1993). Essential elements of integrated coastal zone management. Ocean & Coastal Management, 21(1-3), 81-108.

27 Garmendia, E., Gamboa, G., Franco, J., Garmendia, J. M., Liria, P., & Olazabal, M. (2010). Social multi-criteria evaluation as a decision support tool for integrated coastal zone management. Ocean & Coastal Management, 53(7), 385-403.

Figure 5 Integrated Coastal Zone Management Conceptual Model (Source: Morales, J.A. ,2022).

According to **Figure 5** above, communities and individuals who participate in coastal resources management must adopt and incorporate an array of factors to build resilience against climate change. These factors include natural, social, and economic processes. The conceptual model entails that ICZM is a dynamic, multidisciplinary, and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning (in its broadest sense), decision-making, management and monitoring, and building cases for learning and future operations.

1.6.2 Integrated coastal zone management technology status in Solomon Islands

Like nature-based solution concept, integrated coastal zone management is not a new technology among rural communities across these Islands. For many years, coastal communities have been involved in some form of ICZM strategies, particularly when managing their resources, although some of these actions may not have been structurally coordinated. For example, communities have also participated in the 'Ridge to Reef' initiatives. According to Mcleod et al., (2019)[28], the Ridge to reef initiative aims to provide a holistic intervention for protecting the coastal area by targeting environmental degradation in the uplands ("ridge") that impact coastal ecosystems through sedimentation. Communities have planted mangrove forests and coconut trees along the coastline areas as a sort of barrier against sea level rise and as a fortress against strong winds and storms. By rebuilding the shoreline and maintaining marine ecosystems ("reef"), thereby decreasing storm surges. Thus, this technology is not new across the country, nevertheless, like NbS technology, it just needs to be designed properly to yield maximum benefit to the communities.

28 Mcleod, E., Bruton-Adams, M., Förster, J., Franco, C., Gaines, G., Gorong, B., ... & Terk, E. (2019). Lessons from the Pacific Islands–adapting to climate change by supporting social and ecological resilience. Frontiers in Marine Science, 6, 289.

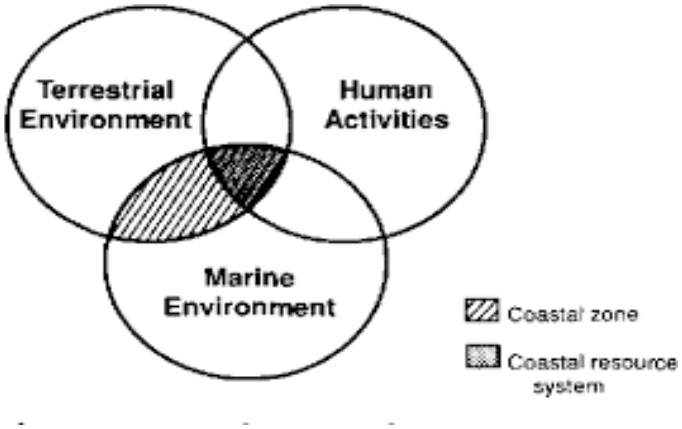

Figure 6 Essential elements of Integrated Coastal Zone Management (ICZM) (Sumber: Thia-Eng, 1993)

The three main components of Integrated coastal zone management include Terrestrial, Human activities and Marine Environment **(refer figure 6 above**). Proper management of these three areas is essential for achieving effective ICZM at the local levels.

1.6.3 Support for this technology

a. Technology and market characteristics

The ICZM technology can be categorized as non-market public goods when established at a community level and requires national or provincial governments' support to develop and manage the technology's implementation for long term sustainability. In some countries, the national government has declared coastal beaches as public goods (Barragán Lazo, 2018). In several contexts, such technology could be a private good, if it is established for recreational or tourism investments targets. Nevertheless, for this purpose the technology is categorized as a public good because of the intention to benefit the whole community or villages.

b. Identification of barriers for the ICZM technology

The workshop identified the following barriers that may need to be addressed for the smooth establishment and implementation of project ideas. The barriers include:

i. High cost of capital
ii. Insufficient legal and regulatory framework for ICZM technology implementation
iii. Lack of incentives for community ownership and participation
iv. High level of land dispute
v. Inadequate information on societal benefit of technology
vi. Limited institutional capacity and management skills of responsible authority

1.6.4 Screening and prioritization of identified barriers

After the compilation of the potential barriers list, it was presented to the coastal erosion technical working group (CETWG) to screen the list and identify the essential barriers that need to be addressed for technology transfer and diffusion to take place, as well as the non-essential barriers that were to be ignored. Barrier analysis tools, such as the starter problem and solution trees, were used to speed up prioritizing of potential barriers. Through consensus among the CESTWG, the final list of barriers was identified and briefly discussed below.

1.6.5 Economic and financial barriers

a) Capital and Maintenance cost – The technology is classified as a public good, therefore its development, operation and maintenance would also remain under the public budget of the national government. However, it's important to note that like NbS technology, ICZM is not a new concept across the country. Nevertheless, many communities do not invest in this technology because of the ***high capital cost*** *such* technology establishment would accrue in the long term. Communities along the coastline areas have been anticipating if this kind of assistance should be factored within the national government's development budget for future planning.

Figure 7 Coastal area management in Honiara, Solomon Islands (Source: Pollard, Taraha and Airahui, 2011)

b) Capital expenditures

In addition to capital and maintenance cost, the capital expenditures are the initial costs incurred in the acquiring high value assets during establishments of projects. These may include purchase of land, buildings, construction, and equipment used in the production of goods or in the rendering of services. According to Seddon et al, (2020)[29], it is the total cost needed to bring a project to a commercially operable status. In this technology, the capital expenditures involve the costs of activities related to setting up of ICZM at the selected sites.

29 Seddon, N., Chausson, A., Berry, P., Girardin, C. A., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. Philosophical Transactions of the Royal Society B, 375(1794), 20190120.

Table 4 Expenses related to establishment of a single ICZM technology.

Main costs of Producing ICZM technology USD$		
Activites	Detail	Costs
Structures- Rocks	If need to be shifted from other areas	300,000
Earth Works (If needed)	Depending on the scope of the ICZM	100,000
Planing of Vegestation	Introduction native trees if not available	100,000
Logistics	Transport costs	100,000
Total cost		600,000

c) Inherited risk of the ICZM

The costs associated with establishing and maintaining the natural environment during the implementation of ICZM project are considered inherited risk (Naumann, et al, (2011)[30]. These costs include the replanting of natural barriers and maintaining the ICZM concept intact over the years. Additionally, the ICZM implementation can pose a few challenges similar to NbS, including addressing knowledge gaps, managing trade-offs, implementing successful actions, dealing with natural elements, and financing projects. Concerns also exist regarding their reliability and cost-effectiveness compared to engineered alternatives, as well as their resilience to climate change.

ICZM addresses societal challenges through resource planning, protecting the environment, and sustainable managing and restoring both natural and modified ecosystems which benefits both biodiversity and human well-being (Albert et al., 2019)[31].

1.6.6 Non- Financial Barriers -

a. Policy, legal, and Regulatory

Ineffective ICZM policy – National Biodiversity Strategic Action Plan (2016-2020): This policy document oversees biodiversity conservation across the country. While it may not be ICZM specific, it promotes activities critical for better planning, zoning, protecting, and environmental conservation. As stated earlier, biodiversity within the Solomon Islands faces continuous pressure from habitat destruction, overexploitation, waste, invasive species, and climate change. The absence of biodiversity values, institutional constraints, insufficient finance, and the lack of scientific information, similar to capacity constraints of NbS technology, further undermine efforts to mitigate these pressures.

30 Naumann, S., Davis, M., Kaphengst, T., Pieterse, M., & Rayment, M. (2011). Design, implementation, and cost elements of Green Infrastructure projects. Final report, European Commission, Brussels, 138.

31 Albert, C., Schröter, B., Haase, D., Brillinger, M., Henze, J., Herrmann, S., ... & Matzdorf, B. (2019). Addressing societal challenges through nature-based solutions: How can landscape planning and governance research contribute. Landscape and urban planning, 182, 12-21.

b. Technical level

Limited local capacity

Despite local knowledge of integrated coastal zone management, designing a meaningful ICZM structure requires experienced environmental and ecological personnel. Most local villages may lack access to these specialized skills. According to McFadden, (2007)[32], local knowledge must be considered in such initiative designs to achieve long-term sustainability.

c. Social, cultural, and behavioural

Land tenure

As previously mentioned, a majority of the lands on the Islands are owned through customary or tribal ownership. This presents a significant challenge in developing projects that can benefit the community due to land disputes and the complex nature of land ownership. To overcome this challenge, the ICZM TWG recommends increasing civic education for community members. By doing so, it will support the implementation of ICZM at the local level. Additionally, this barrier is also apparent for Nature-based Solutions (NbS) technology, which was previously discussed. The lack of clarity and understanding around land ownership and usage can significantly hinder the implementation of NbS technology, which can have a substantial impact on biodiversity and the environment. Therefore, it is crucial to address this challenge and provide community members with the necessary education to support the development of sustainable projects that can benefit both the environment and the community.

Ownership question

Communal properties or structures for public use often face limitations. The question of public or state ownership and funding usually generates a lack of care attitude towards such investments. If a community member destroys such property, there is usually weak, or no penalty imposed on the culprit.

Perception of such technology

Projects funded under aid money are generally perceived as public assets or property, leading to the perception that such funding assistance is short-term. It is important to address this perception and instil a sense of responsibility for the long-term well-being of these projects and benefit of future generations. According to Schoeffel, (1997)[33] there are myths around donor funded projects across the Melanesian region that often lack public support.

d. Information and awareness

Potential benefits of the technology

There is limited knowledge and awareness of the potential benefits that ICZM technology could bring to coastal community and their surrounding environment. ICZM solutions are often designed to benefit both people and the environment. For example, proper planning and zoning enable communities to plant trees or native forests along the coastal sites, providing a natural buffer against coastal erosion. Additionally, ICZM contributes to biodiversity habitat and ecosystem restoration.

Limited awareness of climate change and hazardous events

While there may be some awareness about the impact of climate change on the coastal communities, little can be directly linked to societal challenges through the protection,

32 McFadden, L. (2007). Governing coastal spaces: the case of disappearing science in integrated coastal zone management. Coastal Management, 35(4), 429-443.

33 Schoeffel, P. (1997). Myths of community management: sustainability, the state and rural development in Papua New Guinea, Solomon Islands and Vanuatu.

sustainable management, and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being at the local level. The importance and benefits of ICZM technology implementation needs to be properly explained to communities.

Need for community cooperation through participation

There is often little awareness of the need for community engagement and cooperation to achieve community harmony and collaboration for the public good. Part of this technology involves educating the coastal communities about the importance of ICZM into the future.

1.7 Identified measures.

This section of the report aims to discuss the measures that are needed to overcome the identified barriers to the possible implementation of ICZM technology across the country. The primary methodology adopted in this process involves the development of a problem and solution tree, also known as the fishbone approach, through stakeholder consultation and participation. Additionally, a detailed analysis of current national practices in the relevant sectors was conducted. The series of bilateral consultations with relevant stake holders informed the identification process of key measures necessary to overcome and eliminate the identified barriers (Refer to annex 4 for participants list).

1.7.1 Economic and financial measures

a) **High initial and capital cost** – To offset the high capital cost associated with the establishment of ICZM technology, the national government may consider providing incentives (tax waivers and duties) through the Customs and Excise division to communities and individuals interested in importing equipment for such establishments.
b) **High maintenance cost** – Communities may be required to cover some of the maintenance and improvement costs of the technology. This entails maintaining structures and replanting trees in the event of ecosystem damage.
c) **Inherited risk** – Sustaining the vegetation within the ICZM implementation site must be carried out through the routine maintenance of the technology. This is essential for ensuring the long-term sustainability of the project.

1.7.2 non-financial measures

Non-financial technology management practices are commonly observed across Small Islands Development States (SIDS), particularly in poor and developing countries. This prevalence is primarily a reaction to the limited understanding of technological, socio-economic, and institutional aspects of implementation, management, and diffusion. For example, to address non-financial barriers to ICZM technology implementation, the following measures must be developed and adopted.

a. Policy, legal and regulatory

No dedicated ICZM policy – Currently, there is no dedicated ICZM policy, apart from the NBSAP, which focuses broadly on biodiversity and environment management. There is a need for a specific policy to be developed for the implementation of NbS (Seawall) and Integrated Coastal Zone Management technology in the country. The national or provincial government must support these communities for such initiatives to be effective.

Legal framework – Similar to NbS, the national government should establish a legal framework that protects and promotes the participation of local communities in such initiatives.

This ensures that the development of such initiatives passes relevant environmental impact assessments and does not harm the surrounding ecology prior to implementation.

Regulatory – Communities participating in these initiatives must be able to report any violation of the regulation and rules set for ICZM technology implementation to the relevant authority.

b. Technical Level

Weak Research Capacity – The national government, through the MECDM, must collaborate with regional and international organizations that have experience in similar projects across the region. For example, Clark (2009)[34] identifies the need to support fisheries, protect communities from storm ravages, attract tourists, promote public health, maintain yields from mangrove forests, and preserve coral reefs. In terms of research, regional organizations possess strong analytical tools to determine the design and structure of a ICZM tailored to specific communities.

Limited local capacity – Discussions within the Coastal Erosion Sector Working Group have confirmed the presence of many qualified civil engineers. However, there is a lack of expertise in ecological and environmental qualifications and experience to design suitable NbS and ICZM technologies for the local context.

c. Social, cultural, and behavioural issues

Ownership – There must be a local level of ownership of the concept of ICZM technology on the ground. Only through this ownership can communities participating in the project ensure its long-term success. Pedersen et al. (2005) [35] noted a similar ownership question in a project in Malaysia, which may be applicable to the context in country.

Perception of such technology – Civic education must be extended to community membership to transform their perception about such projects. They must value the project as a gift to the community, and a high level of care must be leveraged to ensure acceptance and long-term benefits are realized by all.

d. Information and awareness

Potential benefits of such technology – Civic education about ICZM technology must be taken to coastal communities. ICZM technology offers integrative strategies to REDUCE climate risks while providing a range of other benefits including climate regulation, recreation, health, tourism, food and drinking water to the communities.

Limited awareness of climate change – The MECDM, through the climate change and Environment Conservation Divisions, must play a role in educating rural communities about building ICZM structure as part of protecting their shores against sea level rise and the impact of climate change. Providing civic education will increase knowledge about the impacts of climate change and how coastal communities can build resilience in the face of extreme coastal events.

34 Clark, J. R. (2009). Coastal seas: the conservation challenge. John Wiley & Sons.

35 Pedersen, J. D., Beck, S., Johansen, H. B., & Jensen, H. B. (2005). Capacity development in integrated coastal zone management: Some lessons learned from Malaysia. Coastal Management, 33(4), 353-372.

1.8 Linkages of the barriers identified.

This section of the report examines common barriers shared by Nature Based Solutions and Integrated Coastal Zone management technologies, which are the two selected project ideas within the Coastal Erosion Sector. Both nature-based solutions and integrated coastal zone management operate on the premise that healthy and well-managed ecosystems provide essential benefits and services to people. These benefits include reducing greenhouse gas emissions, creating safe communities, securing water resources, improving air quality, and enhancing food security. Despite being among the oldest methods for building local resilience, effective implementation of these nature-based adaptation technologies requires strong leadership and expert knowledge."

Table 5 Common barriers identified the two prioritized technologies in Coastal erosion sector.

Barrier Category	Barriers
Economic & Financial	• High Capital and Maintenance cost • Limited financial allocation by national government. • Inadequate donor & loan funding
Policy, legal, and regulatory	• Lack of sound and robust cross - sectorial polies, resource protection, development, and management. • When there are policies, they are ineffective and meaningless
Information & Awareness	• Lack of public information and awareness about the existence and usefulness of the technology. • When there is information, it is insufficient and ineffective.
Institutional & Organisational capacity	• Limited institutional capacities especially at national level in integrating climate change risks in development planning. • Limited human skills and maintenance specially at local level.

The two selected technologies share several common barriers in the context of their similarities both in development and use (*refer to Table 5*). Therefore, it is imperative to take a holistic approach towards finding linkages to find potentially efficient ways and opportunities to address their combined effects.

1.9 Enabling framework for overing the barriers in the Coastal Erosion Sector

1.9.1 Policy development -

A critical yet essential enabling framework for overcoming the identified barriers to diffusion of prioritized technologies in the coastal erosion sector is the development of dedicated policies for both nature-based solution and integrated coastal zone management in the country. The existing NBSAP policy is too general and does not adequately address the unique requirements of these two coastal resource management technologies.

1.9.2 Budgetary support

The government, through the Ministry of Environment, Climate Change, Disaster Management and Meteorology, should seek financial assistance from donor aid partners to support vulnerable communities in this endeavor.

Figure 8 Example of Integrated Coastal zone Management Technology (Source: moderator, 2020)

1.9.3 Diffusion

The mobilization of funds from multi-lateral entities such as GCF, GEF and AF would ensure that identified technologies under the coastal erosion sector are successfully implemented on the ground. The next crucial component of sustainable coastal area resource management in the Solomon Islands involves integrating the social, economic, and environmental aspects of the coastal erosion sector into the cross-cutting themes of coastal resilience at the local levels.

- Based on the above discussions, barriers and measures may cover these broad issues in relation to the selected technologies:
- Ensuring an adequate financial mechanism is available to support implementation,
- Ensuring the integration of climate change considerations into relevant sectoral policies, plans and strategies,
- Strengthening research, training, and increasing awareness of technologies among stakeholders,
- Strengthening institutional capacities at both national and subnational levels
- Designing and implementing practical pilot demonstration projects

1.10 Key Coastal Erosion Measures and Enabling Framework.

As a conclusion to this chapter, the key enabling measures needed to ensure diffusion of the coastal erosion sector are summarized below.

a**)** **Financing Requirement** – High capital cost associated with the two prioritized technologies are evident. Therefore, it is important to incorporate some of these project ideas into the national planning and programming of the country.

b) **Skills and Institutional Capacity development** – It is essential to train environmental engineers and planners to integrate skills in NbS and ICZM into the design and planning of such infrastructure.

c) **Operation and maintenance capacity**- NbS and ICZM will only be effective when there is maintenance and sustainability of such structures and establishments.

CHAPTER 2
ADAPTATION TECHNOLOGIES FOR RELOCATION SECTOR

2.1 Preliminary targets for technology transfer and diffusion in Relocation sector.

2.1.1 Introduction

Well planned relocation can be both a form of disaster risk reduction and a form of climate change adaptation (Shaw, et al, 2010)[36] . Planned relocation can be implemented either pre-emptively before a disaster strikes or as a remedial measure to address the longer-term impacts of climate change. According to Barnett & Webbe (2010)[37] relocation of communities due to impact of climate change extreme event is always perceived to be the last resort. This perception has been prevalent among both governments and vulnerable communities across the country for the past decades. This position has profoundly rooted in traditional approaches where villagers thought that if one is relocated from one's native land, one loses his or her identity and one's right to ownership over land and resources at the original location. However, due to the escalating impact of climate change and related extreme events, the government has now adopted a more contemporary approach towards climate change-induced relocation. Presently, the government has recognized and prioritized relocation as one of its adaptive strategies to the impact of climate change and disaster events. This is reflective in the collaboration of the national government with the International Organization of migration in formulating guideline for planned relocation strategy across the country.

Given the context outlined above, the Solomon Islands Government, through the Ministry of Environment, Climate Change, Disaster Management and Meteorology has recommended that the TNA process focus on the development of technologies within the Coastal Area subsector as outlined in the Solomon Islands NTA Report (2022)[38].

2.1.2 Prioritized technologies

The Relocation Sector Technical Working group has identified six adaptation technologies to be processed through the TNA process. The top two ranked technologies were prioritized through multi-criteria assessment (MCA) process based on their importance in reducing vulnerability of communities and individuals to the severe impacts of climate change. The prioritized technologies are listed in the **table 6** below:

Table 6 The Prioritized technologies for adaptation

No:	Types of Technology Relocation - Adaptation	Ranked
1	Cash Transfer Programme	6
2	Climate Induced relocation policy	1
3	Enabling environment for relocation	4
4	Planned relocation (Permanent)	2
5	Relocation trust Fund	5
6	Temporary Relocation	3

36 Shaw, R., Pulhin, J. M., & Pereira, J. J. (2010). Climate change adaptation and disaster risk reduction: overview of issues and challenges. Climate change adaptation and disaster risk reduction: Issues and challenges, 4, 1-19.

37 Barnett, J. R., & Webber, M. (2010). Accommodating migration to promote adaptation to climate change. World bank policy research working paper, (5270).

38 Solomon Islands Technology Need Assessment (2022). Ministry of Environment, Climate Change, Disaster Management and Meteorology, Honiara, Solomon Islands.

2.1.3 Level Of Experience with The Technology

The national government has varying levels of experience with most of the technologies listed in **table 6**. While some technologies are currently in use across the country, challenges related to their ease of deployment and rapid dissemination to other communities are evident.

In order to ensure the sustainability of these technologies, the TNA process particularly in this second phase of barrier analysis and enabling framework development, establishes initial targets for the transfer and diffusion of the first two prioritized technologies in the sector. Refer to table 6 for details.

2.1.4 Objectives of the Prioritized technologies

The following objectives were established with the prioritized technologies:

1. To develop a National Climate Change Induced Relocation Policy (NCCIRP) and ready for implementation by 2026.
2. To secure funding and support, over the next 10 years, six identified communities with the Planned Relocation technology (PRT).

To achieve these preliminary targets for the transfer and diffusion of technologies in the Relocation sector, relevant stakeholders and players, including coastal sector policymakers, experts, authorities such as MECDM, MLHS, MPGIS, and Provincial Governments, as well as technology dealers, technicians, and water sector experts, must actively participate in the successful implementation of the identified technologies. The implementers include NGOs and CBOs focusing on communities, advocacy groups of women, youth, marginalized members in the communities, village leaders active at local and national levels.

2.2 Barrier Analysis and possible enabling measure for Climate Change Induced Relocation Policy technology.

2.2.1 General description of Climate Change Induced Relocation Policy (CCIRP) technology

The Ministry of Environment, Climate Change, Disaster Management and Meteorology through the Climate Change Division (CCD) is currently reviewing and in the process of finalizing its new National Climate Change policy (NCCP) 2023-2033). The new NCCP supersedes the previous policy which was effective from 2012-2017. The new NCCP is a very high-level document and may not have captured detailed policy directives such as climate induced relocation technology. Furthermore, there is also a current Relocation Guideline (2022) which the national government adopted in 2022. The document provides guidelines for relocation but lacks a clear link to a specific government policy statement. Given this perspective, the Relocation Sector Technical Working Group believes it is imperative to develop and adopt such a document by the national government to ensure that the relocation guideline is firmly anchored in a focused policy.

2.2.2 Technology status in Solomon Islands

a. National Climate Change Policy (2023-2033)

This policy is extremely high level and is focused on all climate change-related activities in the country. It includes policies to mitigate change impacts by reducing greenhouse gas emissions and removing greenhouse gases from the atmosphere, with the aim to slow down the pace and magnitude of climate change and to adapt to its effects by helping communities and businesses build resilience and avoid the worst outcomes. However, the policy lacks specific details regarding the relocation of communities affected by the impacts of climate change.

b. Relocation Guideline (2022)

The relocation guideline is a comprehensive document outlining the strategic planning of relocation exercises in the country, drawing on best practices from various locations. However, it falls short in articulating an overarching policy position and neglects to address the sensitive nature of relocation as a subject matter.

The Relocation Sector Technical Working Group's analysis concludes that a dedicated Climate Change-Induced Relocation policy is critical for the government to effectively address the long-term impacts of climate change. Although this concept is not entirely new to the country, there is a need for a more focused approach to ensure that vulnerable communities are relocated under a clearly defined policy.

2.2.3 Technology category and market characteristics

CCIRP technology falls under the category of non-market public goods technology. Therefore, its development and management requires support from national or provincial governments. Like any technology, certain barriers must be addressed to ensure its effective implementation. The involvement and commitment of governmental agencies are critical for the successful deployment and sustained management of CCIRP technology.

2.2.4 Identification of barriers for the Climate Change Induced Relocation Policy technology

Screening and Prioritization of identified barriers

After compiling the potential barriers list, it was presented to the Relocation Sector Technical Working Group to screen the list and to identify the essential barriers that need to be addressed for technology transfer and diffusion to occur, as well as the non-essential barriers that were to be disregard (see annex ???). The screening and prioritization process for this technology was relatively straightforward compared to other technologies. However, it followed the same process, resulting in the identification of key barriers to the diffusion and transfer of technology during implementation. The major barriers are identified below:

a. No capacity to engage legal experts,
b. No prioritized funding from the state,
c. No direct economic benefit,
d. Cultural insensitivity,
e. Implementation issues,
f. Inadequate information on societal benefit of technology.

The above barriers were categorized into 'financial and non-financial barriers and their detailed discussion continues in the following sections.

2.2.5 Economic and financial barriers

a. No national capacity to engage legal experts –

It is expected that the government will need to incur legal costs to experts to draft such a policy document for the country. While there is limited capacity available nationwide in this space, the government must provide budgetary support for such engagements. Table 7 estimates the cost of such policy development to be USD$250,000.

Table 7 Expenses related to Climate Change Induced Relocation Policy Development

Main costs of Producing NbS technology USD$		
Activites	Detail	Costs
Research	Review of existing policies – National and Regional	50,000
Policy Awarness & Consultaions	Country Wide Consultation	150,000
Drafting & Editing	Hiring of Legal Consultant	50,000
Logistics	Transport costs	50,000
Total cost		**250,000**

b) No prioritized funding by the government,

The national government is currently committed to reviewing the NCCP and Environment Act however there is minimal focus on designing a dedicated national policy of Climate-Induced Relocation strategy.

c) No direct economic benefit

There is perception that land and resources are individually owned Therefore, developing a national climate change-induced policy may require extensive national wide consultations. However, this process is not expected to yield direct benefits for individual families or communities. In this context, communities feel that the government must lead the way in this process.

2.2.6 Non-Financial Barriers

a. Policy, legal, and Regulatory

Culturally insensitivity-

Relocation is a sensitive topic at both the national and local levels across the country. In light of this sensitivity, it is important for relevant authorities to engage in extensive sectoral consultations at the national, provincial, and local levels.

Implementing issues

A national policy on relocation will bear corresponding responsibility to the national government with its implementation. This will incur costs such as capital costs (related to land and infrastructures) and the cost of resources to communities and people involved in the process.

Inadequate information on societal benefit of technology

Relocating to a less desirable location may result in relocation stress, leading to depression and anxiety within communities. Relocation stress should be recognized as a risk factor for depression in long-term care residents, regardless of cognitive status, in the first year after relocation. There needs to be awareness and education on the positive aspects of relocation to reduce anxiety.

b. Technical level

Limited local capacity

While there are several qualified legal experts in the country, the skills required to develop policies in the areas of climate change, relocation, disaster management, and environment are scarce. Only specialized personnel in those areas could perform such technical roles.

Poor knowledge in Climate Change Induced Relocation Policy

There is also a deficiency in the personnel with the capacity to develop climate change-induced relocation policy in the country. These are specialized skill sets that are of great demand nowadays.

c. Social, cultural, and behavioural

Community Support

It is evident that the relevant authorities are not united in developing a specific Climate Change-Induced Relocation policy for the government. Different stakeholders need to be on the same page or in support of such policy intentions to make it relevant to the national context and able to implement such policy objective in the country.

d. Information and awareness

Potential benefits of the technology

There is limited knowledge and awareness of the potential benefits that Climate Change-Induced Relocation policy technology could bring across key sectors in the country. Additionally, there is mixed feeling about the significance of CCIRP and how such policy can be implemented on the ground.

2.3 Identified measures to overcome key barriers to CCIRP.

This section of the report attempts to underpin the measures that are needed to overcome the identified barriers to possible implementation of CCIRP technology in the country. The primary methodology used to identify the most appropriate measures involved the development of a problem tree solution or fishbone approach through consultations and deliberations with stakeholders. Furthermore, a series of bilateral consultations with relevant stakeholders informed the identification of key measures necessary to overcome and eliminate the identified barriers above.

2.3.1 Economic and financial measures

a) **No capacity to engage legal experts** – The government must allocate resources to outsource this legal service externally from its pool of lawyers. The government could leverage external partnerships to secure funding for these critical policies in the country.

b) **No prioritized funding from the state** – The national government should also allocate in its budgetary support towards meeting the cost of such technical service to appropriate ministries. For example, the Ministry of Finance and Treasury could allocate funds in the development or recurrent budget of the MECDM to cover the cost of such service providers.

c) **No direct economic benefit –** The awareness surrounding the formulation and development of CCIRP technology should emphasize the need for policies that benefit the common good of the affected communities rather than individual interests**.**

2.3.2 Non-financial measures

Challenges to implementation are referred to as "implementation barriers, which can be both financial and non-financial. The non-financial barriers can be rooted in a variety of causes, including opposition from key stakeholders, inadequate human resources, lack of clarity on operational guidelines or roles and responsibilities for implementation, and conflicts with other policy priorities.

These non-financial measures are apparent across the Small Islands Development states (SIDS), particularly the poor and developing countries. The existence of non-financial technology management practices is predominantly reactive due to a limited understanding of

technological, socio-economic, and institutional aspect of its implementation, management, and diffusion.

a. Policy, legal and regulatory

No specific policy on Climate Change Induced Relocation – Besides the NCCP and the Relocation Guideline, there is currently no specific policy guiding climate change-induced relocation initiatives in the country. There needs to be a specific policy developed for the purpose of Climate Change Induced Relocation Policy technology implementation in the country. The national government must actively support and facilitate implementation of these relocation initiatives in order for them to be effective.

Legal framework – The national government should establish a legal framework that protects and promotes local communities participating in climate change-induced relocation across the country. This ensures that any climate change relocation initiative is rooted within the legal framework.

Regulatory – The national government must oversee the development of such policies in the country.

b. Technical Level

Weak Research Capacity – The national government, through the MECDM, must collaborate with regional and international organizations that have experience and expertise in the formulation of climate change policies across the region.

Limited local capacity – Discussion within the technical working group on Relocation sector revealed that while the country has many qualified lawyers and policy analysts there is a scarcity in the fields of environment, climate change and disaster management. It is important for the government to provide training opportunities in these technical fields for individuals involved in climate change-induced relocation initiatives.

c. Social, cultural, and behavioral issues

Ownership – There must be a local level of ownership to this CCIRP technology at the national level. For example, the MECDM must be the owner of this policy. Its role is to ensure the development and implementation of this policy in the country. Only through this ownership can the appropriate government ministries and even communities that participated in the project ensure its long-term success.

Perception of such technology – Civic education must be extended to the government and its stakeholders to enhance their understanding of the formulation and significance of this critical policy. They must value and understand the importance of such technology for vulnerable communities across the country.

d. Information and awareness

Potential benefits of such technology – Efforts are needed to disseminate civic education about Climate Change-Induced Relocation Policy and its benefits for the community. One benefit is that when a community faces any extreme climatic event, there is a policy that will guide them in relocating to a much safer location. This builds confidence on the part of the citizens that, in the face of disastrous events related to climate change, they will be relocated to safer destinations.

Limited awareness of climate change – The MECDM, through the climate change division, must play its role in educating the rural communities and provincial government about climate change and how to build homes taking into account events such as sea level rise, coastal erosion, floodings and impact of climate change. Providing civic education will increase the level of knowledge within rural communities and provincial government

about the impact of climate change, enabling them to build resilience in the face of those extreme coastal events.

Figure 9 Lelisiana Community, Malaita Province, impacted by Climate Change (Source: Pip Cohen, 2019)

2.4 Barrier Analysis and possible enabling measures for Planned Relocation.

2.4.1 General description of Planned Relocation technology

Planned relocations are occurring globally. Recent surveys of available literature (Bower and Weerasinghe, 2021; Scott, 2023)[39] [40] have identified over 400 cases of planned relocations globally since 1970. This global finding demonstrates that planned relocation is more geographically widespread than the few cases most often highlighted in the media. While cases were identified on every inhabited continent, some regions are hotspots such as the Pacific.

In the Solomon Islands, communities have taken local initiatives to build resilience in the face of climate change and extreme events (Ha'apio, et al, (2018)[41]. These communities have organized themselves and participated in relocation exercises using their own resources, without depending on the national and provincial levels of government for leadership in such exercises. For example, the Keigold community on Ranogha Island in the western province relocated from Modo village, situated at the coastal area, to higher ground due to sea level rise, storm surges, and land slide at the former site. Another case involves communities taking the leading role in relocating their homes and properties from their old village to the mainland (Walande village from an island in the Southern region of Malaita to the mainland). What is

39 Bower, E., Weerasinghe, S., & Mokhnacheva, D. (2022). Mapping of planned relocation cases: a foundation for evidence-based policy and practice. Forced Migration Review, (69).

40 Scott, M. (2023). Adapting to Climate-Related Human Mobility into Europe: Between the Protection Agenda and the Deterrence Paradigm, or Beyond?. European Journal of Migration and Law, 25(1), 54-82.

41 Otoara Ha'apio, M., Wairiu, M., Gonzalez, R., & Morrison, K. (2018). Transformation of rural communities: lessons from a local self-initiative for building resilience in the Solomon Islands. Local Environment, 23(3), 352-365.

evident in the success of these two stories is that the villagers themselves, along with land owning groups, take the leading role in the relocation to new sites, without government-owned land involved in such process.

2.4.2 Types of Planned Relocation Technology

The planned relocation is a voluntary one agreed upon by the respective community and government. As defined by to McAdam & Ferris (2015)[42] planned relocation occurs under the authority of the State, within national borders, and aims to protect people from risks associated with disasters, environmental change, and the impacts of climate change. Besides planned relocation, other types of relocations are known as "Coordinated and Voluntary Relocations".

2.4.3 Planned Relocation technology status in Solomon Islands

Planned relocation is not a new concept in the country. For many years, communities have engaged in such initiatives, as exemplified in the example provide by Ha'apio et al., (2018) and Monson & Foukona (2014)[43]. While many of these relocation exercises may not have been structurally coordinated by the state they were still successfully implemented at the local levels. Under this technology, the Relocation sectoral technical working group has agreed that the national government must take the lead on developing policies to see its vulnerable communities relocate to safer locations. The government must learn from the past community driven relocation exercises, develop, and implement its own relocation initiatives. While this technology is not new across the country, the government must undertake broad consultations, learn from past community experiences, and design a planned relocation initiative under the Climate Change-Induced Relocation Policy before implementation to maximize benefits for the communities.

2.4.4 Support for this technology

Technology and market characteristics

The Planned Relocation technology falls under the category of non-market public goods when implemented at the community level. This implies that such technology will require national or provincial government support to develop and manage the technology's implementation for long-term sustainability. In some cases, communities themselves have initiated the relocation process, but such exercises were costly for individual households. However, when undertaken collectively by the community, the associated costs become more manageable, as it is distributed among its members or households.

In urban Honiara, the Mataniko riverside settlement is an example of a community that was relocated from their original site to inland April Valley due to the impact of 2014 flash floods. Ha'apio et al (2018)[44] reported that this relocation was initiated by the government in 2015. Unfortunately, the project failed, primarily attributed to the absence of a relocation policy by the national government in response to the impact of climate change on communities However, some individuals have voluntarily relocated from the vulnerable sites, utilizing their financial capacity and resources for independent relocation.

42 McAdam, J., & Ferris, E. (2015). Planned relocations in the context of climate change: Unpacking the legal and conceptual issues. Cambridge International Law Journal, 4(1), 137-166.

43 Monson, R., & Foukona, J. D. (2014). 10 Climate-related displacement and options for resettlement in Solomon Islands. Land solutions for climate displacement, 291.

44 Ha'apio, M. O., Morrison, K., Gonzalez, R., Wairiu, M., & Holland, E. (2018). Limits and barriers to transformation: A case study of April Ridge relocation initiative, East Honiara, Solomon Islands. Climate change impacts and adaptation strategies for coastal communities, 455-470.

2.4.5 Identification of barriers for the Planned Relocation Technology

The workshop highlighted specific barriers that could impede the successful establishment and implementation of project ideas. These identified barriers include:

a. High cost of capital
b. Insufficient legal and regulatory framework for Planned relocation initiative implementation.
c. High level of land dispute,
d. Poor coordination by the government,
e. Inadequate information on societal benefit of technology,
f. Limited institutional capacity and management skills of responsible authority

2.4.6 Screening and prioritization of identified barriers

After compiling the list of the potential barriers, it was presented to the Relocation Sector Technical Working Group (RSTWG) for screening and identification of the essential barriers necessary for technology transfer and diffusion to take place (see annex 3). To expedite the prioritization of potential barriers, the team employed barrier analysis tools such as the starter problem and solution trees. The group reached a consensus to identify and briefly discuss the final list of barriers outlined below.

2.4.7 Economic and financial barriers

a) Capital and Maintenance cost – The technology is classified as a public good, therefore its development, operation and maintenance costs would remain under public budgetary support from the national government. Nevertheless, individuals and communities that have participated in such technologies have incurred significant financial expenses. These expenses include the capital costs of building new homes and the cost of constructing infrastructures such as road, community halls, and church buildings. Maintenance costs refer to operational and inherited costs, which include the cost of maintaining the technology post-implementation. For the planned relocation technology to be effectively implemented across the country, the national government must take ownership of this initiative purposefully to assist vulnerable communities.

b**) Inherited risk of the Planned Relocation**

The cost associated with establishing and maintaining the infrastructure relocation site during implementation are considered inherited risk (Naumann, et al, (2011). These costs include the replanting of natural barriers and the maintenance of both natural and man-made infrastructures at the new site over the years. Moreover, the implementation of such technology would incur cost in other areas including, health, education, community, and religion. The national government must invest in this endeavour to ensure long-term success.

2.4.8 Non- Financial Barriers

a. Policy, legal, and Regulatory

In-effective relocation guideline – The Relocation Guideline (2021) - This policy document provides guidance for planned relocations across the country. Although it may not be anchored in a dedicated planned relocation policy, it outlines critical activities for planning, designing, implementing, and managing such initiatives. As mentioned earlier, any form of relocation is a sensitive issue in the country because it involves land, people, and communities. Climate Change-Induced Relocation policy faces technology capacity constraints due to the absence of dedicated policy, institutional constraints, inadequate finance, and a lack of scientific information, undermining effort to alleviate pressures on the planned relocation process.

b. Technical level

Limited local capacity

Despite local knowledge and lessons learned from previous relocation initiatives, designing and strategizing for a planned relocation initiative requires expertise from physical planners, disaster specialists, and social scientist. Many local villages lack access to these specialized skills. According to McFadden (2007) and (Farbotko, et al, 2020)[45] local knowledge must be considered in the design of such initiatives to achieve long-term sustainability.

c. Social, Cultural, And Behavioural

a) **Land tenure**

Landownership on the Islands is usually customary or tribal owned, making it challenging to develop and implement projects for community benefits (Albert et al., 2018)[46]. Greater civic education is needed for community members to support planned relocation technology implementation at the local level. Without a better understating of such projects, land disputes often arise, acting as a significant barrier to adaptation at the local level. This barrier is also evident for other adaptation technologies.

b) Ownership question

There is usually a limitation of ownership in project-funded properties or structures for public uses. The question of public or state ownership and funding usually generates a negative attitude towards such investments. Under relocation initiatives, households may seek free handouts but show little care for public infrastructures.

c) **Perception of such technology** – Generally, projects funded under aid money are perceived as public goods, and as such there is a belief that such funding is for short-term benefits only, with no concern for maintaining their investments for future generations. This perception was evident when communities relocated from coastal areas around Gizo Island after the 2014 tsunami. Those affected households were relocated with funding assistance from international donor partners to higher land areas around the island. These households occupied those properties for a few months then demolished those buildings and rebuilt again along the coastlines.

d. Information and awareness

Potential benefits of the technology

There is limited knowledge and awareness of the potential benefits that planned relocation technology could bring to coastal communities and their surrounding environment. Furthermore, planned relocation technology solutions are often designed to bring benefits to both people and the environment. For example, proper planning and zoning, along with infrastructure design can allow communities to plant trees or native forests along the coastal sites, providing a natural buffer against coastal erosion at the new relocation site.

Limited awareness of climate change and hazardous events

While here may be some awareness of the impact of climate change on the coastal communities, little can be directly linked to societal challenges through proper planning, build-back-better strategy implementation, protection, sustainable

45 Farbotko, C., Dun, O., Thornton, F., McNamara, K. E., & McMichael, C. (2020). Relocation planning must address voluntary immobility. Nature Climate Change, 10(8), 702-704.

46 Albert, S., Bronen, R., Tooler, N., Leon, J., Yee, D., Ash, J., ... & Grinham, A. (2018). Heading for the hills: climate-driven community relocations in the Solomon Islands and Alaska provide insight for a 1.5 C future. Regional environmental change, 18, 2261-2272.

management, and restoration of both natural and modified ecosystems, benefiting both biodiversity and human well-being at the new relocation site.

Need for community cooperation through participation

There is often little awareness of the need for community engagement and cooperation to foster community harmony and collaboration for the greater public good. There is a need to educate the vulnerable communities of the benefits associated with planned relocation strategies.

2.5 Identified measures to overcome barriers and assist with technology transfer and diffusion.

This section of the report aims to discuss the measures required to overcome the identified barriers hindering the implementation of planned relocation technology across the country. The Relocation sector working group, in their analysis, has identified key areas that need addressing for the effective implementation of planned relocation technology.

2.5.1 Economic and financial measures

a) **High initial and capital cost** – To offset the substantial upfront costs for establishing and implementing planned relocation technology, the national government may consider providing incentives (such as tax waivers and duties) through the Customs and Excise division to communities and individuals involved in importing equipment for this technology. Alternatively, donor partners intending to invest in this technology must be acknowledged at the highest political and diplomacy levels in the country.

b) **High maintenance cost** – Communities may be required to cover some of the infrastructure maintenance and improvement costs at the new relation site. This implies they must maintain structures, replant trees, rebuild the public utilities if damage occurs and improvement are needed in the long run.

Table 8 Expenses related to Single Planned Relocation

Main costs of Producing NbS technology USD$		
Activites	Detail	Costs
Land Aquistion	This will need land acquisition from land owning group	150,000
Infrastructures	Depending on the size of the sea wall	100,000
Building of Homes	Introduction native trees if not available	150,000
Logistics	Transport costs	100,000
Total cost		**500,000**

c) Inherited risk -Repairs to infrastructures and utilities at the new relocation site are viewed as inherited risk. The concerned community must secure funding for maintaining these inherited costs (risk).

2.5.2 Non-financial measures

In addition to the financial barriers and measures detailed earlier, communities also encounter non-financial barriers that need to be addressed as they delve into the implementation of planned relocation technology at the local level. Usually, the existence of non-financial barriers is related to management practices and is predominantly reactional due to the limited

understanding of technological, socio-economic, and institutional aspects surrounding the technology's implementation, management, and diffusion. Below are the identified non-financial measures.

a. Policy, legal and regulatory

No dedicated Climate Change Induced relocation policy – Currently, there is no dedicated Climate Change-Induced Relocation Policy in place, only a guideline for relocation initiatives. The existing guideline is ineffective because it lacks the foundation of an overarching policy specifically tailored for climate-induced relocation. To address planned relocation seriously, the government should develop a dedicated policy, supported by adequate resources for effective implementation.

Legal framework – While some related policies are available, the absence of a legal framework poses a challenge to the effective implementation of the technology.

Regulatory – Communities who participate in such an initiative must be able to report to the relevant authority of any violation of the regulation and rules set for planned relocation technology implementation.

b. Technical Level

Weak Research Capacity – The national government must establish a strong research network around the area of planned relocation across the region. We can draw valuable lessons from countries like Fiji, Vanuatu and our sister nations, which have already been in volved in internal planned relocation within their borders.

Limited local capacity – It is critical to collaborate with neighbouring countries or donors who have already participated in this process within the region. Lessons learned could be useful for our purpose.

c. Social, cultural, and behavioural issues

Ownership – Government ownership of the planned relocation initiative will motivate local communities, fostering their participation and promoting long-term sustainability.

Perception of such technology – Civic education must be extended to community membership to transform their perception about relocation process and exercises in the country. Communities must recognize that relocation presents an opportunity for them to rebuild better and enhance resilience at the new site.

d. Information and awareness

Potential benefits of such technology – It is essential to extend civic education on planned relocation technology to vulnerable coastal communities. The relocation technology offers new integrative strategies to reduce climate risks, providing a range of benefits such as climate resilience and long-term adaptation at the new site. Additionally, there is an opportunity to leverage available mitigation strategies for community resilience.

2.6 Linkages of the barriers identified.

This section of the report identifies several barriers common to both the Climate Change-Induced Relocation policy and Permanent Relocation Technology. These two selected technologies aim to guide vulnerable coastal communities in developing effective resilience strategies at the local level. While these technologies are not entirely new, a relocation guideline technology is already in place, and some forms of voluntary and coordinated

relocation exercises have been implemented in the country, however without proper government interventions. It is envisioned that the national government takes the lead in the implementation of these technologies for relocation initiatives in the country.

Table 9 Common barriers identified the two prioritized technologies in Relocation Sector

Barrier Category	Barriers
Economic & Financial	• High capital cost with relocation initiatives, • Limited financial allocation by national government. • International donor not funding relocation initiatives.
Policy, legal, and regulatory	• Lack of sound and robust policies to coordinate all forms of relocation in the country. • When there are policies, they are ineffective, meaningless and not relocation focused.
Information & Awareness	• Lack of public information and awareness about the existence and usefulness of the technology. • When there is information, it is insufficient and ineffective.
Institutional & Organisational capacity	• Limited institutional capacities especially at national level in integrating climate change risks in development planning and possible relocation initiatives. • Limited human skills and maintenance specially at local level.

The two selected technologies share common barriers and similarities in both development and use (**refer to table 7**). Therefore, it is imperative to take a holistic approach to finding linkages between the two technologies, aiming to discover potentially efficient ways and opportunities to address their combined effects.

2.7 Enabling framework for overcoming the barriers in the Relocation sector.

a) **Policy development** - A critical yet essential enabling framework for overcoming the identified barriers to the diffusion of prioritized technologies in the relocation sector is the development of dedicated policies. These policies are necessary to ensure that the government, communities and NGOs participating in this space are guided and operate within the regulatory framework. Despite the existence of a relocation guideline, it lacks a foundation in any government policy. Ideally, the relocation guideline should be firmly rooted in the broader context of the climate change-induced relocation policy.

b) **Budgetary support** – The government, through the Ministry of Environment, Climate Change, Disaster Management and Meteorology, should collaborate with bilateral partners to secure financial assistance for the development of CCIRP and the planned relocation of vulnerable communities to higher grounds.

c) Diffusion – Give that international funding mechanisms such as GCF, GEF, and AF are unable to fund relocation-related technologies, it is important for bilateral and donor partners to provide the necessary financial resources to support the identified technologies in this sector. Another critical component of relocation policy and implementation in Solomon Islands is the need to integrate social, economic, and environmental considerations related to relocation into cross-cutting themes at both national and local levels.

Based on the above discussions, barriers and measures may address the following broad issues related to the selected technologies:

a) Ensuring adequate financial mechanism is available to support relocation implementation,

b) Ensuring the mainstreaming of climate change considerations into relevant sectoral policies, plans and strategies.
c) Strengthening research, training, and technologies awareness – rising among stakeholders,
d) Strengthening institutional capacities at national and subnational levels
e) Designing and implementing practical pilot demonstration projects

2.8 Key Relocation Measures and enabling Framework.

As a conclusion to this chapter, the key enabling measures necessary for ensuring the diffusion of the relocation sector are summarized below.

a. Financing Requirement – High capital cost is evidenced with the two technologies prioritized. Thus, we need to ensure that some of these project ideas are incorporated into the national planning and programming of the country.
b. Skills and Institutional Capacity development – There is also a need to train environmental engineers and planners to incorporate skills into designing and planning of relocation strategies.
c. Policy support – relocation initiatives will only be effective when there is policy and legal framework are established to support such initiative.

CHAPTER 3
MITIGATION TECHNOLOGIES FOR TRANSPORTATION SECTOR

The Solomon Islands is one of the most vulnerable countries to be impacted by climate change, yet it continues to be increasingly dependent on imported fossil fuels that dominate its greenhouse gas emissions. Solomon Island's NDC is committed to reducing GHG emissions by reducing dependence on imported fossil fuels. The major share of GHG emissions from transport (land and sea) account for 61% of the total emissions from the energy sector, making it a priority area to introduce and implement low-carbon interventions.

Mitigation Expert Working Group members and other significant stakeholders identified a set of mitigation technologies in during the first phase of TNA on the 31st of March and the 1st of April 2022, and finally the two technologies (Rank 1 and 2 refer to table 10) were prioritized through multi-criteria assessment (MCA) process, which was one of the main decision-making tools which aims to determine the best alternative by considering more than one criterion in the selection process. MCA has manifold tools and methods that can be applied in different fields from finance to engineering design. The prioritized technologies are in **table 10** below.

Table 10 Prioritized technologies for Transportation Sector

No	Types of Technology Mitigation	Rank
1	Electric vehicles (EV) Minibus and Vehicle Pooling station	3
2	Electric Out-board Motor	2
3	Sustainable Road (including Drainage & landscaping)	1
4	Sustainable Bridge	4
5	Artificial Harbour	5

TNA Phase II involved the following key steps as part of the process:

a) Identifying the preliminary objectives for technology development and diffusion at a sectoral level.
b) A description of the technologies that have been identified. The provision of potential benefits for adaptation. Determine if this technology is categorized as a market or public good, and provide a description of its status across the country.
c) Identification of essential measures for overcoming barriers, possible linkage between distinct technology barriers, and creation of an enabling framework will assist in overcoming potential barriers while providing a supportive environment for the development and effective spread of the selected technologies.
d) Desktop Reviews: The consultants conducted a thorough analysis of existing country reports and articles for the forestry and transportation sectors. As a result, the paper conducted a literature assessment to better understand the background of the country's selected adaptation and mitigation sectors. This method aided in the formulation and completion of the TNA report's Second Phase.
e) Validation Consultation meetings, after the desktop review process, a series of workshops and bilateral meetings were held by both the Adaptation and Mitigation consultants with respective Technical Working Groups. These series of meeting were

critical to verify and validate the ideas captured through the desktop review and the preliminary meetings and whether they were correctly reflected in the final report.

Table 11 Methods followed in the barrier analysis and enabling framework.

No	MAIN STAGES OF ANALYSIS	METHODS AND TOOLS
1	Identification of Stakeholders	• Phase 1 of TNA process
2	Identification of Potential barriers	• Literature Review, consultation meetings and brainstorming
3	Analysis of barriers	• Use of logic thinking problem tree design, expert opinions, and consultations
4	Measures developed to overcome barriers	• Translating barriers into measures using solution tree during Technical Working Group consultations
5	Screening and validation of important barriers and measures	• Validation through extensive consultation during TWG consultations
6	Preparation of the BAEF Report (Draft)	• TNA Adaptation & Mitigation consultations drafted report
7	Final Report	• First CCC/USP expert reviewed and then MECDM/NTASC approval of the report.

3.1 Preliminary Targets for Technology Transfer and Diffusion in Transportation Sector

As outlined in the NDS 2016-2035 transport target, the Solomon Islands Government aims to achieve, by 2030, a safe, affordable, accessible, and sustainable transport system for all, with a specific focus on enhancing road safety through the expansion of public transport. These targets align with the National Transportation Plan 2011-2030, reflecting Solomon Islands Government's vision for the transport sector is: 'An effective transport infrastructure and transport services to support sustained economic growth and social development in the Solomon Islands'.

According to the Solomon Islands Transport Asset Management System (SITAM), 2015, the country's transportation infrastructure faces challenges, particularly with unmaintainable unsealed roads, bridges, culverts, and outdated wharves. The emphasis is on the rehabilitation and upgrading of existing land infrastructure rather than the construction of new roads, bridges, and airfields to enhance the provincial land transportation network. However, there is a crucial need for the expansion and rehabilitation of maritime infrastructure, including the development of an artificial harbour to reduce transport costs and distances in the sea transport system.

Meanwhile, the transportation issue within Greater Honiara (East Honiara, Central Honiara, and West Honiara) is a lack of road infrastructure, which causes traffic congestion. It can be frustrating for drivers when they encounter heavy traffic as it prompts them to take alternative routes to avoid getting stuck. However, this often makes the distance longer, which impacts their income at the end of the day. It can be challenging for drivers to make enough income when they have to take longer routes. Furthermore, the Greater Honiara also face poor road infrastructure conditions, as seen by numerous potholes, pavement degradation, a lack of an effective drainage network, and pavement procedures.

According to a study by Barth and Boriboonsomsin (2008), transportation has a significant impact on carbon dioxide (CO2) emissions associated with traffic congestion. The study suggests that as traffic congestion increases, so do CO2 emissions and fuel consumption. The driving behaviour of individuals generally influences CO2 emissions and fuel consumption. Therefore, it is crucial to improve traffic operations, particularly by minimizing traffic congestion, to reduce CO2 emissions.

The Solomon Islands have set a goal of reducing greenhouse gas emissions by 27% by 2025 and 45% by 2030 in line with their NDC of 2016. To achieve this, they should have a plan to improve road conditions to reduce the traffic congestion by implementing an efficient drainage system and enhancing the pavement. This will reduce the use of fossil fuels resulting from longer route alternatives and traffic congestion.

The Solomon Islands also facing a significant challenge in the form of excessive greenhouse gas emissions caused by sea transportation. As an archipelagic nation with over 1000 islands, sea transportation is one of the most important means of moving people from one island to another. In the Western and Central Provinces, boats and canoes are the primary modes of transportation, accounting for about 90% of all transportation in the area. This mode of transportation is mainly used for transporting goods, services, and people from one island to another. Since the islands are small, the locals heavily depend on waterways for their daily necessities, including food and income from fishing.

In 2012, the total cost of petroleum fuels in Solomon Island was 843 million SBD, which accounted for roughly 14% of the country's national gross domestic product (GDP). The transport sector, including land and sea transport, alone consumes more than 50% of the petroleum fuel imported into the country. All sea transport in the Solomon Islands relies solely on fossil fuels. This is a cause for concern as transport, whether it's on land or sea, is responsible for 61% of the total emissions from the energy sector, according to the Solomon Islands' Nationally Determined Contributions (NDC, 2016). This significantly contributes to the country's greenhouse gas (GHG) emissions.

Immediate action is required to mitigate the harmful effects of these emissions on the environment. The government and relevant authorities must take strict measures to address the situation before it's too late. A potential solution to reduce this contribution would be to use electric outboard motors.

Table 12 Technology Categories and The Market Characteristics in Transportation Sector

No	Selected Technology	Category	Classification
1	Sustainable Road (including Drainage & landscaping)	Publicly provided goods	Publicly offered commodity
2	Electric Out-board Motor	Consumer goods	Widespread consumption

Preliminary Targets for Technology Transfer and Diffusion in Transportation Sector can be seen on the **table 13** below:

Table 13 Target of the Selected Technology

No	Selected Technology	Target of the Technology
1	Sustainable Road (including Drainage & landscaping)	• Mendana Avenue: From Mataniko River Bridge to White River, length: 6 Km (One way) or 12 Km in Total • Hibiscus Avenue: From Mendana Avenue to Lengakiki Road, length: 1.5 Km (one way) or 3 Km in Total
2	Electric Out-board Motor	• 10 electric outboard motors 40 HP • Two electric pole chargers in Honiara

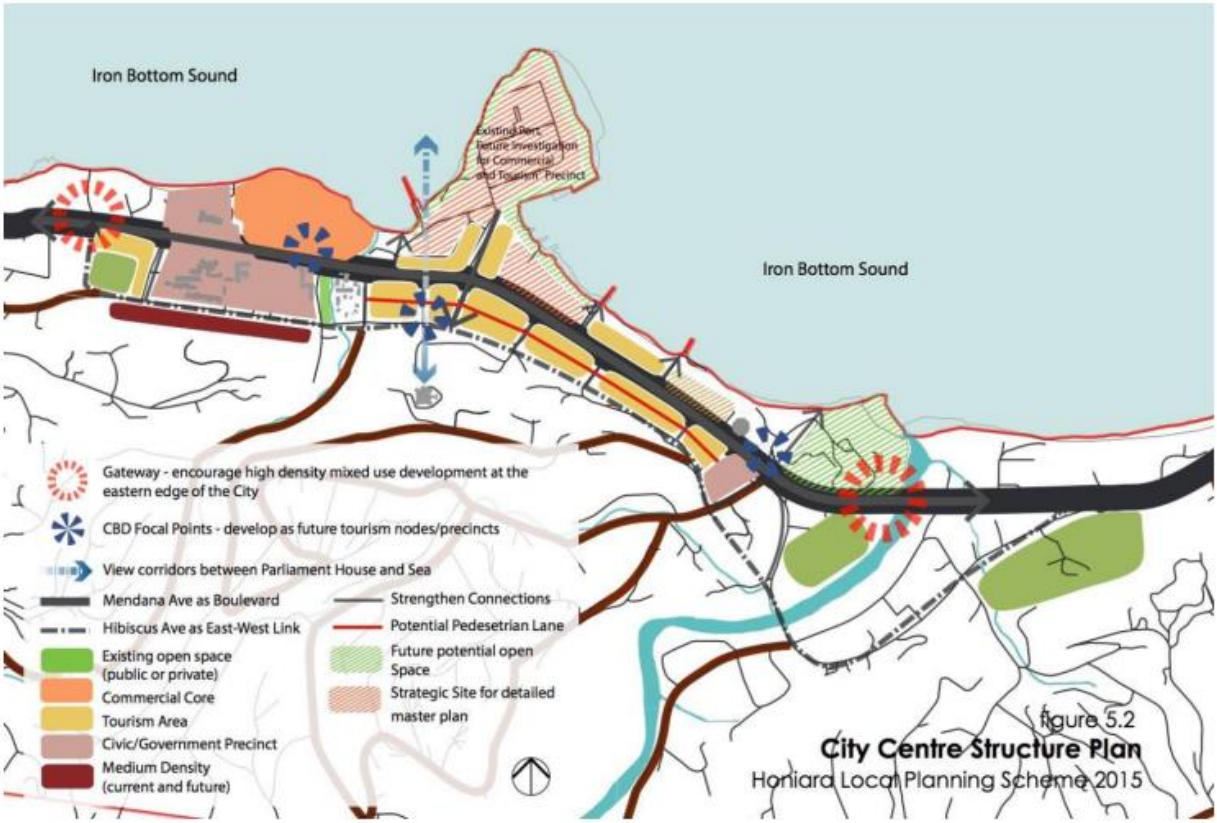

Figure 10 Planning for Mendana Avenue as Boulevard according to Honiara Local Planning Scheme 2015
(Source: Ministry of Land Housing and Survey , 2015)

3.2 Barrier analysis and possible enabling measures for Technology Sustainable Road

3.2.1 General description of technology Sustainable Road

One of the main causes of road damage in Greater Honiara is that road drainage cannot accommodate the surface runoff rainwater. Reducing service runoff will also reduce suspended sediments and debris (rubbish). The road damage causes the delay of travel time and increases the use of fossil fuel, it brings the impact of increasing the GHG emission in town. The dependency on motor vehicle in Greater Honiara is high as the pedestrian pathway does not accommodate pedestrian needs in terms of safety and comfort. To address these issues, there's a critical need for sustainable road design implementation in the Solomon Islands. Such designs should not only cater to road infrastructure but also integrate efficient drainage systems for long-term resilience.

Figure 11 Mendana Avenue without any street trees
(Source: Author, 2023)

Figure 12 Hibiscus Avenue without any street trees and blocked street drainage
(Source: Author, 2023)

The design of sustainable roads includes the implementation of green stormwater management strategies and facilities that utilize vegetation, permeable surfaces, soils, and engineering principles to collect, convey, clean, and infiltrate stormwater runoff from the streets. By incorporating a landscape buffer, GHG emissions can be absorbed, and the urban heat island effect can be reduced, resulting in a lower local temperature in urban areas. The use of permeable surfaces and a proper drainage system ensures that the road construction is durable and has a positive impact on travel time, travel cost, and the reduction of fossil fuel consumption by eliminating traffic delays. For instance, planting street trees in cities like Semarang and Surabaya can reduce the urban heat island effect from 29°C to 27°C and also lower the CO2 level.[47]

47 Seprila Putri Darlina, Bandi Sasmito and Bambang Darmo Yuwono (2018). ANALISIS FENOMENA URBAN HEAT ISLAND SERTA MITIGASINYA (STUDI KASUS : KOTA SEMARANG). Jurnal Geodesi Undip, 7(3), pp.77–87.
47 Pratiwi, A.Y. and Jaelani, L.M. (2021). Analisis Perubahan Distribusi Urban Heat Island (UHI) di Kota Surabaya Menggunakan Citra Satelit Landsat Multitemporal. Jurnal Teknik ITS, 9(2). doi:https://doi.org/10.12962/j23373539.v9i2.53982.

Figure 13 The planting of street trees on the Main Road in Semarang and Surabaya City is intended to reduce urban heat islands and absorb CO2.
(Source: Pemkot Semarang (2017), Surabaya (2023))

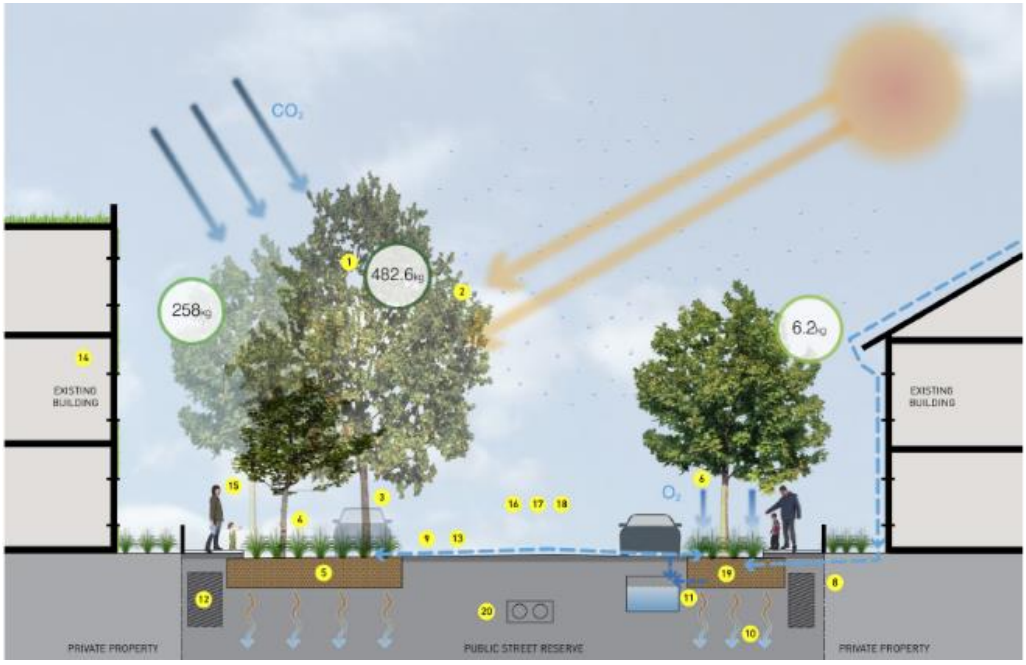

Figure 14 Concept and Implementation of green complete streets
(Source: Chen, 2015)

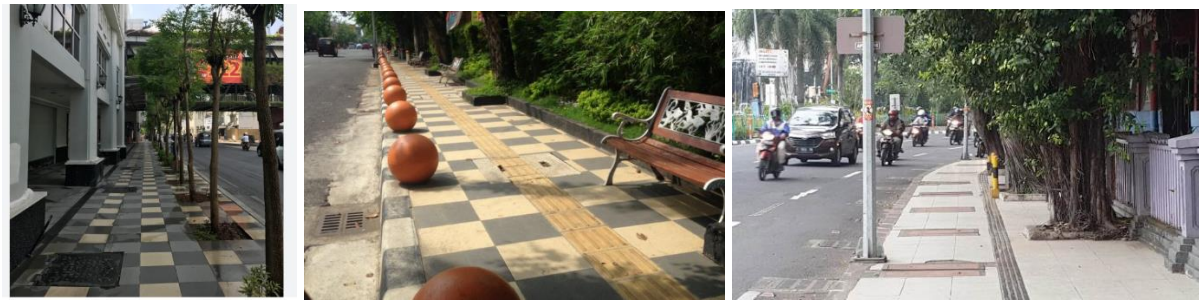

Figure 15 Implementation of Integrated Green Street in Surabaya and Semarang City
(Source: JalanLagi (2017), Media (2017), and Quora (2019))

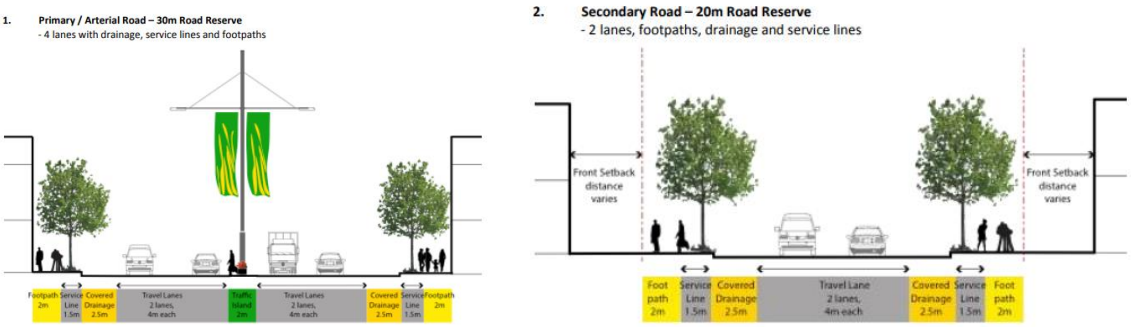

Figure 16 Technical Guideline of Road Design in Honiara According to Honiara Local Planning Scheme, 2015
(Source: Ministry of Land Housing and Survey, 2015)

Note: the standard widths for uses within roads as per the various road reserves above are: • One vehicle lane = 4.0 metres • Drainage = 2.5 metres (covered or U Design, 400mm to 600mm depth) • Footpath = 2.0 metres • Service lines = 1.5 metres • Traffic island = 2.0 metres

Technology brief descriptions:

1. To create a pedestrian-friendly environment, it's important to consider the impact of water runoff and how to manage it effectively. Two options include interlocked pavement or pervious concrete which can absorb the water runoff. Additionally, drainage grills can be used to cover the drainage channels, allowing the runoff to pass through the drainage system.
2. To enhance the natural beauty of the area, consider planting local trees such as Cherry Trees, Rain Trees, Mahogany, *Cassia* or Golden Shower, *Monoon longifolium*, or False Ashoka, and Bayan Trees. These trees should have small leaves that are easily decomposed, providing a natural way to manage the waste that comes from the trees.
3. Another way to add greenery to the area is by providing green traffic islands using short shrubs of local vegetation such as *Acalypha siamensis*, Vetiver Grass, Hibiscus, Bougainville, Asoka or Ixora Paludosa, and sansivera. These islands can help to reduce carbon emissions and provide shade for pedestrians.
4. Finally, it's important to provide street furniture for pedestrians such as benches, rubbish bins, information boards, halt or bus bays, or shelter. All of these amenities can help to create a more comfortable, safe, and enjoyable environment for pedestrians.

3.2.2 Identification of Barriers for Technology Sustainable Road

The identification of barriers to sustainable road technology was carried out through a comprehensive process that included literature review, key information interviews, information analysis, and stakeholder consultations. The aim of this exercise was to identify the factors that hinder the adoption of sustainable road technologies and to propose solutions to overcome them. The barriers were firstly compiled, screened, decomposed, and then analysed to identify the underlying problems and root causes. The barriers to technology were classified into two main categories: economic and financial barriers and non-financial barriers.

1. **The economic barriers** refer to the high initial costs of acquiring and implementing sustainable road technology, while the financial barriers relate to the lack of funding and investment required to support the development and deployment of such technology. The detailed analysis of these barriers provides valuable insights and recommendations for policy makers, investors, and other stakeholders to overcome these challenges and promote the adoption of sustainable road technology.
2. **Non-financial barriers** were further segregated into various subcategories, including policy, legal, and regulatory barriers, technical barriers, institutional and organizational capacity barriers, social, cultural, and behavioural barriers, and information and awareness barriers. These subcategories were identified based on their potential to affect the adoption of sustainable road technologies.
    a. **Policy, legal, and regulatory** barriers refer to the laws, regulations, and policies that may hinder the adoption of sustainable road technologies.
    b. **Technical** barriers refer to the lack of knowledge, skills, and technical expertise required to implement sustainable road technologies.
    c. **Institutional and organizational capacity** barriers refer to the limitations in the capacity of organizations and institutions to adopt sustainable road technologies.
    d. **Social, cultural, and behavioural** barriers refer to the lack of acceptance of sustainable road technologies by society, culture, and individuals.
    e. **Information and awareness** barriers refer to the lack of information and awareness about sustainable road technologies, their benefits, and their potential impact on the environment and society.

Overall, the identification of these barriers is crucial in developing effective strategies to overcome them and promote the adoption of sustainable road technologies.

3.2.2.1 Economic and financial barriers

1. To construct or repair a pedestrian way and drainage infrastructure that spans an entire city, a significant investment of funds is required. Additionally, there are substantial operation and maintenance (O&M) costs associated with such a project.
2. Unfortunately, the challenge is compounded by the lack of information available on the performance and cost-effectiveness of low-impact development (LID) infrastructure. LIDs are an innovative approach to infrastructure that aims to reduce the impact of urbanization on the environment.
3. However, there is a pervasive perception among private and public developers and lenders that LIDs can be as expensive as conventional infrastructures. This perception stems from a poor understanding of LIDs, including the cost to design, construct, and maintain them. Furthermore, there is an insufficient economic analysis of the environmental and social benefits of green infrastructure. Therefore, it is crucial to conduct a thorough economic analysis of LIDs to understand their true cost-effectiveness and benefits. This analysis can provide a better understanding of the role LIDs can play in the development of sustainable infrastructure that is both environmentally friendly and cost-effective.

Table 14 cost estimation for the technology implementation

Project activity	Green Infrastructure			Conventional Infrastructure
	Price / Unit	Volume	Total Price (USD)	Total Price (USD)
Rehabilitation of sealed road	USD 750,000/Km[48]	7.5	USD 5.7 M	USD 4 M
Foot Path and Landscape	USD 200,000/ Km	7.5	USD 1.5 M	USD 1.35 M
Drainage Improvement	USD 450,000/ Km	7.5	USD 3.375 M	USD 2.7 M
Feasibility Study, Detail Engineering Design and Handbook	N/A	Package	USD 2.5 M	N/A
Maintenance	10-20 % from initial cost	Yearly	USD 1-3 M	USD 0.75-2 M

3.2.2.2 Non-financial barriers

A. Policy, legal, and regulatory

1. The current state of policy, legal, and regulatory frameworks related to urban green streets in Honiara, Solomon Islands, is concerning.
2. Firstly, there are no technical guidelines in place either from the Ministry of Infrastructure and Development or Local authority (Honiara city council) on how to develop and maintain green streets. This lack of guidance can lead to inconsistent practices and suboptimal outcomes.
3. Secondly, there is an absence of comprehensive land use, transportation planning, and drainage planning at the national level. This lack of planning makes it difficult for local governments to develop actionable strategies that align with the national priorities. Additionally, the Honiara local planning scheme is incompatible with the climate change projection, which raises concerns about the suitability of current planning practices for a changing climate.
4. Thirdly, there is a significant gap in local ordinances, building codes, health codes, drainage codes, and parking spaces. The absence of these codes and ordinances can lead to suboptimal development practices, which can have long-term consequences for the city's livability and sustainability.
5. Fourthly, the existing municipal codes and ordinances prefer grey infrastructure over Low Impact Development (LID) strategies. This preference can lead to missed opportunities to develop green streets that can provide multiple benefits, including better stormwater management, air quality improvement, and urban heat island reduction.
    1 Finally, there is weak enforcement of the existing urban planning codes and regulations. This lack of enforcement can lead to non-compliance, which undermines the effectiveness of the existing policies and regulations.

48 http://sirap.sb/images/Docs/SI_National_Transport_Plan_2017-36_v03e.pdf

B. Institutional and Organisational Capacity

1. Despite the urgent need for sustainable urban development, only a handful of professional institutions have shown any interest or taken any steps towards implementing these initiatives. This lack of engagement is alarming, as it suggests that the importance of sustainable urban development is not being given the attention it desperately requires.
2. Moreover, it has been observed that both the ministry level and local authority lack adequate management structures to enforce street drainage and monitor street trees. This lack of oversight can result in poorly implemented drainage systems and exacerbate flooding and other environmental issues, leading to long-term damage to the local ecosystem.
3. Finally, the absence of a specialised division within both the Ministry of Infrastructure and the local municipality dedicated to urban landscape or street landscape development is a major impediment to sustainable urban development. Without such departments, there is a lack of expertise in implementing sustainable urban development initiatives such as Green Street and LID. This can lead to missed opportunities to achieve more sustainable and resilient urban landscapes and could result in long-term societal and environmental harm.

C. Socio-Cultural, Information, and awareness

In terms of socio-cultural challenges, it has been observed that there is a lack of understanding within the community regarding the importance of road drainage. This can be attributed to the fact that there are limited awareness-raising initiatives on the issue. Furthermore, community voices tend to be ignored when it comes to infrastructure development. This is evident in instances where community voices related to protecting roadside trees have gone unheard. Additionally, there is a lack of awareness amongst the public regarding green infrastructure. This lack of awareness is a significant obstacle to the implementation of sustainable infrastructure solutions.

D. Technical and Human Skill

1. Regarding technical and human skill challenges, one notable issue is the inadequate technical expertise of local governments to design and deploy effective project designs. This can result in poorly constructed infrastructure that can be costly to repair and maintain over time.
2. Furthermore, the technical expertise and knowledge of green infrastructure and low-impact development amongst local governments are limited. This can lead to missed opportunities to implement sustainable infrastructure solutions.
3. Additionally, there appears to be insufficient knowledge and capacity amongst local governments to effectively interpret data related to climate change events and assess the impact of it. This lack of capacity can result in an ineffective response to climate change events.
4. Another issue is the lack of research related to the primary materials used for road infrastructure. In particular, there is a need to explore the use of local materials as an alternative to the mostly imported road drainage and pavement materials. The use of local materials could not only have a positive impact on the local economy but also reduce the carbon footprint associated with transportation of materials.
5. Additionally, no nursery centre is available to supply the vegetation needed for green streets. This limits the ability to create green infrastructure solutions.

Addressing these challenges will require a comprehensive approach that involves collaboration and coordination amongst various stakeholders, including local governments, community members, and infrastructure development experts. Addressing the technical and human skill challenges will require investments in training and capacity building of local government officials and infrastructure development experts. Addressing the socio-cultural challenges will require a focus on community engagement and awareness-raising initiatives. Finally, addressing the lack of research related to primary materials will require investments in research and development of locally sourced materials.

Table 15 Summary of Barriers to Sustainable Road

No	Barrier Factors	Score of Barrier
A.	Economic and Financial Barriers	
1	A high cost of investment and O&M cost is needed for undertaking construction or repair of a citywide existing pedestrian way and drainage infrastructure.	5
2	Lack of information on performance and cost-effectiveness of low impact development (LID) infrastructure	4
3	There is a perception among private and public developers and lenders that LIDs (Low impact developments) can be as expensive as conventional infrastructures. This perception comes from the poor understanding of LIDs: cost to design, construct, maintain and insufficient economic analysis of environmental and social benefits of green infrastructures.	3
B	Policy, legal, and regulatory	
1	No technical guidelines related to urban green streets, either from the Ministry of Infrastructure and Development or Local authority (Honiara city council)	5
2	Absence of concrete and comprehensive land use, transportation planning, and drainage planning, at the national level with actionable strategies at the local government scale	5
3	The Honiara local planning scheme is not compatible with the climate change projection	5
4	Absence of or poorly developed local ordinances; building codes; health codes; drainage codes; and parking spaces	5
5	Weak enforcement of the existing urban planning codes and regulations	5
6	Absenteeism of Safeguard guideline for sustainable road	3
C	Institutional and Organisational Capacity	
1	Few professional institutions have concerns about green street and LIDs	3
2	Limited management at the ministry level and local authority to do the enforcement on street drainage and monitor the street trees	4
D	Socio-Cultural, Information, and awareness	
1	Lack of understanding from the community related to the importance of road drainage	5
2	Community voices tend to be ignored by the local authority when it comes to infrastructure development, for example, community voices related to protecting roadside trees	5
3	Lack of awareness related to green infrastructure to the public	5
E	Technical and Human Skill	

No	Barrier Factors	Score of Barrier
1	The inadequate technical expertise of local governments to design and deploy effective project designs	5
2	The technical expertise and local governments lack knowledge of green infrastructure and low-impact development	3
3	Limited knowledge and capacity to effectively interpret data related to climate change events and assess the impact of it	5
4	Lack of research related to the main material will be used previous concrete by using the local material	4
5	Most of materials for the road drainage and pavement are mostly imported	5
6	No available nursery centre is to supply the vegetation needed for the green street	5

The score of Barrier:
1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

3.2.3 Identified measures

Given the significant social importance of implementing energy efficiency measures in the public sector and their potential to reduce greenhouse gas emissions, it is necessary to invest in this sector in a large-scale and long-term manner. This is because the high energy savings potential of these measures means that they have an actual payback period. To make this investment possible, it is essential to work with financial resources and attract funds from both internal and external sources. This report section aims to discuss the necessary measures to overcome the identified barriers to implementing sustainable road technology across the country. The transportation sector working group analyzed the situation and identified the following key areas that need to be addressed for the effective implementation of transportation technologies...

3.2.3.1 Economic and financial measures

One of the biggest challenges in implementing low impact development (LID) infrastructure is the high cost of investment and operation & maintenance (O&M). Additionally, there is a lack of information regarding the performance and cost-effectiveness of LIDs, which further complicates the situation. Moreover, private and public developers and lenders often view LIDs as expensive as conventional infrastructures, which creates a barrier to their adoption. To overcome these economic and financial barriers, there are some measures that could be taken.

1. Firstly, local governments should be allocated an adequate development budget for the design, development, construction, and subsequent operation and maintenance of green street and road drainage.
2. Secondly, exploring and competing for donor funding opportunities, especially international climate mitigation financing, could help diffuse and transfer green infrastructure technology. The economic benefits of this technology are numerous, including decreased costs of damages resulting from road damage, reduced consumption of fossil fuels, and a decrease in local temperature.

3. Thirdly, providing incentives to developers and consumers of LIDs could encourage the market to create a space for green infrastructure tools, equipment, and initiatives. This would facilitate the movement of LIDs from a public good status to a market good through indulging private investors in public-private partnerships or standalone private projects. By implementing these measures, the economic and financial barriers to LID infrastructure could be overcome, and the benefits of this technology could be realized.

3.2.3.2 Non-Financial Measures

A. Policy, legal, and regulatory

1. Firstly, it suggests providing comprehensive technical guidelines related to the urban green street as a handbook. The technical reference will enable local consultants or contractors to design the road landscape using the available local material. The guidelines will include detailed information on materials, design, maintenance, and sustainability, ensuring that the urban green street is environmentally friendly, sustainable, and aesthetically pleasing.
2. Secondly, the text recommends preparing an action plan or technical plan for each ward's transportation and drainage system in the urban area. The plan will be developed based on the current urban infrastructure and will take into account the future needs of the area. The plan will include details on the transportation network, including public transport, cycling, and pedestrian infrastructure, as well as the drainage system and flood management measures.
3. Additionally, the text highlights that the local planning scheme document is being updated to reflect the recent climate change issues. The updated document will address the need to reduce greenhouse gas emissions, promote renewable energy, and conserve natural resources, among other things.
4. Moreover, the text recommends increasing and strengthening the enforcement of urban planning code and regulation implementation. This will ensure that all new development projects adhere to the regulations and requirements set out in the local planning scheme document. The enforcement will be carried out by local authorities, and penalties will be imposed on non-compliant developers.
5. Lastly, it suggests providing technical guidelines for low-impact development infrastructure. The guidelines will include information on the design, construction, and maintenance of low-impact development infrastructure. The guidelines will ensure that these types of infrastructure are implemented in a sustainable manner and are effective in mitigating the environmental impacts of climate change.

B. Institutional and Organisational Capacity

To facilitate the effective maintenance of green streets and LIDs, it is recommended that a dedicated division be established at the ministry or local authority level. This division should be responsible for overseeing the maintenance of green streets and LIDs, including their design, construction, and maintenance.

C. Socio-Cultural, Information, and awareness

1. To increase public awareness of green streets and LIDs, it is recommended that various social media platforms be utilized for disseminating information.
2. The dissemination of information should be focused on promoting the benefits of green streets and LIDs, including their ability to reduce stormwater runoff, control flooding, and improve water quality.

3. Additionally, efforts to expand information dissemination to the community, including churches, should be made, as the latter is a critical channel for conveying information in the Solomon Islands

D. Technical and Human Skill

1. To facilitate the effective implementation of green streets and LIDs, it is recommended that technical workshops be provided to national experts and local government officials. These workshops should focus on providing participants with a comprehensive understanding of green streets and LIDs, including their design, construction, and maintenance.
2. Additionally, there is a need to strengthen research and development efforts related to green streets and LIDs, through collaborations between the ministry, local government, and universities. Such collaborations should focus on identifying best practices for the design, construction, and maintenance of green streets and LIDs. Finally, it is recommended that a nursery center be established to provide the necessary street vegetation. This center should be responsible for growing and supplying the vegetation required for the implementation of green streets and LIDs.

Table 16 Summary of Identified Measured for Sustainability Road Technology

No	Identified Measures	The Score of Identified Measure
A.	**Economic and Financial**	
1	Allocate adequate development budget to local governments for the design, development, construction and subsequent operation and maintenance of the green street and road drainage	5
2	Explore and compete for donor funding opportunities particularly international climate adaptation financing for the diffusion and transfer of green infrastructure. The economic benefits of this green infrastructure technology are received from the combination of the decreased cost of damages resulting from road damage and reduced consumption of fossil fuel, and reduced the local temperature	5
3	Provide incentives to developers and consumers of LIDs to encourage the market to create a space for green infrastructure tools, equipment, and initiatives so the technology could move from a public good status to market good through indulging private investors in public-private partnerships or stand-alone private projects.	5
B	**Policy, legal, and regulatory**	
1	Provide the technical guidelines related to the urban green street	1
2	Prepare the action plan or technical plan for the transportation and drainage system in the urban area for each ward	5
3	Updating the Local planning scheme document to the recent climate change issues	5
4	Increase and strengthen the enforcement of urban planning code and regulation implementation	4
5	Provide the technical guideline of Low impact development infrastructure	5
C	**Institutional and Organisational Capacity**	
1	Provide a special division at the ministry level or local authority to maintain green street and LIDs	3
2	Local community ownership to look after green climate	4

No	Identified Measures	The Score of Identified Measure
D	**Socio-Cultural, Information, and awareness**	
1	Increasing the awareness to the public related to green streets and LIDs through many social media platforms	5
2	Awareness up to church level	5
E	**Technical and Human Skill**	
1	Provide the technical workshop related to green streets and LIDS to the national expertise and local government	5
2	Strengthen the research and development related to green streets and LIDS with the collaboration between the ministry, local government, and university	5
3	Provide the nursery centre to supply the needs of street vegetations	5

The score of Identified Measure:
1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

3.3 Barrier analysis and possible enabling measures for Electric Out-Board Motor (E-OBM)

3.3.1 General description of technology for Electric Out-Board Motor

The transportation services via sea in the Solomon Islands have long relied on petrol outboard motors as the primary mode of transportation for supplies and people between islands as seen on **figure 17**. However, the increasing cost of petrol fuel has had a direct impact on the prices of goods and passenger fees due to the heavy dependence on these motors. The fluctuating prices of fossil fuels have been linked to the rise in cost, leading to a substantial increase in prices over time, thereby posing a significant challenge for the islanders who rely on sea transportation for their daily needs.

Figure 17 Outboard Motorboats waiting for Passengers to travel to other Islands in Solomon Islands
(Source: JetSetWa (2018); WireStock (2017))

Currently, the sea public transportation services in Solomon Islands, are getting higher and higher in cost. This is due to the petrol fuel which is very expensive as a result also increases the cost of public transportation using outboard motor. Some sea transportations were used for getting supplies from the towns to the villages and when the petrol fuel increases, the cost of sea transportation for each people or the cargo fees also increases.

In this context, electric outboard motors have emerged as a game-changer in the boating industry, offering a highly efficient and sustainable alternative for traditional outboard motors. They are eco-friendly and offer numerous environmental benefits, including less air and noise pollution. They are simple to use, require minimal maintenance, and provide a smooth and quiet ride, making them an ideal solution for the transportation needs of the islanders.

However, it is crucial to note that electric outboard motors require an understanding of battery types, charging methods, and range limitations to make an informed decision. They offer a balance between speed and efficiency and provide a higher torque, faster acceleration, and better manoeuvrability than traditional motors, making them a more reliable and efficient choice.

Furthermore, electric outboard motors are a perfect fit for fishing boats as they offer a peaceful cruising experience without scaring away fish or disrupting the natural environment. They are also more energy-efficient and cost-effective in the long run, making them a game-changer in the boating industry, particularly in places like the Solomon Islands where the dependence on sea transportation is high.

Figure 18 40 HP Electric Outboard Motor Engine[49]

Figure 19 *Shore pool and solar panel for boat charger[50]*

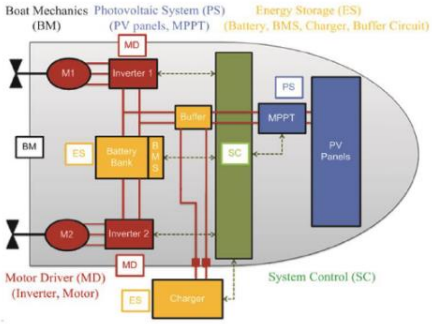

Figure 20 *Electric diagram of the all-electric boat[51]*

49 (https://www.torqeedo.com/us/en-us/products/outboards/deep-blue.)
50 (https://plugboats.com/first-st-tropez-electric-boat-show-charge-up-success/)
51 (https://www.researchgate.net/publication/268511955_Integrated_Motor_Drive_Design_for_an_All-Electric_Boat)

Technology brief descriptions:
An electric outboard motor is a reliable, eco-friendly, and low-maintenance option to power your boat. The motor uses a battery as its primary power source, which can be charged using solar panels on the boat or shore pool. Alternators can be used as a backup power source, ensuring that the battery is always charged and ready to use. An alternator or starter charges the battery when the engine runs.

Electric outboard motors are available in a range of sizes, with a 40-80 HP motor having a usable energy of 12.8-51.2 kWh. Lithium-Ion batteries are used to power these motors, known for their high energy density, long life, and low rate of self-discharge. It takes approximately 4-5 hours to charge the battery to 80% of its capacity.

Electric outboard motors have several advantages over traditional petrol-powered motors, including their low maintenance, quiet operation, and lack of fuel or exhaust smells. Furthermore, they offer impressive performance, with a maximum propeller speed of 2,400 rpm and a top speed of up to 50 km/hour.

Overall, electric outboard motors are an excellent choice for those seeking eco-friendliness, low maintenance, and practicality. The technology represents a step forward in sustainable boating solutions, making it an attractive option for boaters who value environmental responsibility.

3.3.2 Identification of Barriers for Technology Electric Out-Board Motor

The barrier identification of sustainable road technology was based by literature review, key information interviews, information analysis and stakeholder consultations. Barriers were firstly compiled, screened, decomposed and then analysed of problems and root causes. The barriers of technology classified in to two main categories:

1. Economic and financial barriers
2. Non-financial barriers, which are further segregated into policy, legal and regulatory barriers, technical barriers, institutional and organizational capacity barriers, social, cultural, and behavioural barriers, and information and awareness barriers.

3.3.2.1 Economic and financial barriers

The adoption of electric outboard motors is facing significant economic and financial challenges, which are impacting its widespread adoption. These challenges can be broadly classified into two categories: high cost and high prices.

1. One of the major factors driving the high cost of electric outboard motors is the limited availability of technology and raw materials. The production of batteries, which are a critical component of the motor, is still in its nascent stage and faces several challenges. These include the scarcity of raw materials needed for their production, which has resulted in a limited supply of batteries and driven up their cost. This has made the initial cost of electric outboard motors significantly higher than their conventional counterparts.
2. The high price of electric outboard motors is another significant barrier to their adoption. Conventional outboard motors are cheaper, making them more attractive to consumers. The price difference has made consumers hesitant to switch to electric outboard motors, despite the environmental benefits they offer. Consumers are generally price-sensitive, and the higher cost of electric outboard motors has proven to be a significant barrier to their adoption.

3. In conclusion, the high cost and high prices of electric outboard motors are the main economic and financial barriers to their widespread adoption. Addressing these challenges will require significant investment in technology and raw materials, as well as innovative business models that can help reduce costs and make these motors more affordable for consumers.

Table 17 Cost Estimation for Electric Outboard Motor Technology Implementation

Project activity	Price / Unit	Volume	Total Price
40HP electric Outboard Motor Engine	USD 10,000	10	USD 100,000
Electric pole charge station	USD 750,000	2	USD 1.5 M
Other additional cost	N/A	lumpsum	USD 500,000

Price for conventional outboard motor engine 40 HP in Solomon Islands is SBD 40,000 or USD 5,000

3.3.2.2 Non-financial barriers

A. Policy, legal, and regulatory

1. Renewable energy ecosystem: Despite the growing popularity of renewable energy sources, the current supply is still insufficient to meet the increasing demand for electricity. Therefore, it is essential for the government to support the development of renewable energy ecosystems by investing in some of the most promising alternatives, such as solar, wind, geothermal, and hydroelectric power.
2. Impact of tax and subsidy policies: Tax and subsidy policies are commonly used to incentivize the adoption of electric outboard motors. However, to achieve a broader and more significant impact, it is necessary to focus on governmental policies aimed towards distributors. These policies can effectively promote the diffusion of electric outboard motors, which are more environmentally friendly and efficient compared to traditional fossil fuel-powered motors. By incentivizing the adoption of electric outboard motors, we can reduce our carbon footprint and protect our environment for future generations.

B. Infrastructure

1 In some areas of the Solomon Islands, a significant portion of the population faces a severe electricity supply shortage. The lack of power not only hampers residents' daily lives but also poses a significant challenge to the transportation sector. With a shortage of charging stations for electric vehicles, the prospects of transitioning to cleaner modes of transport could be better. .

2 Moreover, the shortage of maintenance shops for electric outboard motors is a significant concern for boat owners who rely on these motors to power their boats. As the availability of skilled technicians and spare parts is limited, boat owners are finding it increasingly difficult to maintain their electric outboard motors. This can lead to significant downtime and financial loss for boat owners who depend on their boats for their livelihoods. .

3 To make matters worse, the availability of vendors selling electric outboard motors in the Solomon Islands is limited. This not only limits the options for boat owners who are looking to purchase or replace their electric outboard motors but also drives

up the cost of these motors due to limited supply. The lack of access to affordable and reliable electric outboard motors further exacerbates the challenges faced by boat owners in the Solomon Islands. .

C. Technology

1. Electric outboard motors can be a great alternative to traditional fuel-powered motors, but it is important to understand their unique features and limitations. One potential challenge is the longer charging duration due to the battery performance. This means that users may need to plan ahead and allow more time for charging compared to traditional fuel-powered motors.
2. Another important factor to consider is the battery capacity and lifespan. Electric outboard motors are typically constructed by substituting the fuel tank of a standard outboard with batteries and chargers. While these batteries are built to last an extended period, they will eventually wear out at a specific time. Most suppliers currently offer an 8-year or 100,000-mile warranty, which can provide some peace of mind. However, it's important to keep in mind that the limited battery life will eventually require frequent replacement, which can be a significant burden for electric outboard motor users in terms of time and cost.

D. Costumer Behaviour

1. Increasing customer awareness is a crucial aspect of our strategy to attract new customers. In particular, we need to educate potential users about the numerous benefits of Electric outboard motors, including financial incentives, infrastructure availability, and potential fuel-related savings. These factors are likely to play a significant role in determining the uptake of this technology by the consumers.
2. Another crucial factor that needs to be addressed is the range anxiety of consumers when deciding on the location and availability of charging stations. This refers to their concern over the distance they can travel on a single charge before needing to recharge their electric outboard motors. In the context of the Solomon Islands, where there is still a scarcity of electricity, this concern becomes more pronounced. Therefore, it is essential to take into account the consumers' range anxiety when deciding on the location and availability of charging stations.

E. Technical and Human Skill

1. One of the major challenges faced in the maintenance of electric outboard motors is the inadequate technical expertise. This can lead to improper handling of the motor, resulting in damage or malfunction. It can also lead to inefficiencies and increased maintenance costs in the long run. Therefore, it is important to have skilled personnel who possess the necessary technical expertise to maintain and repair electric outboard motors.
2. Another issue that needs to be addressed is the lack of knowledge about the sufficiency of quality equipment at competitive prices. This makes it difficult for consumers to make informed decisions while purchasing electric outboard motor parts. It can also lead to the purchase of substandard parts, which can compromise the performance and safety of the motor. Therefore, there is a need for more information and education about the quality and pricing of electric outboard motor parts.

3. Lack of training on the maintenance of electric outboard motors is also a major concern. This can lead to improper maintenance practices and can cause damage to the motor. It can also result in increased downtime for the motor, leading to losses for the user. Therefore, it is important to provide adequate training to personnel who are responsible for the maintenance of electric outboard motors.
4. Additionally, all the electric outboard motor parts are imported, which can lead to delays in repairs and maintenance. This is because of the time required to procure the parts, which can be a challenge for users who require immediate repairs.

Table 18 Summary of Barriers to Electric Outboard Motor

No	Barrier Factors	Score of Barrier
A.	Economic and Financial Barriers	
1	High initial cost: High initial costs, especially for batteries, are due to the limited availability of technology and raw material issues that restrict electric vehicle adoption	5
2	High capital cost : The higher capital cost of electric outboard motors refers to the initial investment required to purchase these motors compared to their conventional gasoline-powered counterparts. Electric outboard motors typically incorporate advanced technologies such as lithium-ion batteries, electric motors, and sophisticated control systems, which contribute to their higher upfront price.	5
B.	Policy and Regulation	
1	Renewable energy ecosystem: However, current renewable energies are insufficient for electricity demand. Government strategy is an essential part of supporting renewable energy ecosystems by focusing on some of the most promising alternatives	5
2	Impact of tax and subsidy policies: outboard motor taxes and purchase subsidies are frequently used to provide incentives for the adoption of electric outboard motors. Compared to the consumer side, governmental tax and subsidy policies for distributors have a better effect on electric outboard motors diffusion	5
3	Absence of regulation of electric OBM operation and management	5
C	Infrastructure	
1	Shortage of electricity supply in Honiara and, it's also will cause the shortage of charging station	5
2	Shortage of maintenance shop electric outboard motor	5
3	Limit of vendor electric outboard motor in Solomon Islands	5
D	Technology	
1	The long charging duration because of the battery performance	5
2	Battery capacity and lifespan: Electric outboard motors are typically constructed by substituting the fuel tank of a normal outboard with batteries and chargers. Because Electric outboard motors batteries are built to last for a long period of time, they will eventually wear out at a specific time. Most suppliers currently provide an 8-year or 100,000-mile warranty. Limited battery life requires frequent replacement, which is a major burden for Electric outboard motors	5
3	Inadequate charging port / station facilities for E-OBM	5
E	Customer behaviour	

No	Barrier Factors	Score of Barrier
1	Customer awareness: need customer awareness to bring new customers. Potential users' awareness of the benefits of Electric outboard motors such as financial incentives, infrastructure availability, and potential fuel-related savings are likely to be essential factors affecting their uptake	5
2	Range anxiety: Consumers' range anxiety is important in making decisions about charging stations as currently Solomon Islands itself still facing electricity scarcity, especially in the Western Province.	3
F	Technical and Human Skill	
1	The inadequate technical expertise in the maintenance the electric outboard motor	5
2	There is a lack of knowledge about the sufficiency of quality equipment at competitive prices.	5
3	Lack of training on the electric outboard motor maintenance	5
4	All the electric outboard motor parts are imported	5

The score of Barrier:
1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

3.3.3 Identified measures

In this section of the report, we will delve into the measures required to tackle the identified barriers to implementing electric outboard motors, particularly in the transportation sector. The transportation sector working group has identified the crucial areas that need to be addressed for the effective implementation of transportation technologies. It is worth noting that the implementation of energy efficiency measures in the public sector holds great societal significance and has the potential to reduce GHG emissions significantly. However, such implementation requires large-scale and long-term investments due to the high energy-saving potential. Thankfully, the utilization of working financial resources and attracting funds from both internal and external sources make the implementation of the program feasible.

3.3.3.1 Economic and financial measures

One of the significant barriers to implementing electric outboard motors is the high initial investment cost and the high price of electric outboard motor spare parts.

1. To overcome this economic and financial barrier, the government can provide subsidies to encourage the procurement of electric outboard motors.
2. Furthermore, electric outboard motor distributors can be exempted from some taxes and fees to incentivize their distribution, and operator and customer incentives can be provided through subsidy fees.

These measures will help overcome the economic and financial barriers and encourage the adoption of electric outboard motors, making them more accessible and affordable for everyone.

3.3.3.2 Non-Financial Measures

A. Policy and Regulation

The importance of non-financial measures in promoting the growth of renewable energy ecosystems and underlines the role of government policies and regulations in supporting them. Specifically, tax and subsidy policies for electric outboard motor distributors have a more significant impact on the adoption of this eco-friendly alternative compared to direct consumer incentives.

The significance of government strategy in supporting renewable energy ecosystems and promoting sustainable energy solutions by focusing on the most promising alternatives, policymakers can create a conducive environment for the growth of renewable energy technologies. This, in turn, can help reduce carbon emissions and contribute to global efforts to combat climate change.

Electric outboard motors are an excellent example of a promising alternative. They have gained popularity in recent years due to their eco-friendliness and cost-effectiveness. However, their adoption rate remains low, primarily due to the higher upfront cost compared to traditional gasoline-powered motors. This is where non-financial measures, such as tax and subsidy policies for distributors, can play a crucial role in accelerating their diffusion.

By incentivizing distributors to promote electric outboard motors through tax exemptions or subsidies, the government can encourage more people to switch to this sustainable alternative. This would lead to the creation of a more comprehensive supply chain, resulting in lower prices and a more extensive distribution network. Ultimately, these measures would contribute to the growth of the renewable energy ecosystem and accelerate the transition towards a cleaner and greener future.

B. Infrastructure

As part of the infrastructure development plan for Solomon Islands, efforts will be focused on establishing and maintaining a sustainable and reliable source of renewable electricity. To achieve this, natural resources such as solar and wave energy could be utilized. The region has abundant sunshine and a long coastline, which makes it an ideal location for generating solar and wave energy. The goal is to develop a renewable energy system that can meet the energy needs of the local community while minimizing environmental impact.

In order to ensure that the renewable energy system is operating at peak efficiency, a maintenance workshop will be established in the Solomon Islands. The workshop will be staffed with experienced technicians who will be responsible for conducting regular maintenance checks, repairs, and upgrades to the infrastructure. This will help to prevent downtime and ensure that the energy supply remains stable and reliable over the long term.

In addition to the maintenance workshop, electric outboard motor spare part vendors will also be established in Solomon Islands. These vendors will provide easy access to replacement components, reducing downtime and ensuring that the local economy can continue to thrive. By having readily available spare parts, local fishers and boat owners will be able to keep their electric motors in good working condition, which will help to support their livelihoods.

C. Technology:

When it comes to technology, one useful proposal would be to incorporate an additional battery into the charging station. By doing so, users would be able to charge their devices using both the primary battery and the secondary one simultaneously. This would make the charging duration much faster and more efficient.

Another idea could be to upgrade the charging port facilities to provide faster and more efficient charging. This could involve investing in new charging technologies that are capable of delivering higher power output or enhancing the existing infrastructure to enable faster charging speeds. By implementing these technological advancements, users would benefit from more convenient and rapid charging of their devices.

D. Customer Behaviour:

In terms of customer behavior, two critical aspects to consider are the level of awareness among customers and distributors regarding electric outboard motors, and the cost-effectiveness of public transport, alongside the pros and cons of new electric outboard motors.

To determine the level of customer and distributor awareness, it is essential to gauge the knowledge and understanding of customers and distributors about electric outboard motors, their features, benefits, and limitations. This would enable businesses to identify the potential market size and demand for electric outboard motors.

Furthermore, the cost-effectiveness of public transport is a key consideration, and it is important to weigh the advantages and disadvantages of electric outboard motors relative to traditional gasoline outboard motors. This includes assessing the overall financial costs, environmental impact, and performance of electric outboard motors and comparing them to their gasoline counterparts.

It is also important to examine the impact of the cost of public transport on customer preferences, as this can influence the decision-making process. By analysing customer behaviour and preferences, businesses can tailor their marketing strategies, develop more effective products and services, and maximize their market share. Overall, taking into account these factors can help businesses stay competitive and meet the needs of their customers in an ever-changing market.

E. Technical and Human Skill

The following are two recommendations to enhance technical and human skills in the field of electric outboard motor maintenance, research and development:

1. Technical Workshop: To improve the technical expertise of individuals working with electric outboard motors, it is recommended to organize a workshop that provides training on the maintenance of electric outboard motors. The workshop can cover topics such as troubleshooting, repairing, and maintaining electric outboard motors. The workshop can be conducted by experts in the field and can be aimed at individuals in the industry, government agencies, or academic institutions.

2. Collaboration for Research and Development: To promote research and development in the area of electric outboard motors, it is recommended to encourage collaboration among the ministry, local government, and university. The collaboration can help to

pool resources, expertise, and knowledge in order to undertake research and development projects related to electric outboard motors. The projects can focus on areas such as performance improvement, cost reduction, environmental impact, and safety. The collaboration can also help to facilitate the sharing of information and best practices among different stakeholders.

Table 19 Summary of Identified Measured for Electric Out Board Motor

No	Identified Measure	The Score of Identified Measure
A.	Economic and Financial Barriers	
1	Subsidies from the government in the procurement of the electric outboard motor by MID	5
2	Exemption from some taxes and fees for electric outboard motor distributor and private sector order	5
3	Incentives of the operator and costumer of E-OBM through subsidy fees	5
B.	Policy and Regulation	
1	Government strategy is an essential part of supporting renewable energy ecosystems by focusing on some of the most promising alternatives	1
2	Compared to the consumer side, governmental tax and subsidy policies for distributors have a better effect on electric outboard motors diffusion	2
3	Amend, develop and implement the new enforcement regulation	5
C	Infrastructure	
1	Provide the renewable electricity source in Honiara using natural resources such as Solar Panel and wave energy	5
2	Provide the maintenance workshop and electric outboard motor spare part vendors in Honiara	5
D	Technology	
1	Provide the extra battery in the charging station to speed up the charging duration	5
2	Provide more efficient and faster charging port facilities	5
E	Customer behaviour	
1	Customer and distributor awareness related to electric outboard motors	5
2	Affordable cost of public transport	5
3	Pros and cons of new E-OBM	5
F	Technical and Human Skill	
1	Provide the technical workshop in the maintenance of the electric outboard motor	5
2	Strengthen the research and development related to electric outboard motor with the collaboration between the ministry, local government, and university	5

The score of Identified Measure:
1: Not very Significant
2: Not Significant

3: Moderate
4: Significant
5: Very Significant

3.4 Linkages of the barriers identified

During the analysis process, many barriers and other obstacles of the system were identified which could be common to all technologies, and just a few of which would become specific for a certain technology and sector. The aggregation and summary of the common barriers of technology in the Transportation sector is presented in Table 20.

Table 20 Linkage Barrier for Transportation Sector

Barrier Category	Barriers
Economic and financial barriers	• The cost of investment and O&M is high. • The government has limited financial allocation.
Policy, legal, and regulatory	• The technical regulation that pertains to green infrastructure and electric outboard motor is not yet available in the Solomon Islands • There is no tax policy to support the implementation of green infrastructure and green transportation systems.
Socio-Cultural, Information, and awareness	• Lack of awareness and understanding from the community regarding the benefits of green infrastructure and green technology in transportation systems. • The public's pessimistic attitude towards the implementation of green infrastructure and transportation is a result of the unclear enforcement system and the shortage of power supply for electric outboard motors. • There is a perception among private and public developers and lenders that LIDs (Low impact developments) can be as expensive as conventional infrastructures and technology.
Organisational	• Limited institutional capacities at national level and on the local government related to green infrastructure and green transportation system. • There is no division that specifically responsible to the green infrastructure and green transportation system at the national level or local government.
Technology and Technical	• The inadequate technical expertise in maintenance for green infrastructure and green transportation system • Lack of research related to developing the green infrastructure and green transportation system using available local and affordable material.

3.5 Enabling framework for overcoming the barriers in Transportation Sector

To effectively tackle the barriers that hinder the adoption of prioritized technologies in the transportation sector, it is essential to develop an enabling framework that promotes the use of green infrastructure and transportation systems.

1. One of the most crucial steps towards achieving this goal is the creation of technical guidelines that are specifically designed for green infrastructure and transportation systems. These guidelines will help to ensure that the infrastructure is well-equipped to support the use of electric outboard motors and other eco-friendly transportation options.
2. To make green infrastructure and transportation systems financially sustainable, it is important for governments to work together and identify alternative funding sources that can support their implementation. Additionally, a well-designed tax system can incentivise the adoption of these technologies, leading to a more sustainable and environmentally friendly transportation sector.
3. To facilitate the implementation of this framework, a dedicated division within the Ministry of Infrastructure and Development (MID) should be established. This division can work collaboratively with private sector entities and local municipalities to ensure that the operational and maintenance processes are efficient and effective. By doing so, it will be possible to create a more sustainable and eco-friendly transportation sector that benefits everyone.

CHAPTER 4
MITIGATION TECHNOLOGIES FOR FORESTRY SECTOR

Solomon Islands has the highest percentage of forest cover in the Pacific Island Country region, it contains over 89% forest cover and is therefore considered a High Forest Cover Low Deforestation Country (HFLD) with low historical but very high and steeply increasing recent forest emissions, largely as a result of growing logging industry (FRL Report 2019).

The IPCC fourth report has shown that GHG will continue to increase to affect our climate (SIG, 2017). Solomon Islands as a Small Island Developing State (SIDS) is only marginally responsible for but among the most vulnerable countries to the adverse impacts of climate change (GFDRR, 2011). This is due to the circumstance that the majority of the population lives along coastlines, which agglomerates economic and infrastructure activities in these locations. The most likely impacts for this location will derive from sea-level rise, which affects crops and freshwater sources, especially in the low-lying islands.

Mitigation Expert Working Group members of Forestry Sector and other significant stakeholder had identified a set of mitigation technologies in during the first phase of TNA, and finally the two technologies (Rank 1 and 2) were prioritized through multi-criteria assessment (MCA) process which was one of the main decision-making tools which aims to determine the best alternative by considering more than one criterion in the selection process. MCA has manifold tools and methods that can be applied in different fields from finance to engineering design. The prioritized technologies are in **table 21**below.

Table 21 Prioritized technologies for Forestry Sector

No	Types of Technology Mitigation	Rank
1	Reforestation and Rehabilitation	3
2	Protection of watershed through Establishment of Forest Reserves	4
3	Establish a network of terrestrial protected areas	2
4	Agro-forestry & Food Security	5
5	Multi-Purpose National Forest Inventory	1

4.1 Preliminary Targets for Technology Transfer and Diffusion in Forestry Sector

Solomon Islands contains over 89% forest cover and is therefore considered a High Forest Cover Low Deforestation Country (HFLD) with low historical but very high and steeply increasing recent forest emissions, largely as a result of growing logging industry (FRL Report 2019). The government through a Food and Agriculture Organization (FAO) of UN supported programme on reducing emissions from deforestation and degradation (REDD+) has carried out a historical forest cover change to quantify emissions and removals and developed a forest reference level (FRL).

FRL sets the benchmark on which the results-based payments will be made for emission reductions from deforestation, forest degradation and carbon stock enhancement. Solomon Islands is committed to undertake a multi-purpose national forest inventory over the next few years. This will provide the basis for forest monitoring and informed decision-making to improve forest management and research. Further Solomon Islands intends to implement

sustainable logging policy (Sustainable Logging Policy 2018) and quantify forest carbon sequestration and protect forest above 400-meter contour.

SIG also intends to protect at least 20% of the terrestrial and inland water; 15% of coastal and marine areas enabling ecological, representative and well-connected system of protected area in the country, as provided in The National Biodiversity Strategic Action Plan 2016-2020. The newly launched National Forestry Policy 2020 is also hoped to assist the government manage and sustain the country's forest resources for the benefit and resilience of all Solomon Islanders. The two goals of the first strategy of the policy (Strategy 3.1. Forest Conservation Strategy) are Goal 1. Protection and conservation of biodiversity and forest ecosystems; and Goal 2. Recognition and promotion of ecosystems services for sustainable livelihood.

Adaptation priorities still linked to vulnerability and adaptation (V&A) and disaster risk reduction (DRR) strategies highlighted in the NCCP, NAPA, and foreseen long-term adaptation needs foreseen in the National Adaptation Plan (NAP). The Government of Solomon Islands considers it vital and urgent to develop the capacity of the country to assess risks and vulnerabilities associated with climate variability and change and to reduce climate change risks and adapt to the predicted impacts of climate change (MECDM 2016). This includes short term disaster risk reduction measures for climate variability and episodic extreme events, and long-term adaptation to climate change including, inter-alia, enhancing ecosystem and social resilience, climate proofing infrastructure and relocating communities as a last resort.

In 2016 and 2017, around 65% of the country's export earnings came from forestry, mainly through the sale of round logs, which accounts for 20% of the state revenue (CBSI, 2017). On a positive note, logging activities in rural areas give rise to employment opportunities, royalties, and spin-off benefits to resource owners and surrounding communities that improve rural livelihood at least during the lifetime of the logging developments. On the other hand, the social and environmental repercussions including GHG emissions are significant and may persist over a long period of time. 76% of all forest-related emissions in the Solomon Islands are caused by commercial logging and small-scale portable sawmill operations (Milling) in lowland and hill forests. The implementation of selected priority technologies will reduce greenhouse gas (GHG) emissions from deforestation, forest degradation and carbon stock enhancement.

Table 22 Technology Categories and The Market Characteristics in Forestry Sector

No	Selected Technology	Category	Classification
1	National Forest Inventory (NFI)	Other non-market goods	Non-tradable technologies transferred and diffused under non-market conditions
2	Establish network of terrestrial protected areas (N-TPA)	Other non-market goods	Non-tradable technologies transferred and diffused under non-market conditions

Preliminary Targets for Technology Transfer and Diffusion in Forestry Sector can be seen on the table below:

Table 23Target of the Selected Technology

No	Selected Technology	Target of the Technology
1	National Forest Inventory (NFI)	• 20 Ministry of Forestry officers certified as National Forest Data Collectors • Forest thematic map for the Solomon Islands in Choiseul Province • Solomon Islands Forest Data Base Choiseul Province
2	Establish network of terrestrial protected areas (N-TPA)	• Establish a network of terrestrial protected areas for 20% or 5,838.33 Km2 or 583,833 Ha of terrestrial area protected by 2030

4.2 Barrier analysis and possible enabling measures for National Forest Inventory

4.2.1 General description of technology National Forest Inventory

Forest inventories are systematic collections of data on the location, composition, and distribution of forest resources. The generated data allows for the assessment of various forest products and services and is a prerequisite for sustainable forest management. Depending on the specific goals and decision processes, forest inventories are implemented at the local, regional, national, or global levels.

National forest inventories (NFIs) are defined in FAO's Voluntary Guidelines on National Forest Monitoring (VGNFM) as a technical process of data compilation and forest resources analysis for a whole country. NFIs can build upon multiple data sources, including field inventories and remote sensing, to estimate relevant forest characteristics at particular points in time. NFIs enable countries to evaluate their stocktaking of a country's forest resources. They are multi-purpose and can be used to capture data on, for example, biodiversity, socio-economic aspects of forest use, and carbon storage. These data inform forest management decisions, national policy, and international reporting requirements.

Figure 21 Field Assessment on Forest Inventory in Papua New Guinea and Indonesia

Forest inventories are in general, systematic collections of data for a defined area of interest which constitutes the population of interest. They aim to gather data on the location, composition, and distribution of both the "resource forest" and the "ecosystem forest" that are relevant for forest-related processes in management, policy, and research.

Technology brief descriptions:

National Forest Inventory (NFI) is designed as a multipurpose NFI, which will collect information not only on timber volume but also on non-timber forest products, carbon stock, soil characteristics, biodiversity in both flora and fauna, and socio-economic aspects of Solomon Islands forests. NFI consists of 4 (four) main components such as:

a. Forest resources assessment (FRA),
b. Forest resources monitoring (FRM)
c. Geographic information system (GIS)
d. User involvement.

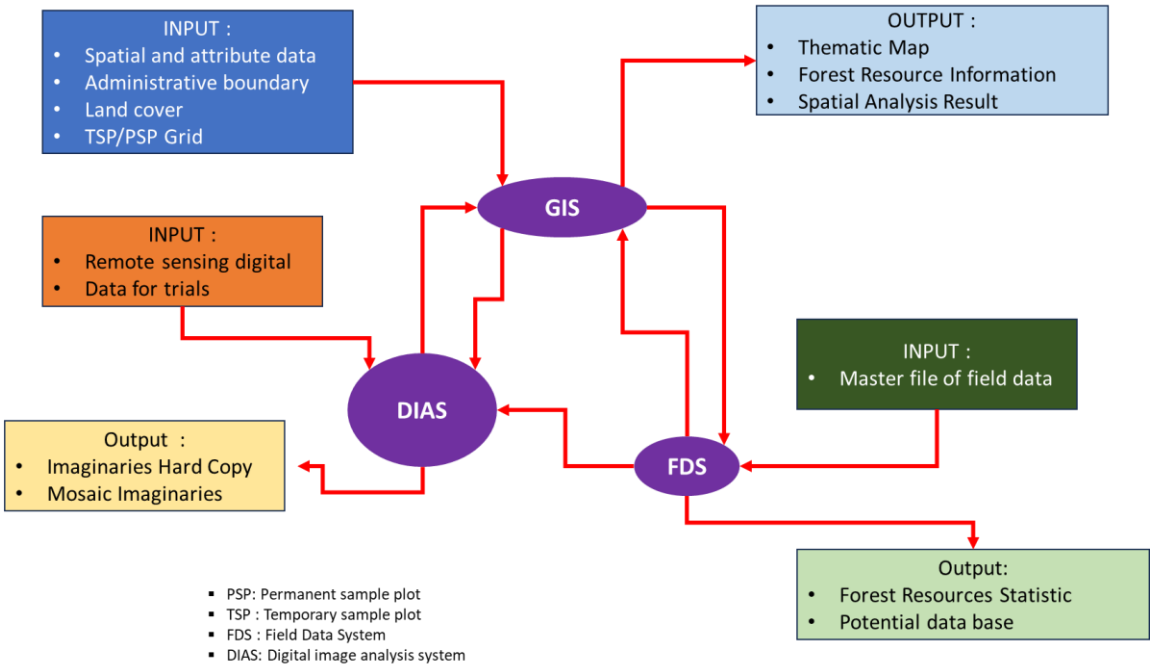

Figure 22 Concept of National Forest Inventory

Activities in National Forest Inventory:

1. **Conduct a two-staged sampling design.** Create a systematic grid for the country, involving an evenly-distributed point grid of 10,000 points covering the land area (approximately 2.8 km between sample points)
    a. Stage 1: Use Collect Earth software and aerial photo interpretation to identify grid land cover/ land use type, along with vegetation stratification of types across the entire country.
    b. Stage 2: Conduct ground surveys for each strata a minimum of approximately 50 sample points (450 in total) to obtain field-based information to determine robust estimates for each stratum.
2. **Clustered plot design** is used for field sampling. The aim is to capture the variation of selected sample plot locations using a cluster plot design (five, 0.04 ha circular subplots). A sampling plan was developed and piloted by the PICs during two NFI

workshops organized by FAO, the Ministry of Forestry and Research (MoFR) having developed and tested field survey plot methodologies with PIC colleagues. The time commitment required to complete a parcel in the field has been tested on a small scale and is used in the budgetary estimate of this proposal.

3. **Measure key ecosystem components, and model the rest**. Through several external- and self-reviews and tests of the capacity within the MoFR to conduct field measurements, a key strategy will be to ensure the key forest ecosystem components are measured to ascertain the forest cover and conditions, and biomass & carbon stocks
4. **Utilize proximity of field crews to conduct rapid management surveys**. As a secondary priority, field crews will conduct rapid, low time and resource cost surveys to augment management and monitoring of land use activities. Such surveys will be designed and tested as part of Year 1 (Pilot) implementation to evaluate cost and utility. Secondary surveys to be considered include, but are not limited to:
    a. **Rapid road condition survey**. To be conducted as crews utilize road networks to access field sites. Focus on identifying road network (GPS tracking) and road conditions (e.g., land failures, sediment sources to streams, etc.).
    b. **Rapid post-harvest assessment**. Conducted as field crews access sample plots. Assessment of harvest practices, damage, utilization, streamside buffer areas, and other compliance issues.
    c. **Cultural survey**. Identification of culturally important areas for exclusion, protection, or sensitive information that may affect future land use decisions.
    d. **Traditional Owners Profiles**. As part of the outreach and implementation segments of the project, traditional owners will be interviewed to identify needs, their management objectives, identify boundaries, and survey other important aspects that may affect future policy through the interview process.

Figure 23 Remote sensing and GIS-technology in forest inventory52

4.2.2 Identification of Barriers for Technology National Forest Inventory

The barrier identification of national forest inventory was based by literature review, key information interviews, information analysis and stakeholder consultations. Barriers were firstly compiled, screened, decomposed and then analysed of problems and root causes. The barriers of technology classified in to two main categories:

a. Economic and financial barriers

52 https://nfg.no/wp-content/uploads/2019/01/ForestInventory.pdf

b. Non-financial barriers, which are further segregated into policy, legal and regulatory barriers, technical barriers, institutional and organizational capacity barriers, social, cultural, and behavioural barriers, and information and awareness barriers.

4.2.2.1 Economic and financial barriers

The main economic and financial barriers to this technology were identified as:

- High cost of preparing the updated satellite image as the basic information, cost for the satellite imaginary is $ 1 M USD.
- High cost of field data collection, as the transport fees in the Solomon Islands is very expensive, Total cost for a plot (2.8 Km^2) of NFI is $4,500 US. Total cost for field data collection for 2500 plots sample of forest inventory is $ 11.250 M USD, excluding the plot audit. Awareness, workshop and other additional spending: 2 M.
- High prices on operational and management, in updating the data on the field and data related to information system.

4.2.2.2 Non-financial barriers

A. Policy and Regulation

Solomon Islands already has Solomon Islands REDD+ Readiness RoadMap 2014-2020 as the basic guideline for tackling climate change by securing the future of forest ecosystems and livelihoods. Still, this policy has yet to be supported by derivative technical policies that can be used as direct guidance for conducting NFI, both from government organizations and community organizations concerned about forest area data collection.

B. Infrastructure and technology

- Access to supporting infrastructure, such as roads, good air, and sea transportation systems, is crucial for the implementation of NFI. The implementation of field surveys in the Solomon Islands is currently hindered by the limited transportation system.
- The Solomon Islands lack communication services, particularly the internet network, as it is necessary for data management.
- There are currently many gaps in the data due to the need to update the primary data used for NFI implementation, such as the limited availability of the latest satellite imagery.
- Limited availability of facilities for Design and Analysis Toolkit for Inventory and Monitoring (DATIM), including an analysis tool for inventory and monitoring (ATIM) used for creating tables; a spatial intersection tool (SIT); a design tool for inventory and monitoring plans (DTIM); and a data compilation system (DCS) to add FVS attributes to DATIM datasets.

C. Technical and Human Skill

- The technical and human resources fields are experiencing a major problem due to the limited number of field experts who can carry out forest inventories compared to the forest area. This is also backed by un optimal forest inventory training process for forest volunteer community groups.
- There is a need for more availability of a team of experts in processing and managing DATIM data for those who focus on updating existing data in the field.

D. Social and Cultural

- Landownership out on the Islands is usually customary or tribal owned. Thus, making it difficult for the inventory officer to access inventory plot sites.

Table 24 Summary of Barriers to Sustainable Road National Forestry Inventory

No	Barrier Factors	Score of Barrier
A.	**Economic and Financial Barriers**	
1	High cost of preparing the updated satellite image as the basic information	4
2	High cost of field data collection, as the transport fees in the Solomon Islands is very expensive	5
2	High prices on operational and management, in updating the data on the field and data related to information system	5
B.	**Policy and Regulation**	
1	there are no technical regulations for the implementation of NFI	5
C	**Infrastructure and Technology**	
1	Lack of transportation infrastructure to access the sites	5
2	Lack of communication infrastructure especially the internet connection to upload and download the data from the site inventory	4
3	Lack of The Design and Analysis Toolkit for Inventory and Monitoring (DATIM) including an analysis tool for inventory and monitoring (ATIM) used for creating tables; a spatial intersection tool (SIT); a design tool for inventory and monitoring plans (DTIM); and a data compilation system (DCS) to add FVS attributes to DATIM datasets	5
4	Many data gaps exist, including recent forest map (geospatial information)	4
D	**Technical and Human Skill**	
1	The inadequate technical expertise in forest inventory workflow (planning, field work, inventory, analysis)	5
2	Inadequate expertise to do the DATIM	4
3	A limited number of technical expertise and forest inventory volunteer	4
E	**Social and Cultural**	
1	Lack of land right to access inventory plot sited	5

The score of Barrier:
1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

4.2.3 Identified measures

Taking into account that the implementation of energy efficiency measures in the public sector has a great social significance and a great potential for reducing GHG emissions, and given that this sector requires large-scale and long-term investments that have a real payback period due to the high energy saving potential, the implementation of the program becomes possible and expedient due to working financial resources and attracting funds from both internal and

external. This section of the report bids to discuss the measures that are needed to overcome the identified barriers to possible implementation of National Forest Inventory across the country. The National Forest Inventory sector working group in their analysis has identified the key areas below as the areas to address for effective implementation of the forestry.

4.2.3.1 Economic and financial measures

To overcome the barrier in economic and financial categories related to a high-cost High cost of preparing the updated satellite image as the basic information, high cost of field data collection, and the High prices on operational and management, in updating the data on the field and data related to information system. Some measure to overcome the economic and financial barrier such as:

- Increase access to financial resources for National Forest Inventory Explore and compete for donor funding opportunities particularly international climate fund.
- Allocating special funds for implementing NFI because NFI is primary data for the Ministry of Forestry in conducting forest resource assessments before issuing policies related to production forests and logging areas.

4.2.3.2 Non-Financial Measures

A. Policy, legal, and regulatory

Provides technical guidelines for NFI implementation that are easy to comprehend and implement by field officers and volunteer groups.

B. Infrastructure and Technology

- Collaborating with the private sector to provide support infrastructure, particularly in the areas of transportation and telecommunications.
- Collaborate with local and international higher education and research institutions to develop the necessary technology for data processing and management.

C. Technical and Human Skill

- Organize a technical workshop for the forest officer on Forest Inventory.
- Enhance research and development through collaboration with the ministry, local government, and university.
- Establish the internship program with a university or volunteer to be a part of forest inventory.

D. Social Cultural and awareness

- Clear information to the tribes and community regarding the land access fees and consultation or permission from landowners of inventory plot sites.

Table 25 Summary of Identified Measured for National Forest Inventory

No	Identified Measure	Score of Identified Measure
A.	**Economic and Financial Barriers**	
1	Allocate adequate budget for NFI	5
2	Explore and compete for donor funding opportunities particularly international climate adaptation financing for FNI activity	5
B.	**Policy and Regulation**	

1	Provide the NFI technical regulation	5
C	**Infrastructure and technology**	
1	Increase the transportation infrastructure and telecommunication to support NFI	5
2	Updating the Forest data map	4
3	Provide the update Design and Analysis Toolkit for Inventory and Monitoring (DATIM) including inventory and monitoring (ATIM) used for creating tables; a spatial intersection tool (SIT); a design tool for inventory and monitoring plans (DTIM); and a data compilation system (DCS) to add FVS attributes to DATIM datasets	5
D	**Technical and Human Skill**	
1	Provide the technical workshop for the forestry officer for Forest Inventory	5
2	Strengthen the research and development with the collaboration between the ministry, local government, and university	5
3	Open up the intern program with university or volunteer local resources owner to be part of forest inventory	4
E	**Social Cultural and awareness**	
1	Clear information to the tribes and community regarding the land access fees and consultation or permission from landowners of inventory plot sites.	5

The score of Identified Measure:

1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

4.3 Barrier analysis and possible enabling measures for Establish a Network of Terrestrial Protected Areas

4.3.1 General description of technology for Network of Terrestrial Protected Areas

The Solomon Islands have a limited number of protected areas established under Provincial Ordinance or Customary Law. Establishment of areas under the Protected Areas (PA) Act 2010, will increase the legal status of these areas and new areas identified by landowners and the government as requiring protection. Early evidence indicates that there is significant landowner interest in establishing PAs, and conservation areas, however there is a lack of clarity on how these will be funded and limited support to landowners and communities to undertake the relevant steps to establish PAs. Increasing capacity within MECDM to support PA establishment as well as promoting PA development, as part of approaches to land use planning will be important in establishing an effective PA network. Recorded 585.03 km² / 29,191.65 km² (2.00%) as terrestrial protected area in Solomon Islands.[53] Currently, none of the Solomon Islands' terrestrial area is formally protected under current legislation, while 3% of the land area is managed for conservation but not formally protected. This is well short of the Aichi target of 10% of terrestrial areas protected by 2020[54].

53 https://pipap.sprep.org/country/sb
54 Solomon Islands State of Environment Report 2019

However, the conservation challenges and threats that the Solomon Islands face are common to most Pacific Island countries. According to Solomon Islands National Biodiversity Action Plan 2016-2020, at least 10 percent of the terrestrial and inland water, and 15 percent of coastal and marine areas of the Solomon Islands are protected and managed effectively by 2020; enabling an ecological, representative, and well-connected system of a protected area, and have been integrated into the wider island and seascape management initiatives[55].

The people have a high dependency on marine and terrestrial resources for subsistence and also for generating cash income. A number of threats and pressures exist on these marine and terrestrial resources including logging, overfishing, pollution, and climate change. All of these factors are compounded by rapid population growth, particularly in coastal areas. This leads to an increase in coastal development and additional pressure on both terrestrial and near-shore natural resources in the area.

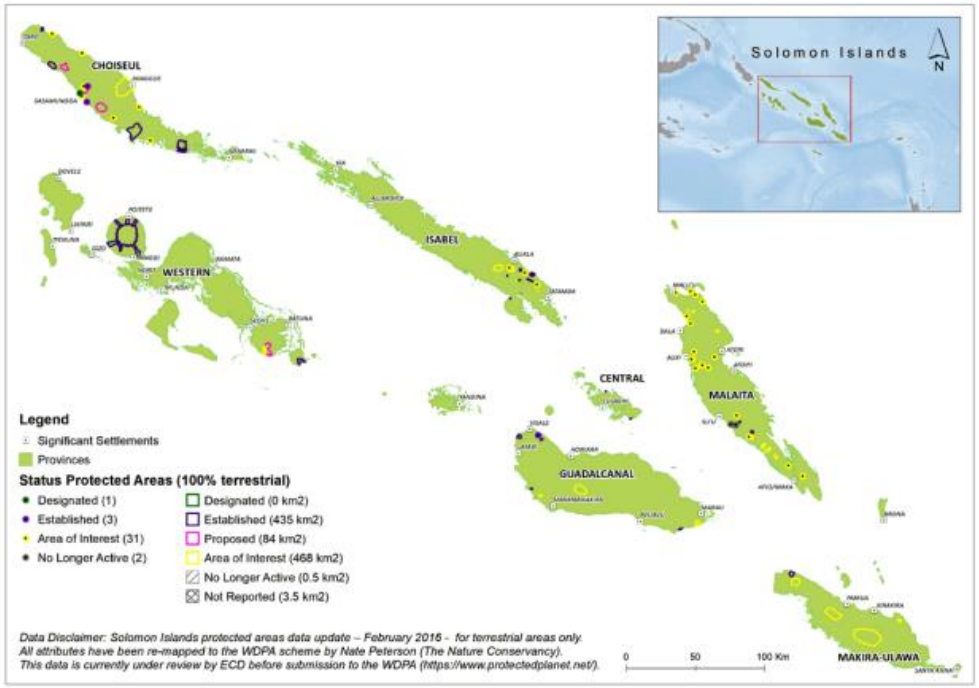

Figure 24 Terrestrial protected areas of Solomon Islands (status 2016)

Technology brief descriptions:

- National forest inventory
- Set up the governance of protected areas including the government, indigenous people, and local community
- Applying the categories related to national aim in conservation
- Measure the performance of a protected area and its periphery (or a protected area system) compared to its aims. The performance of the protected area (or protected area system) concerns its results and impacts, including its classic functions of conservation, environmental education, recreation, etc., but also its cultural, social, or economic functions
- Take decisions that are adapted and evolved in relation to this performance and ensure the context of the protected area evolves. The context is the framework for implementing management of the protected area (or the system).
- Delineation of protected area determination into the database
- Establish the terrestrial protected area

55 https://www.cbd.int/doc/world/sb/sb-nbsap-v2-en.pdf

4.3.2 Identification of Barriers for Technology Network of Terrestrial Protected Areas

The barrier identification of Network of Terrestrial Protected Areas was based by literature review, key information interviews, information analysis and stakeholder consultations. Barriers were firstly compiled, screened, decomposed and then analysed of problems and root causes. The barriers of technology classified in to two main categories:

A. Economic and financial barriers
B. Non-financial barriers, which are further segregated into policy, legal and regulatory barriers, technical barriers, institutional and organizational capacity barriers, social, cultural, and behavioural barriers, and information and awareness barriers.

4.3.2.1 Economic and financial barriers

The study to establish a National Protected Areas System in the Solomon Islands has recently been completed and they have identified the gaps and capacity needs of the system. To implement the network of terrestrial protected areas, Solomon Islands experienced several obstacles, including a lack of financial support to establish terrestrial protected areas and a lack of funding to maintain the network of terrestrial protected areas.

20% of Solomon Islands Forest targeted as protected area, around 583,833 Ha by 2030. The cost for establish the terrestrial protected area in Solomon Islands is USD 250/ Ha or USD 146M, Awareness and Workshop: 2 M, Total Cost = USD 148M

4.3.2.2 Non- Financial Barrier

A. Policy and Regulation

Solomon Islands already have Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas, but TPAs have not been used as the main tool for conservation because they are not a political priority. The lack of common standards on the definition of a TPA and the level of protection contributes to this barrier.

B. Institutional And Organizational Capacity Barriers

The complexity and length of administrative procedures for creating a TPA, including its construction, obtaining funding, and difficulties for managers in developing a regulatory framework due to lack of decision-making or legal prerogatives due to lack of synchronization. The issue is that not all stakeholders are involved in management or have the same influence in decision-making.

C. Technical and Human Skill

The lack of human resources capacity has identified the importance of strengthening the level of appropriate capacity building as a key element necessary for promoting management effectiveness in TPAs. Various stakeholder consultative meetings identified issues such as insufficient training and knowledge of existing staff, an overall lack of staff, limited scientific and technical information pertaining to individual TPAs, as well as a lack of knowledge among communities in and nearby TPAs as key challenges.

D. Technology

Solomon Islands lacks sufficient basic data on the Forest National Inventory, which is crucial for establishing the TPA, monitoring and evaluating the program. The result was a number of data gaps, including a recent forest map.

E. Socio Culture and Awareness

Different and potentially conflicting views of the socioeconomic and ecological costs and ecological costs and benefits. The existence of "losers" and "winners" after the establishment of TPAs, restricted or expanded activities, lack of compensation measures, and lack of information and awareness to the public or local stakeholders on the role and objectives of TPAs.

Table 26 Summary of Barriers to Network of Terrestrial Protected Areas

No	Barrier Factors	Score of Barrier
A.	**Economic and Financial Barriers**	
1	Lack of financial support to establish terrestrial protected areas	5
2	Lack of funding to maintain the network of terrestrial protected areas	4
B.	**Policy and Regulation**	
1	The use of TPAs as a conservation tool is not a political priority	5
2	Lack of common standards on the definition of a TPA and the levels of protection	4
C	**institutional and organizational capacity barriers**	
1	Complexity and length of administrative procedures for the creation of MPAs, their development, obtaining funding	5
2	difficulty for managers to make the regulatory framework evolve due to a lack of decision-making or legal prerogatives	4
3	not all stakeholders are involved in management and/or do not have the same influence in decision making	4
D	**Technical and Human Skill**	
1	Lack of clarity in geographic delineation and overlapping regulatory frameworks	4
2	Lack of scientific knowledge in natural sciences and/or human and social science	4
3	A limited number of technical expertise in managing and monitoring TPA	4
F	**Technology:**	
1	Solomon Islands does not have strong basic data related to Forest National Inventory as an important component in establishing the TPA, monitoring and evaluating the program.	5
2	Many data gaps exist, including recent forest map	5
E	**Socio Culture and Awareness**	
1	lack of information and awareness to the public or local stakeholders on the role and objectives of TPAs	5
2	different and potentially conflicting views of the socioeconomic and ecological costs and ecological costs and benefits	5
3	Lack of clear incentive for resources owners	5
4	existence of "losers" and "winners" after the establishment of MPAs, restricted or expanded activities, lack of compensation measures	4

The score of Barrier:

1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

4.3.3 Identified measures

Taking into account that the implementation of energy efficiency measures in the public sector has a great social significance and a great potential for reducing GHG emissions, and given that this sector requires large-scale and long-term investments that have a real payback period due to the high energy saving potential, the implementation of the program becomes possible and expedient due to working financial resources and attracting funds from both internal and external. This section of the report bids to discuss the measures that are needed to overcome the identified barriers to possible implementation of Terrestrial Protected Areas across the country. The Terrestrial Protected Areas sector working group in their analysis has identified the key areas below as the areas to address for effective implementation of the forestry.

4.3.3.1 Economic and financial measures

To overcome the barrier in economic and financial categories funding for strengthening the system must be secured elsewhere. Although donor dependency is often unsustainable, Solomon Islands must secure financial assistance during its current infant stage, purposely to strengthen its financial and managerial capacity to minimize the potential rapid decline of the biodiversity in the country. Think of TPAs as capable of generating economic benefits by developing long-term financing strategies in carbon trading

However, it is hoped that with financial assistance come to hand, the Solomon Islands will develop and implement a financing strategy for the national system as well as for individual PAs. Explore and compete for donor funding opportunities, particularly international climate mitigation schemes.

4.3.3.2 Non-Financial Measures

A. Policy and Regulation

Establish regulations that clearly define prohibited activities and the actors involved. The code will be a technical guide in implementing the TPA; apart from containing the technical regulations for the TPA, this regulation must also include the sanctions and benefits of establishing a TPA for the community.

B. institutional and organizational capacity barriers

To reduce and speed up administrative procedures for creating TPAs, developing them, and obtaining funding, it's important to maintain communication and coordination between stakeholders. Ensure that the regulatory framework is strengthened to support decision-making or legal prerogatives in TPAs, and that all stakeholders are involved in management and have equal influence on decision-making.

C. Technical and Human Skill:

In order to have a sufficient number of trained support personnel, it is important to provide training on forest ecology and socio-economic problems in schools, universities, professionals, and the community. Promoting continuous training among various professions and encourage actors to work towards implementing shared goals.

utilizing protocols and monitoring systems that are scientifically robust and standardized.

D. Technology:

Strengthen basic data related to the Forest National Inventory as an essential component in establishing the TPA, monitoring and evaluating the program. Encourage collaboration between researchers and users in data collection by using the update tools and unify overlapping tools in the same territory (e.g., within the same TPA or coherent sector).

E. Socio Culture and Awareness

Consult with stakeholders to determine the socioeconomic effects of solid protection for establishing strategies, objectives, and regulations of TPAs; Develop a clear, long-term communication strategy to promote the results of the researchers' work and raise awareness of the benefits of TPA.

Table 27 Summary of Identified Measured for Establish a Network of Terrestrial Protected Areas

No	Identified measure	Score of Identified measure
A.	**Economic and Financial Barriers**	
1	Allocate funding to establish the network of terrestrial protected areas	5
2	Think of TPAs as capable of generating economic benefits by developing long-term financing strategies in carbon trading	5
3	Explore and compete for donor funding opportunities, particularly international climate mitigation schemes.	5
B.	**Policy and Regulation**	
1	Enact rules that clearly define prohibited activities and the actors involved	5
C	**institutional and organizational capacity barriers**	
1	Maintain the communication and coordination between stakeholders to cut off and speed up administrative procedures for the creation of TPAs, their development, obtaining funding	5
2	Strengthen the regulatory framework to support the decision-making or legal prerogatives in TPAs	4
3	not all stakeholders are involved in management and/or do not have the same influence in decision making	4
D	**Technical and Human Skill**	
1	training on the ecological and socioeconomic issues of the forest in schools, universities, professionals, and in the community	4
2	strengthen the continuous training between the different professions	4
3	encourage actors to work toward the implementation of a common objective	4
4	use scientifically robust and standardized protocols and standardized monitoring systems	5
E	**Technology:**	
1	Strengthen basic data related to Forest National Inventory as an important component in establishing the TPA, monitoring and evaluating the program.	5
2	encourage collaboration between researchers and users in data collection by using the update tools	4
3	unify overlapping tools in the same territory (e.g., within the same TPA or coherent sector)	5

No	Identified measure	Score of Identified measure
F	**Information, Awareness and Socio Cultural**	
1	consult with stakeholders to determine the socioeconomic effects of strong protection, for the establishment of strategies, objectives, and regulation	5
2	develop a clear, long-term communication strategy to promote the results of the researchers' work and raise awareness of the benefits of TPA	5

The score of Identified Measure:
1: Not Very Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

4.4 Linkages of the barriers identified

During the analysis process, many barriers and other obstacles of the system were identified which could be common to all technologies, and just a few of which would become specific for a certain technology and sector. The aggregation and summary of the common barriers of technology in the Forestry sector is presented in **Table 28**

Table 28 Linkage Barrier for Forestry Sector

Barrier Category	Barriers
Economic and financial barriers	• High cost in preparing the basic data for both NFI and N-TPAs • High prices on operational and management, in updating the data on the field and data related to information system. • The government has limited financial allocation.
Policy, legal, and regulatory	• No derivative technical policies that can be used as direct guidance for conducting NFI and N-TPAs, both from government organizations and community organizations concerned about forest area data collection
Institutional And Organizational Capacity Barriers	• The complexity and length of administrative procedures for creating a TPA, including its construction, obtaining funding, and difficulties for managers in developing a regulatory framework due to lack of decision-making or legal prerogatives due to lack of synchronization.
Technical and Human Skill	• The lack of human resources capacity has identified the importance of strengthening the level of appropriate capacity building as a key element necessary for promoting management effectiveness in N-TPA and NFI.
Infrastructure and technology	• The Solomon Islands lack communication services, particularly the internet network, as it is necessary for data management. • There are currently many gaps in the data due to the need to update the primary data used for NFI and N-TPA implementation.

Barrier Category	Barriers
Socio Culture and Awareness	Different and potentially conflicting views of the socioeconomic and ecological costs and ecological costs and benefits. Lack of compensation measures, and lack of information and awareness to the public or local stakeholders on the role and objectives of N-TPAs.

The two selected technologies have shared several common barriers and similarities both in development and use (**refer table 28**), therefore it is only imperative to take a holistic approach towards finding linkages between the two technologies to find potentially efficient ways and opportunities to address combined effects.

4.5 Enabling framework for overcoming the barriers in Forestry Sector

- A critical but important enabling framework for overcoming the identified barriers to the diffusion of prioritized technologies in the forestry sector is the development of technical guidelines for the NFI and N-TPA so that it could be used as the technical reference for the forestry officer and forest volunteer.
- Increase access to financial resources for NFI and N-TPAs, explore and compete for donor funding opportunities particularly international climate fund. Allocating special funds for implementing NFI because NFI is primary data for the Ministry of Forestry in conducting forest resource assessments before issuing policies related to production forests and logging areas.
- Maintain communication and coordination between stakeholders. Ensure that the regulatory framework is strengthened to support decision-making or legal prerogatives in N-TPAs, and that all stakeholders are involved in management and have equal influence on decision-making.
- In order to have a sufficient number of trained support personnel, it is important to provide training on forest ecology and socio-economic problems in schools, universities, professionals, and the community. Promoting continuous training among various professions and encourage actors to work towards implementing shared goals.

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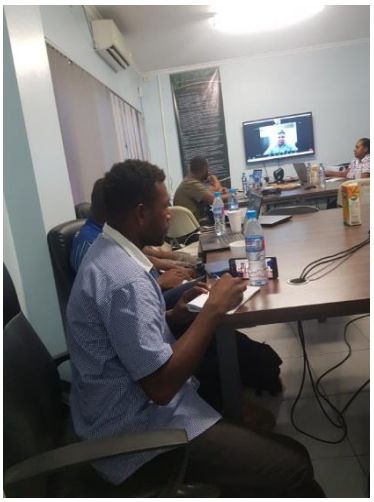
ANNEXES

ANNEX 1 - ADAPTATION WORKING GROUP WORKSHOP



ANNEX 2 - LIST OF ADAPTATION WORKING GROUP

SOLOMON ISLANDS TECHNOLOGY NEEDS ASSESSMENT (TNA)

BAEF / BARRIER ANALYSIS AND ENABLE FRAMEWORK WORKSHOP

ADAPTATION SECTORAL WORKING GROUP

ATTENDANCE REGISTER

Date: 10TH October 2023 **Venue: Ministry of Environment HQ Conference Room, ATL Building, and Honiara**

NO	Name	Position	Organisations/ Departments	Email	Signature
1	Ben Bilua	Media & Cons	SICCI	bilua ben @ gmail.com	
2	Nelly Kere	~~Project Officer~~	CPO PMU	nz keregmail.com	
3	Boyong Moon	MD	Eagon	bymoon@egon.com	
4	Shadrach Gukuna	Assistant Planner	PACSOL	shashana76@gmail.com	
5	Dr Michael Hapa	CNFA	CFA	Mhapa@gmail.com	
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7	DOUGLAS YEE	NPC/IFMP	FAO	douglas.yee@fao.org	
8	MASELYN KOPURIA	SSCO	CCD-MECDM	Mkopuria@mecdm.gov.sb	
9	Nancy Raeka	SPO	pmu/water	NRaeka@mecdm.gov.sb	

NO	Name	Position	Organisations/ Departments	Email	Signature
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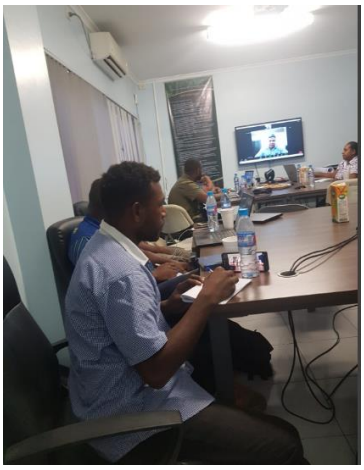
12	BARNABAS BAGO	NPC/PMEU	PMEU/MECDM	BBago@mecdm.gov.sb	
13					
14					
15					
16					

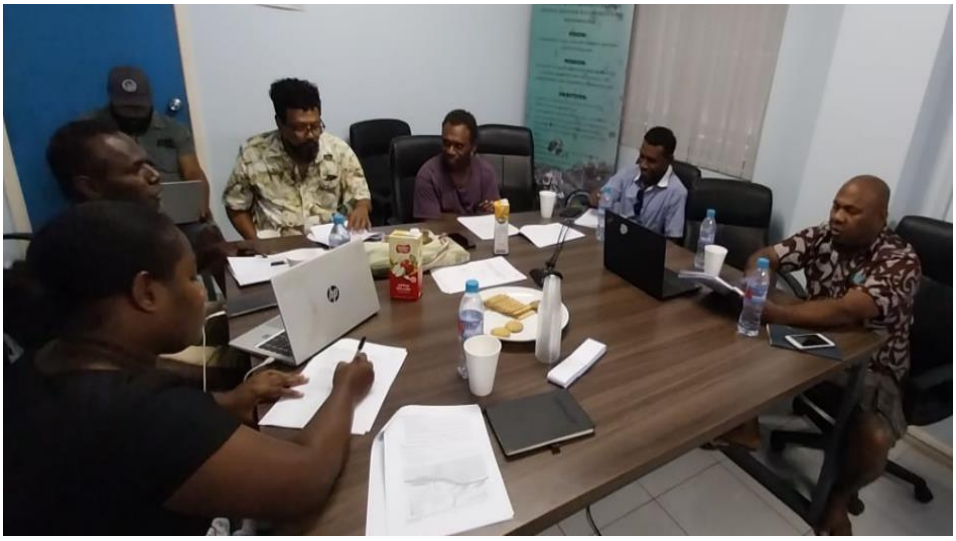
ANNEX 3 – MITIGATION CONSULTANT DID THE INDIVIDUAL CONSULTATION WITH MINISTRY OF INFRASTRUTURE AND DEVELOPMENT

Consultation with Director of Civil Engineering – MID

Consultation with Asset Manager – MID

ANNEX 4 – MITIGATION WORKING GROUP WORKSHOP





ANNEX 5 - LIST OF MITIGATION WORKING GROUP

SOLOMON ISLANDS TECHNOLOGY NEEDS ASSESSMENT (TNA)

BAEF / BARRIER ANALYSIS AND ENABLE FRAMEWORK WORKSHOP

MITIGATION SECTORAL WORKING GROUP

ATTENDANCE REGISTER

Date: 11TH October 2023 **Venue: Ministry of Environment HQ Conference Room, ATL Building, Honiara**

NO	Name	Position	Organisations/ Departments	Email	Signature
1	Craig · Quan	Engineer	SIEA	craigwaletafisiguan@gmail.com	
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4	Diana Vasula	Sustainable Dev	SIMA	diana.vasula@sima.gov	
5	Chris Wagafua	Climate Finance	MoFT	CWagafua@mof.gov.	
6	George Hiri	PAO - NTF	MID - NTF	GHiri@mid.gov.sb	
7	Shawn Uhuro	Assistant Planner	Parliament		
8	Florence Pupuka	REDD+ Officer	MoFR	fpupuka@mofr.gov.sb	
9	Arnold Angwaroa	REDD+ Officer	MoFR	aangwaroa@mofr.gov	

NO	Name	Position	Organisations/ Departments	Email	Signature
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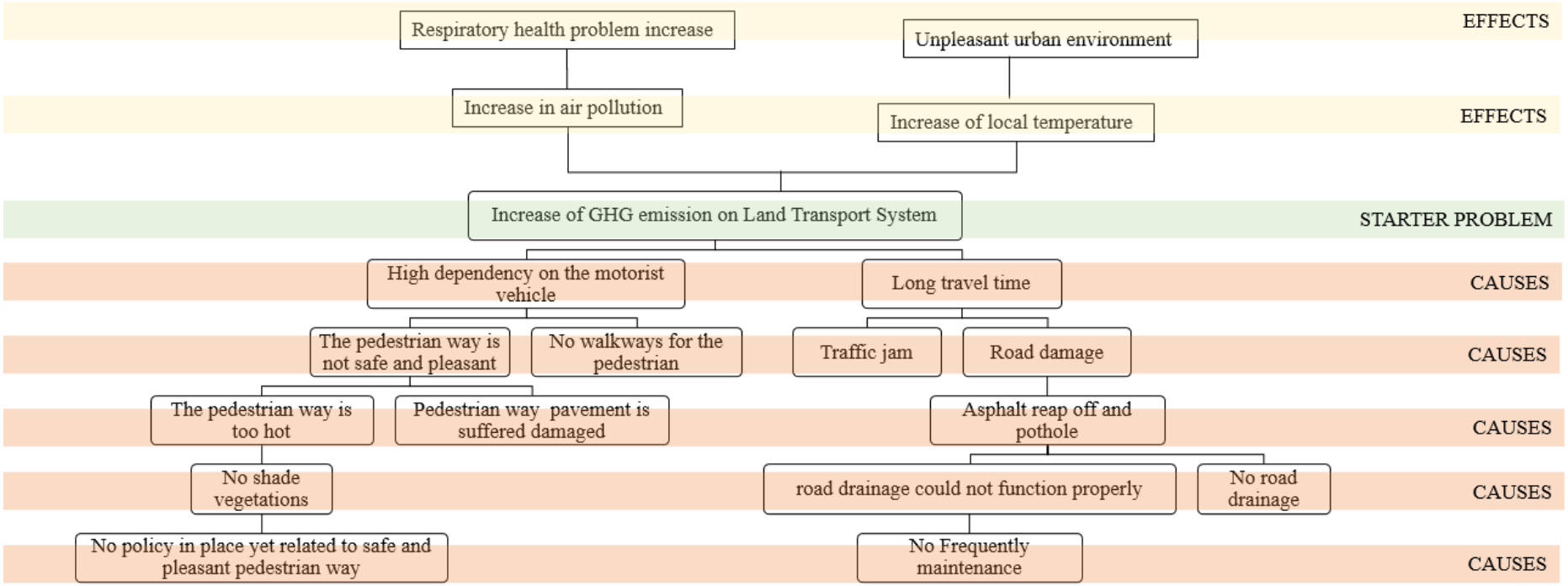
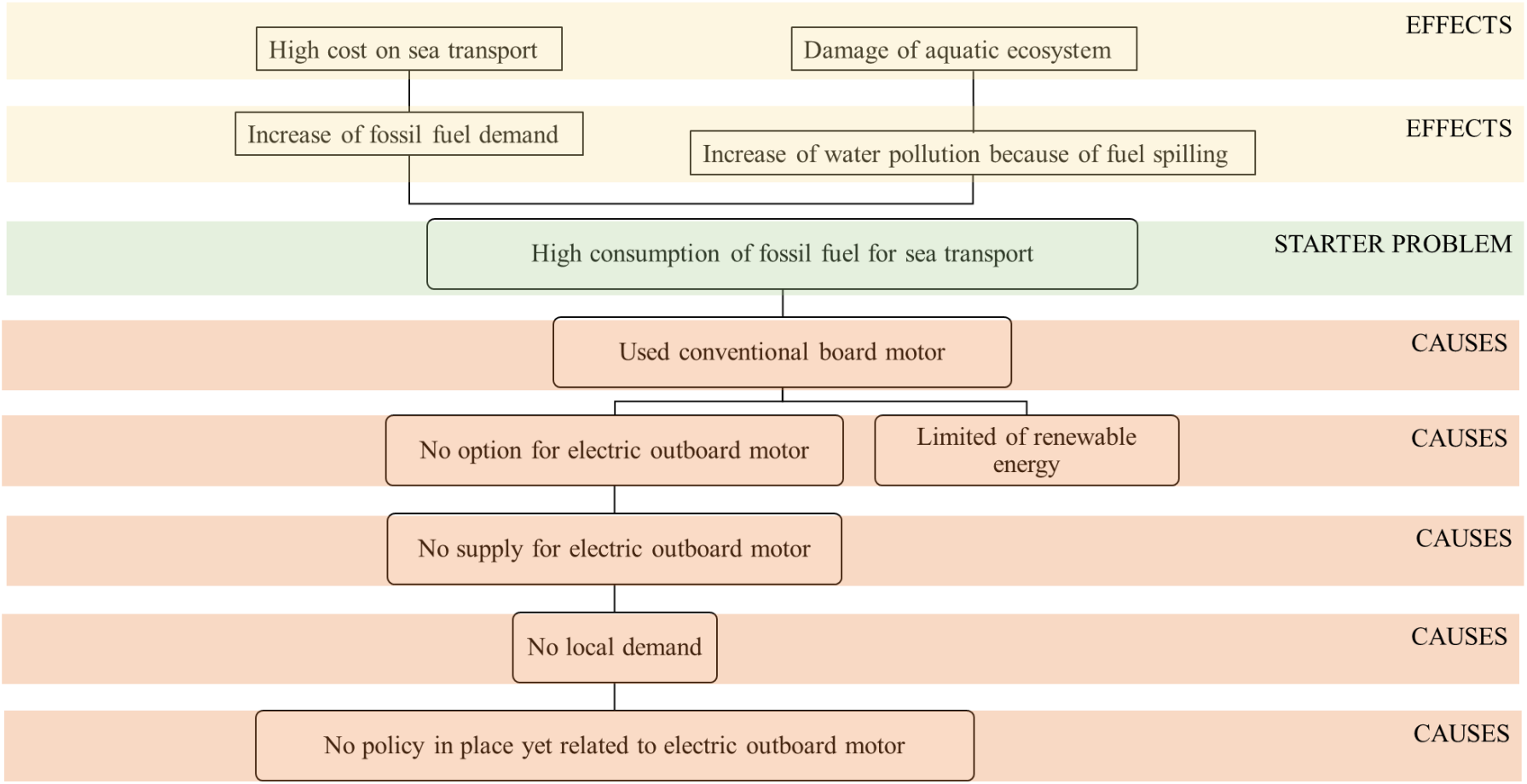
12	MASELYN Kopuria	Mitigation officer	CCD-MECDM	MKopuria@mecdm.gov.sb	
13	B. Bako	NPC/PMCU	MECDM	BBako@mecdm	
14	Michael Maepio	CPS	MECD	mhapio@	
15	Nancy Raeka	SPO	PMCU/MECDM	NRaeka@mecdm.gov	
16					
17					

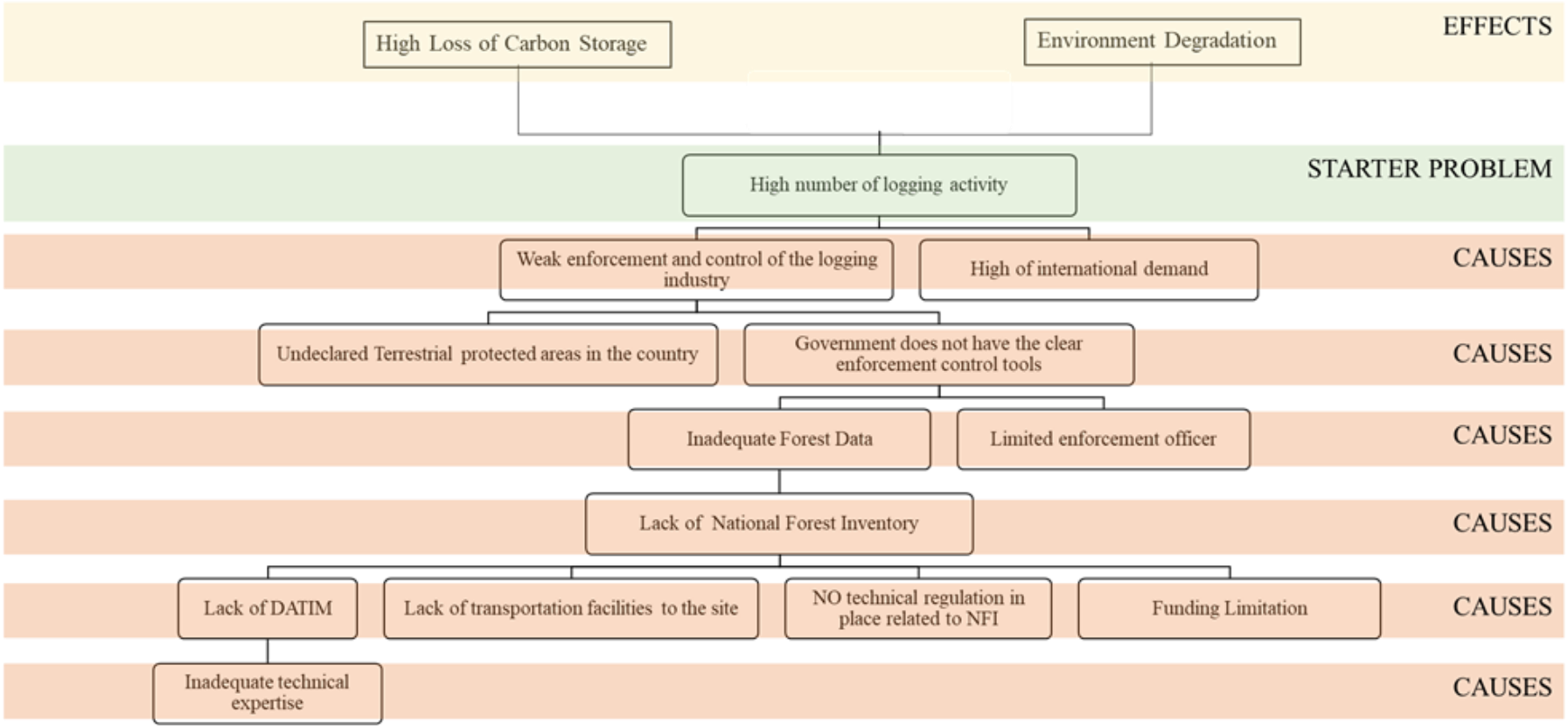
ANNEX 6 – SUSTAINABLE ROAD PROBLEM TREE



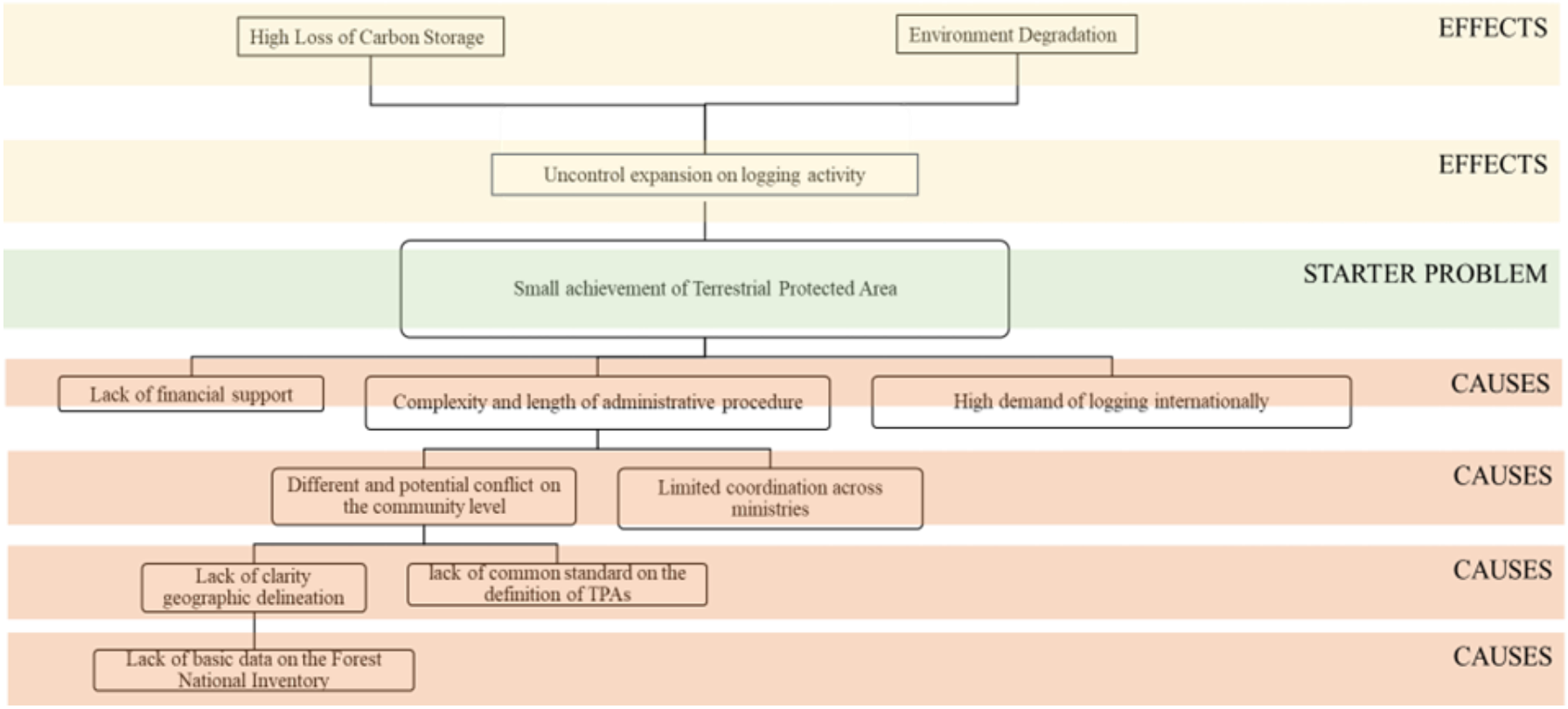
ANNEX 7– ELECTRIC OUT BOARD MOTOR PROBLEM TREE



ANNEX 8 – NATIONAL FOREST INVENTORY PROBLEM TREE



ANNEX 9 – NETWORK FOR TERRESTRIAL PROTECTED AREA



ANNEX 10 – BARRIER ANALYSIS AND MEASURES OF TRANSPORTATION SECTOR WORKING GROUP SCORING

STAKEHOLDER WORKSHOP II

BARRIER ANALYSIS AND ENABLING FRAMEWORK FOR THE SOLOMON ISLANDS TRANSPORTATION SECTOR

TNA TECHNOLOGY NEEDS ASSESSMENT

2023

UN environment programme | gef | UN environment programme supported by UNOPS | USP THE UNIVERSITY OF THE SOUTH PACIFIC

* Replace "Western Province" with Honiara.

Participants, please list the possible barrier to implementing the Sustainable Road technology and give the score of barrier significance to the technology

No	Transport Barrier Factors	Score of Barrier
A.	**Economic and Financial Barriers**	
1	A high investment cost and O&M cost is needed to construct or repair a citywide existing pedestrian way and drainage infrastructure.	5
2	Lack of information on performance and cost-effectiveness of low-impact development (LID) infrastructure	4
3	There is a perception among private and public developers and lenders that LIDs (Low-impact developments) can be as expensive as conventional infrastructures. This perception comes from the poor understanding of LIDs: cost to design, construct, and maintain and insufficient economic analysis of environmental and social benefits of green infrastructures.	3
	Safe guards	5
B	**Policy, legal, and regulatory**	
1	No technical guidelines related to urban green streets, either from the Ministry of Infrastructure and Development or Local authority (Honiara city council)	5
2	Absence of concrete and comprehensive land use, transportation planning, and drainage planning, at the national level with actionable strategies at the local government scale	5
3	The Honiara local planning scheme is not compatible with the climate change projection	5
4	Absence of or poorly developed local ordinances; building codes; health codes; drainage codes; and parking spaces	5
5	Weak enforcement of the existing urban planning codes and regulations	5
6 X	The existing municipal codes and ordinances prefer grey infrastructure over LIDs	
	Safe guards	5
C	**Institutional and Organisational Capacity**	
1	Few professional institutions have concerns about green street and LIDs	3
2	Limited management at the ministry level and local authority to do the enforcement on street drainage and monitor the street trees	4

No	Barrier Factors	Score of Barrier
	....	
D	**Socio-Cultural, Information, and awareness**	
1	Lack of understanding from the community related to the importance of road drainage, law seal and Co	5
2	Community voices tend to be ignored by the local authority when it comes to infrastructure development, for example, community voices related to protecting roadside trees	5
3	Lack of awareness related to green infrastructure to the public	5
	....	
	....	
E	**Technical and Human Skill**	
1	The inadequate technical expertise of local governments to design and deploy effective project designs	5
2	The technical expertise and local governments lack knowledge of green infrastructure and low-impact development	3
3	Limited knowledge and capacity to effectively interpret data related to climate change events and assess the impact of it	5
4	Lack of research related to the main material will be used previous concrete by using the local material	4
5	Some of materials for the road drainage and pavement are mostly imported	5
6	No available nursery center is to supply the vegetation needed for the green street	5
	....	
	....	

The score of Barrier:
1: Very Not Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

No	Identified Measures	The Score of Identified Measure
A.	**Economic and Financial Barriers**	
1	Allocate adequate development budget to local governments for the design, development, construction and subsequent operation and maintenance of the green street and road drainage	5
2	Explore and compete for donor funding opportunities particularly international climate adaptation financing for the diffusion and transfer of green infrastructure. The economic benefits of this green infrastructure technology are received from the combination of the decreased cost of damages resulting from road damage and reduced consumption of fossil fuel, and reduced the local temperature	5
3	Provide incentives to developers and consumers of LIDs to encourage the market to create a space for green infrastructure tools, equipment, and initiatives so the technology could move from a public good status to market good through indulging private investors in public-private partnerships or stand-alone private projects.	5
4	Exemption from some taxes and fees for developers and some bonus subsidies to consumer group for at least a period of 3 years of technology promotion	Remove
	.....	
	.....	
B	**Policy, legal, and regulatory**	
1	Provide the technical guidelines related to the urban green street	1
2	Prepare the action plan or technical plan for the transportation and drainage system in the urban area for each ward	5
3	Updating the Local planning scheme document to the recent climate change issues	5
4	Increase and strengthen the enforcement of urban planning code and regulation implementation	4
5	Provide the technical guideline of Low impact development infrastructure	5
	.....	
	.....	

No	Identified Measures	The Score of Identified Measure
C	**Institutional and Organisational Capacity**	
1	Provide a special division at the ministry level or local authority to maintain green street and LIDs	3
	...local Community ownership to look after green channels...	
	...	
D	**Socio-Cultural, Information, and awareness**	
1	Increasing the awareness to the public related to green streets and LIDs through many social media platforms	5
	... Awareness up to church level...	5
	...	
E	**Technical and Human Skill**	
1	Provide the technical workshop related to green streets and LIDS to the national expertise and local government	5
2	Strengthen the research and development related to green streets and LIDS with the collaboration between the ministry, local government, and university	5
3	Provide the nursery center to supply the needs of street vegetations	5
	...	
	...	

The score of Identified Measure:
1: Very Not Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

ANNEX 11 – BARRIER ANALYSIS AND MEASURES OF FORESTRY SECTOR WORKING GROUP SCORING

No	Barrier Factors	Score of Barrier
A.	**Economic and Financial Barriers**	
1	High cost of preparing the updated satellite image as the basic information	4
2	High cost of field data collection, as the transport fees in the Solomon Islands is very expensive	5
2	High prices on operational and management, in updating the data on the field and data related to information system	5
	.....	
	.....	
B.	**Policy and Regulation**	
1	there are no technical regulations for the implementation of NFI	5
	.....	
	.....	
C	**Infrastructure / Access**	
1	Lack of transportation infrastructure / Difficulty to access sites (geographically)	5
2	Lack of communication infrastructure especially the internet connection to upload and download the data from the site inventory	4
3.	Lack of Land Rights to access inventory plot sites	5
4.	.....	
D	**Technology:**	
1	Lack of The Design and Analysis Toolkit for Inventory and Monitoring (DATIM) including an analysis tool for inventory and monitoring (ATIM) used for creating tables; a spatial intersection tool (SIT); a design tool for inventory and monitoring plans (DTIM); and a data compilation system (DCS) to add FVS attributes to DATIM datasets	5
2	Many data gaps exist, including recent forest map (geospatial information	4
E	**Technical and Human Skill**	
1	The inadequate technical expertise in forest inventory workflow (planning, field work, inventory, analysis)	5
2	Lack of expertise to do the DATIM	4
3	A limited number of technical expertise and forest inventory volunteer	4
	.....	
	.....	

The score of Barrier:
1: Very Not Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant

No	Identified Measure	Score of Identified Measure
A.	**Economic and Financial Barriers**	
1	Allocate adequate budget for NFI	5
2	Explore and compete for donor funding opportunities, particularly international climate adaptation financing for FNI activity.	5
	.....	
	.....	
B.	**Policy and Regulation**	
1	Provide the NFI technical regulation	5
	.....	
	.....	
C	**Infrastructure** / Access	
1	Increase the transportation infrastructure and telecommunication to support NFI	5
2.	Land Access fees and Consultations/Permission from land owner of inventory plot sites	5
D	**Technology:**	
1	Updating the Forest data map	4
2	Provide the update Design and Analysis Toolkit for Inventory and Monitoring (DATIM) including inventory and monitoring (ATIM) used for creating tables; a spatial intersection tool (SIT); a design tool for inventory and monitoring plans (DTIM); and a data compilation system (DCS) to add FVS attributes to DATIM datasets	5
	.....	
	.....	
F	**Technical and Human Skill**	
1	Provide the technical workshop for the forestry officer for Forest Inventory	5
2	Strengthen the research and development with the collaboration between the ministry, local government, and university	5
3	Open up the intern program with university or volunteer to be part of forest inventory (local resource owners)	4
	.....	
	.....	

The score of Identified measure :

1: Very Not Significant
2: Not Significant
3: Moderate
4: Significant
5: Very Significant