República Democrática de Timor-Leste

TECHNOLOGY NEEDS ASSESSMENT REPORT

MITIGATION

February 2023

TECHNOLOGY NEEDS ASSESSMENT

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TECHNOLOGY NEEDS ASSESSMENT REPORT

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Foreword

Timor-Leste is a member of Small Island Developing States (SIDS) and the Least Developed Country (LDC) which is very vulnerable to the effects of climate change and has been experiencing the negative impacts of extreme weather events, including intense storms and sea-level rise. The impacts of climate change are already undermining its development. Hence, without addressing the drivers of climate change and providing support for the most vulnerable sectors, these impacts will continue to worsen.

As a party to the UNFCCC, the government of Timor-Leste is fully committed to developing and implementing to make its major development sectors climate-resilient and also to mitigate greenhouse gas from the potential sectors. For example, the Nationally Determined Contribution (NDC) listed a number of mitigations and adaptation measures to enable sustainable low-carbon development and to build climate risk resilience in Timor-Leste. To support the implementation of its NDC and other national strategies, Timor-Leste is currently conducting a Technology Needs Assessment (TNA) to identify priority technology transfer investments and determine which environmentally sound technologies (EST) are the most effective in adapting and mitigating climate change.

The Secretary of State for the Environment (SSE) acknowledges that the TNA project is the first thorough national exercise undertaken toward assessing our needs for climate change technology. It was carried out by SSE through National Directorate for Climate Change (NDCC) in collaboration with the United Nations Environment Programme Copenhagen Climate Centre (UNEP-CCC) and the Asian Institute of Technology (AIT) and was funded by the Global Environment Facility (GEF). The Climate Change Working Groups (CCWG), key stakeholders, and local experts were all consulted during the TNA process.

Timor-Leste is proud to have completed the first phase of the TNA with the assistance of other line ministries, international agencies, non-governmental organizations, private sectors, academia, and youths. Through this collaboration, various technologies have been identified for both mitigation sectors (Transportation, and Agriculture, Land Use and Forestry) and adaptation sectors (Sustainable Development Land Management in Agriculture, and Infrastructure and Natural Methods to Prevent Erosion). The prioritized technologies are indeed aligned with the Timor-Leste Climate Change Policy (CCP), National Adaptation Plan (NAP), and NDC for climate mitigation and adaptation in Timor-Leste.

I look forward to seeing findings, recommendations, and implementation in deploying and diffusing the prioritized technologies.

Demétrio do Amaral de Carvalho
Secretary of State for the Environment

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Abbreviations

ADO	Automotive Diesel Oil
ADT	Average Daily Traffic
AFOLU	Agriculture, Forestry, and Other Land Use
AIT	Asian Institute of Technology
ANAS	Autoridade Nacional Agua e Saneamento
ANE	Autoridade Nacional Para a Eletricidade
ANLA	Autoridade Nacional de Licenciamento Ambiental
AQI	Air Quality Improvement
A&R	Applicability and Replicability
BA	Barrier Analysis
BAEF	Barrier Analysis and Enabling Framework
BRT	Bus Rapid Transit
BTL	Bee Timor-Leste
C	Capital
CCFL	Climate Change Framework Law
CCWG	Climate Change Working Group
CD	Capacity Development
CH_4	Methane
CNFP	Centro Nacionál Formação Profissional
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
COP	Conference of the Parties
CTCN	Climate Technology Centre and Network
CVTL	Cruz Vermelha Timor-Leste
DGOU	National Directorate of the Urban Organization (DGUO)
DMA	Dili Metropolitan Area
DNCC	National Directorate for Climate Change
DTU	Danish Technical University
EF	Enabling Framework
EST	Environmentally Sound Technology

EV	Electrical Vehicles
FAO	Food and Agriculture Organization
FOLU	Forestry and Other Land Use
FS	Food Security
GCG	Global Environment Facility
GHG	Greenhouse Gases
IEP	improve Economic Performance
INDC	Intended Nationally Determined Contribution
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
IPCC GL	IPCC Guideline
JC	Job Creation
LDC	Least Developed Country
LEDS	Low-Emission Development Strategies
LPG	Liquefied Petroleum Gas
LSA-TL	Laudato Si Animators Timor-Leste
LUCF	Land Use Change and Forestry
LVG	Liquefied Gas for Vehicle
MAF	Ministry of Agriculture and Fisheries
MCA	Multi-Criteria Analysis
MFO	Marine Fuel Oil
MSA	Ministry of State Administration
MSW	Municipal Solid Waste
MTC	Ministry of Transport and Communication
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NCCP	National Climate Change Policy
NCE	National Contracting Entity
NDB	National Directorate of Biodiversity
NDC	Nationally Determined Contribution
NDCC	National Directorate of Climate Change

NDFWMR	Directorate for Forestry, Watershed Management, and Reforestation
NE	Not Estimated
NGO	Non-Governmental Organisation
NMT	Non-Motorised Transportation
NO	Not Occurring
N_2O	Nitrous oxide
NPF	National Policy on Forests
NSDP	National Strategic Development Plan
O&M	Operational & Management
PLUP	Participatory Land Use Planning
R	Reliability
RDTL	Democratic Republic of Timor-Leste
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RGHGE	Reduce GHG Emissions
RNP	Relevance to National Policies/Plans/Priorities
RPES	Restore and Protect Ecosystem Services
RSO	Research and Systematic Observation (RSO)
S	Sustainability
SALT	Slopping Agricultural Land Technology
SDGs	Sustainable Development Goals
SDP	Strategic Development Plan
SIDS	Small Island Developing States
SIE	Social Inclusion and Equity
SNC	Second National Communications
SSE	Secretary of State for Environment
SSEI	Secretary of State for Equality and Inclusion
SWDS	Solid Waste Disposal Site
TAP	Technology Action Plan
TFS	Technology Fact Sheet
TI	Trigger Investment
TNA	Technology Needs Assessment
TOD	Transit-Oriented Development

TSMP	Transport Sector Master Plan
TYIFD	Timorese Youth Initiative for Development
UDP	UNEP DTU Partnership
UN	United Nations
UNICEF	United Nations International Children's Emergency Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USP	University of the South Pacific
VPD	vehicles per day
WWT	Wastewater Treatment

Executive Summary

The Democratic Republic of Timor-Leste officially joined the UNFCCC in October 2006, and since then Timor-Leste has fully committed to the requirements of the multilateral process established by the UNFCCC. The current Global Technology Needs Assessment (TNA) project, deriving from the window (i) of the Strategic Program on Technology Transfer, is designed to support countries to carry out improved TNA within the framework of the UNFCCC. TNAs are crucial to the Convention's technology transfer efforts and provide an opportunity to follow an increasing need for new equipment, techniques, practical knowledge, and skills to limit GHG emissions and/or reduce sectors' and livelihoods' vulnerability to climate change.

The TNA involves a three-stage process and has three main goals:

1. To identify and prioritize technologies that can contribute to the mitigation goals of the participating country;

2. To identify barriers hindering the acquisition, deployment, and diffusion of prioritized technologies;

3. To develop Technology Action Plans (TAP) that specify activities and enable frameworks to facilitate the transfer, adoption, and diffusion of selected technologies.

The first part of the TNA report intends to identify and analyse priority technology needs that have the greatest mitigation potential while meeting national sustainable development goals and priorities. The sectors were selected based on the Timor-Leste GHG emissions status, including taking into account the mitigation measures listed in the NDC. Hence, the agreed sectors of mitigation to be included in the TNA process are:

1. Transportation sector

2. Agriculture, land use and forestry sector

This report was prepared through a consultative and gender-inclusive process with the participation of stakeholders from the government, public institutions, public enterprises, non-governmental organizations, UN agencies, the private sector, and youth organizations of the pertinent sectors prioritized for TNA. Through their involvement, they provided knowledge, experience, and insight into specific technology challenges and opportunities. In addition to consulting with stakeholders, a number of policy papers, plans, and strategies such as SDP 2011-2030, NDC, SNC, INDC, NCCP, including sectoral policies and project documents were further examined to identify and prioritize the sectors' potential benefits and needs from mitigation.

The TNA stakeholders actively participated in the technology identification and prioritization process using multi-criteria analysis (MCA). During the consultation workshop, the respective stakeholders discussed the identified criteria and indicators and validated them. The criteria for technology prioritization for mitigation measures are cost, and benefits related to economic, social, environmental, climate, and local context. The performance matrix was established, and scoring was conducted by evaluating the performance of each technology against each of the criteria. All stakeholders involved in the transportation and agriculture, land use and forestry sectors used Technology Fact Sheets (TFS) and their collective experiences to discuss each criterion. In the

process of scoring technologies, stakeholders used a consensus-based decision-making process facilitated by the mitigation consultant and the National Contracting Entity (NCE)'s staff.

For each sector, the following technologies were identified as the most preferred options;

Transportation Sector

1. Develop pollution control Decree-Law
2. Low carbon development strategy
3. Research on installing solar system-based charging stations
4. Public transport maximization

Agriculture, land use and forestry

1. Agroforestry
2. Participatory Land Use Planning
3. SALT (Slopping Agricultural Land Technology)
4. Cover Crop

Chapter 1: Introduction

1.1. About the TNA project

The TNA process originates from the Poznan Strategic Programme on Technology Transfer established at the Fourteenth Conference of the Parties (COP 14) to the United Nations Framework Convention on Climate Change (UNFCCC), with the aim to scale up investment in technology transfer thus enabling developing countries to address their needs for environmentally sound technologies.

Since 2010, developing countries have received technical and methodological assistance from the UNEP Copenhagen Climate Centre (UNEP-CCC, formerly UNEP DTU Partnership) to conduct TNAs. The Global Environment Facility, through its Poznan strategic programme on technology transfer has provided support for these TNA projects. During the period 2010 – 2013, UNEP-CCC supported 36 developing countries to undertake TNAs. Since late 2014, UNEP-CCC has been providing similar support to a second phase of 26 new countries. In 2018, 22 additional countries, mainly least developed countries (LDCs) and small island developing states (SIDS) initiated their TNA as part of Phase III of the global TNA project. In June 2019, TNA project Phase IV was approved by the Global Environment Facility to support 17 LDCs and SIDS, including Timor-Leste.

The Democratic Republic of Timor-Leste officially joined the UNFCCC in October 2006, and since then Timor-Leste has fully committed to the requirements of the multilateral process established by the UNFCCC. The current global TNA project, deriving from the window (i) of the Strategic Program on Technology Transfer, is designed to support countries to carry out improved Technology Needs Assessments within the framework of the UNFCCC.

The purpose of the TNA project is to assist participant developing country Parties to identify and analyse priority technology needs, which can form the basis for a portfolio of environmentally sound technology (EST) projects and programmes to facilitate the transfer of, and access to, the ESTs and know-how in the implementation of Article 4.5 of the UNFCCC Convention. Hence, TNAs are central to the work of Parties to the Convention on technology transfer and present an opportunity to track an evolving need for new equipment, techniques, practical knowledge, and skills, which are necessary to mitigate GHG emissions and/or reduce the vulnerability of sectors and livelihoods to the adverse impacts of climate change.

The main objectives of the project are:

1. To identify and prioritize through country-driven participatory processes, technologies that can contribute to adaptation and mitigation goals of the participant countries, while meeting their national sustainable development goals and priorities (TNA Report)
2. To identify barriers hindering the acquisition, deployment, and diffusion of prioritized technologies (BAEF Report)
3. To develop Technology Action Plans (TAP) specifying activities and enabling frameworks to overcome the barriers and facilitate the transfer, adoption, and diffusion of selected technologies in the participant countries (TAP Report).

Further, the TNA process will develop Concept Notes for attracting funding to implement selected technologies in priority areas of national relevance.

1.2. Existing national policies on climate change mitigation and development priorities

Understanding the geographic setting of Timor-Leste is crucial for comprehending the overall perspective of Timor-Leste's national strategies and policies, development priorities, including mitigation measures.

Timor-Leste is a small country situated at the eastern end of the Indonesian archipelago with a population of about 1.3 million in 2020. It covers 15,000 square kilometres of land area with mountainous terrain and a tropical climate (hot, semi-arid) and rainy and dry seasons. Being exceptionally mountainous, the country's central highland reaches heights of 3.000 m, and less than half of it has a slope of more than 40 percent, which can cause soil erosion during periods of heavy rain. The coastal plain is less mountainous, but still highly susceptible to natural disasters, with cyclones, earthquakes, tsunamis, and heavy rainfall all exacerbated by poor and insufficient infrastructure and social welfare.

Timor-Leste, as a member of the Small Island Developing States (SIDS) category of the UNFCCC, is very vulnerable to the effects of climate change and has been experiencing the negative impacts of extreme weather events, including intense storms and sea-level rise. The intensity and frequency of extreme rainfall events with the associated risk are predicted to increase as a result of climate change. Cities and communities along coastal lines are at risk from sea-level rise, flooding, cyclones, strong winds, and extreme precipitation, causing infrastructure damage, water-borne diseases, and landslides.

On 4th April 2021, Timor-Leste was hit by Tropical Cyclone Seroja, causing flash floods and landslides across the country, with the capital Dili and the surrounding low-lying areas being the hardest damaged. According to the UN Timor-Leste (2021), It was estimated that at least 45 people died, 30,367 households were affected, and nearly 10,000 people were forced to seek refuge in Dili, the capital. It also damaged many critical infrastructures such as roads, bridges, hospitals, and private housing to an unimaginable extent. Hence, the strategic and critical policies and plans are essential.

Timor-Leste has ratified United Nations Framework Convention on Climate Change (UNFCCC), including the Kyoto Protocol, the Convention on Biodiversity, the Convention on Desertification, the Vienna Convention, and the Montreal Protocol for reducing substances that destroy the ozone layer. The government of Timor-Leste has no GHG reduction target but instead has made commitments to reduce emissions in sectors including transport, agriculture, forestry, energy, and waste. Hence, Timor-Leste has taken a number of actions to mitigate the impacts and reduce GHG emissions, despite contributing only 0.003% of the total global GHG emissions on an annual basis.

1.2.1. National Climate Change Policy (NCCP)

Timor-Leste adopted its first National Climate Change Policy (NCCP) in 2021. The policy guides national efforts to minimize the contribution to climate change and reduce its adverse impact on the country. In NCCP, the primary objective is to set out how, and according to which principles, laws, and policies are to be interpreted and read, and coordinate and clarify how the Democratic Republic of Timor-Leste responds to climate change.

As part of its policy to mitigate GHG emissions in the energy sector, Timor-Leste focuses on two themes: the development and use of renewable energy technologies, as well as the development of energy efficiency measures for buildings, industrial applications, and vehicles. Aside from this, mining and petroleum (oil and gas activities) activities are subject to environmental regulations that require companies to develop plans to reduce emissions and control them. Within Timor-Leste, the policy to mitigate GHG emissions in transportation revolves around two themes: (1) reducing GHG emissions from vehicles fleet (public and private); and (2) promoting public transportation in urban areas and between communities. An effort is underway to establish vehicle emission regulations and to promote and implement a Decree-Law No. 30/2011 regarding the age of used vehicles imported into Timor-Leste.

As for forest and other land use within Timor-Leste, the policy regarding GHG emissions is focused on increasing the use of forests as carbon sinks. This policy aims to increase afforestation and reforestation in Timor-Leste, including the planting of 1 million new trees each year. It also involves promoting customary forestry management practices and natural regeneration of forest areas, accessing carbon markets (such as those provided by REDD+ mechanisms), and improving the sustainable management of forests and forest lands. As part of broader efforts to increase the resilience of coastal ecosystems, these policies also specifically target carbon sequestration in mangroves.

In terms of agriculture, the policy to reduce GHG emissions is focussed on the adoption of permanent agriculture and the resulting decrease in emissions from slash-and-burn techniques, the promotion of biogas and composting, and so-called smart agricultural practices. While in the waste sector, the policy is concentrated on encouraging sustainable waste management and using market-based mechanisms to encourage the reduction of GHG emissions. These policies, plans, and strategies mentioned in NCCP will be further operationalised by Timor-Leste's intention to pass an innovative climate change-focused Decree-Law.

1.2.2. Climate Change Framework Law (Draft)

At present, Timor-Leste is developing a Climate Change Framework Law (CCFL) that will create a legal framework for Timor-Leste's climate change response and pass this law in 2023/2024. The purpose of this Law is to establish a basic legal framework for private and public participation in opportunities for economic development and improved livelihoods, especially in rural areas, that will emerge with the growth of the global green economy.

The draft of the Law also covers the long-term mitigation targets which focus on the:

1. Setting high goals for climate change mitigation and limiting global temperatures to 1.5 degrees Celsius
2. Reduction of GHG emissions
3. Decarbonization efforts and new scientific and technological knowledge
4. Promotion of the achievement of long-term emissions reductions
5. Limiting or reducing Timor-Leste's GHG emissions across the economy through regulations, measures, and actions
6. Statement of Timor-Leste's greenhouse gas emissions over 5 years, along with an evaluation of Timor-Leste's NDC and long-term emissions reduction target

1.2.3. Nationally Determined Contribution (NDC)

As part of the UNFCCC commitment, Timor-Leste formally submitted an Intended Nationally Determined Contribution (INDC) to the UNFCCC Secretariat in 2016. Under the INDC, the Government of Timor-Leste has identified a number of potential measures to mitigate climate change for each sector, as outlined in the Table 1 below:

Table 1: Potential measures to mitigate climate change

Sector	Potential Mitigation Options
Energy	
Renewable and low carbon energy	Achieve higher efficiency and less carbon emissions from power generation through the use of (pico/micro-hydro), biomass, biogas, solar PV, wind power at different scales, natural gas power generation, etc.
Energy efficiency in transportation sector	Continue to promote and implement the current Decree-law (No. 30/2011) on used vehicles which are imported into Timor-Leste to be less than 5 years of factory production.
Public transport	Promote use of public transport by enabling convenient (routes to all areas) and reliable access to bus and micro-bus, constructing appropriate facilities such as proper bus stops, terminals, and establish necessary regulations to control the transportation system.

Agriculture	
Livestock management	Promotion of biogas and composting for reduction of agricultural emissions.
Sustainable agriculture	Reducing slash and burn practices by introducing permanent agriculture with improved management practices and sustainable, climate-smart agricultural technologies and processes.
Forestry	
Rehabilitation of degraded lands	Sustainable forest management and land degradation neutrality.
REDD+	Explore opportunities to participate in international REDD+ programmes.
Afforestation and reforestation	One million trees are expected to be planted every year based on National Strategic Plan.

Source: INDC, 2016

Due to the Paris Agreement entered into force on 4 November 2016, the INDC was converted to a Nationally Determined Contribution (NDC). Timor-Leste's NDC continues to emphasize the direction and priorities set out in its INDC while expanding the details and specifics of its commitments, initiatives, and engagements from 2022-2030.

The NDC has been redesigned around 4 areas of commitment:

1. **Climate risk governance:** It clarifies the intention of establishing a robust framework for managing climate risks.
2. **Nature-positive growth and transition:** It reinforces nature-based solutions as a basis for mitigation, adaptation, and sustainable socio-economic development.
3. **Low carbon development:** It promotes national carbon sequestration as a means of reducing net domestic emissions together with any offshore carbon emission reduction activities under Article 6 of the Paris Agreement.
4. **Climate change adaptation and resilience building:** It recognises the need to advance activities in alignment with Article 7.1 of the Paris Agreement and its recognition of the importance of enhancing adaptive capacity as well as the importance of Article 7.8.

The key mitigations arrangements and options of Timor-Leste set out under its first NDC, inclusive of actions related to the scale-up of renewable energy services, improved energy efficiency and transport efficiency, the promotion of sustainable forest management, and the introduction of improved methods and policies related to waste management in relation to low carbon development path.

1.2.4. Timor-Leste Strategic Development Plan (SDP) 2011–2030

Timor-Leste's Strategic Development Plan (SDP) reflects the people's aspirations for a prosperous and strong nation over the next twenty years. The plan is created to encourage change, promote courageous group action, and envision a better future. As part of the SDP, a number of specific climate change objectives are outlined, such as the establishment of renewable energy and afforestation/reforestation activities.

The SDP acknowledges that a greater contribution to climate change mitigation efforts and assistance in meeting our commitments under international climate change agreements will come from increasing the quantity of power produced from wind, solar, hydro, and other renewable energy sources.

Additionally, other actions that will be undertaken to improve sustainable land management and develop a sustainable forestry include reforestation of all degraded areas, particularly in the Dili area's steep terrain, implementing initiatives to reduce slash-and-burn practices during the dry season, and providing forestry workers with technical and management training.

In its revised and adjusted form, the current SDP also recognises that climate change presents a serious threat to Timor-Leste and will pose both physical and environmental challenges.

1.2.5. Environmental Basic Law (Decree-Law No. 26/2012)

The Environmental Basic Law (Environmental Framework Law 26/2012) sets out the framework and guiding principles for the conservation and protection of the environment, including the preservation and sustainable use of natural resources, which protect the fundamental rights of the citizens of Timor-Leste. Regarding climate change, the law requires "the State shall implement the measures necessary for climate change adaptation and mitigation in terms of reducing greenhouse gas emissions into the atmosphere and/or their removal by sinks and minimizing the negative effects of the impacts of climate change on biophysical and socioeconomic systems." It also requires the State to reduce, control and maintain the release of greenhouse gas emissions and other polluting substances into the atmosphere within the limit of quality and environmental emissions standards.

1.2.6. Conditions and Procedures to Observe Regarding the Importation of Motor Prohibitions (Decree-Law 30/2011)

The purpose of the Decree-Law 30/2011 is to "regulate the conditions and procedures to be observed in relation to the import of mixed and light passenger vehicles." The import of vehicles shall contribute to economic growth. It is therefore essential to define the features of the vehicles to be imported into Timor-Leste, to ensure both consumers and the environmental are protected. Article 2 states that "it shall be forbidden to import mixed and light passenger vehicles of over five

years old, as of the date of manufacture". Hence, promoting and implementing the current Decree-Law (No. 30.2011) will support the mitigation efforts for in the transportation sector.

1.2.7. National Policy on Forests of Timor-Leste (NPF) 2017-2030

The National Policy on Forest of Timor-Leste is based on a vision derived from the Strategic Development Plan (2011-2030): "building social capital and improving the country's infrastructure supported by an emphasis on natural resource management strategies and environmental care and protection." The objective of the policy is to provide people with environmental, social, and economic benefits through sustainable management of forest resources and river basins.

The regenerated forest can contribute to preserving the health of the environment, conserving biological diversity, maintaining food security, preserving water resources, generating renewable energy at a low cost, and reducing greenhouse gas emissions. As outlined in the policy, the most effective way to mitigate the effects of climate change is to improve the sustainability of forest management and use. Mitigating effects will be monitored to demonstrate the contributions of forestry to climate change mitigation.

1.2.8. Biodiversity Decree-Law no. 6/2020

The Biodiversity Decree-Law establishes the legal framework for the protection and conservation of biodiversity, completing the provisions of the National System of Protected Areas and implementing the Basic Law for the Environment, which expressly mandates the adoption of measures necessary for the protection and conservation of species, habitats, and ecosystems. In terms of climate change, this Decree-Law states that a government entity responsible for the environment must encourage the adoption of mitigation and adaptation measures that promote the resilience of local communities, ecosystems and species in light of the challenges resulting from climate change and its negative effects on biodiversity.

1.2.9. Timor-Leste Integrated Vulnerability Assessment (IVA)

Environmental deterioration and climate change are having an increasing impact on Timor-Leste. The topography, climate sensitivity, and inadequate infrastructure of Timor-Leste exacerbate bottlenecks in agricultural production, access to essential services, and employment prospects. The Secretary of State for Environment (SSE) through the National Directorate for Climate Change (NDCC) has been conducting the Integrated Vulnerability Assessment (IVA) for more than 80 villages across the country to examine how rural communities are impacted by environmental and development changes, and how these changes influence those communities' capacity to meet their most basic requirements.

The IVA provides baseline data about communities' vulnerability through a standardized approach that can be replicated across locations and time periods. The framework serves as a tool to identify indicators that measure exposure, sensitivity, and adaptive capacity of the community to climate change. These indicators consider the livelihood assets (LA) and human security objectives (HSO) of the community.

Based on the IVA report, the environmental damages and water security happened to the most vulnerable HSOs. Human activity has been the main contributor to environmental degradation and low water volume, which has led to environmental and water security vulnerabilities. For example, farmers still use traditional farming methods (such as slash-and-burn and shifting agriculture) in the majority of villages. The climate variability during the dry season also contributes quite significantly to low water volume. Women and children and persons with disabilities are the most vulnerable groups. Another major factor contributing to water scarcity is widespread deforestation around water sources. The government frequently receives requests from many areas to provide services for agriculture and health as well as to enhance the water supply program.

The IVA results show the connections between the LAs and HSOs. Technology, funding, and resources have also undermined human capacity to cope with climate change and vulnerability. This includes technical support from pre- to post-disasters.

1.3. Sector Selection

The baseline for the selection of priority sectors for climate change mitigation is based on Timor-Leste's Second National Communication (SNC) to the UNFCCC, aligned with the Intended Nationally Determined Contribution (INDC), Nationally Determined Contribution (NDC) Timor-Leste 2022 – 2030, and Timor-Leste National Climate Change Policy (NCCP). The INDC report submitted to the UNFCCC secretariat in 2020 presents the national GHG inventory, including potential measures to mitigate climate change for each sector. The process for selecting the priority mitigation sectors for the TNA project is also discussed in this section.

1.3.1 An overview of sectors, projected climate change, and GHG emissions status and trends of the different sectors

Timor-Leste is an insignificant emitter of GHG by world standards. The main contributors to emission generation are the energy sector, followed by agriculture and waste. In 2015, total GHG emissions from the energy, agriculture, and waste sectors were 5,303.86 Gg CO_2e, while Forestry and Other Land Use (FOLU) sector was a net sink in among 1,478.73 Gg CO_2 (Table 2), so the total of GHG emissions in 2015 only reached 3,825.12 Gg CO_2-e CO_2e.

Without taking FOLU into account, Timor-Leste's overall GHG emissions dropped by nearly 64% to 5,303.85 Gg CO_{2e} from emissions from the same sector in 2005, when energy made up the majority (84.03%) of emissions, followed by agricultural (12.55%) and waste (4.42%). There was an uneven distribution of GHG emissions among the three gases recorded: CO_2 totaled 4,510.04 Gg or 85.03%

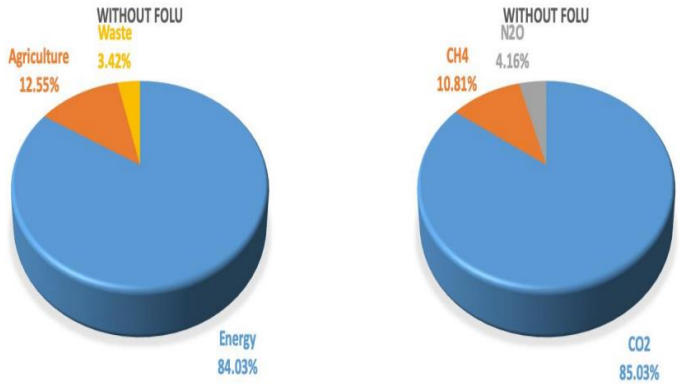
of total emissions; methane (CH4) totaled 573,10 Gg CO_{2e} or 10.81% of total emissions; and nitrous oxide (N2O) totaled 220.71 Gg CO_{2e} or 4.16 % of total emissions (Figure 1). In addition, GHG emissions for some sectors were Not Occurring (NO), while others were Not Estimated (NE).

Table 2: Summary of national GHG emissions in year 2005 and 2015 (in Gg GO_2e)

No	Sectors	Year	CO_2	CH_4	N_2O	CF_4	C_2F_6	CO	NOx	NMVOC	SOx	Total 3 Gases
1	Energy	2005	13,988.87	14.73	11.47	NO	NO	NE	NE	NE	NE	14,015.07
		2015	4,441.34	8.11	7.47	NO	NO	NE	NE	NE	NE	4,456.92
2	Agriculture	2005	0.08	400.44	156.01	NO	NO	NO	NO	NO	NO	556.54
		2015	0.03	476.75	188.99	NO	NO	NO	4.16	71.39	NO	665.76
3	AFOLU	2005	302.74	NE	NE	NO	NO	NO	NO	NE	NE	302.74
		2015	-1,478.73	NE	NE	NO	NO	NO	NO	NE	NE	-1,478.73
5	Waste	2005	42.02	64.41	16.58	NO	NO	NE	NE	NE	NE	123.01
		2015	68.68	88.24	24.25	NO	NO	NE	NE	NE	NE	181.17
Total (CO_2-eq)		2005	14,353.56	22.48	0.60	0.00	0.00	0.00	0.00			15,013.06
		2015	3,031.32	573.10	220.71	0.00	0.00	0.00	4.16			3,825.12

Source: SNC, 2020

Figure 1: GHG emissions estimates by sectors (left) and by gasses (right) in 2015 without forestry and other land use



Source: SNC, 2020

In Timor-Leste, GHG emissions of energy sectors are generated from two main sources: (1) fuel combustions; and (2) fugitives. There are a few sectors that contribute to the fuel combustion emissions reported in Timor-Leste's National GHG Inventory:

1. **Main Activity Electricity, and Upstream Oil and Gas Industry**: the main activity of electricity covers the combustion of diesel oil for electricity generation, while the oil and gas industries cover the combustion of natural gas and diesel oil for their own needs.

2. **Civil Aviation, and Road and Water-Borne**: the fuel combustion in civil aviation, and road and water-borne transportation cover petroleum product combustion, such as gasoline with RON 88 and higher than RON88, automotive diesel oil (ADO), marine fuel oil (MFO), jet fuel, and aviation gasoline.

3. **Commercial/Institution and Residential:** commercial/institution and Residential includes kerosene, LPG, and diesel oil for cooking, heating, and generating electricity, especially kerosene, LPG, and diesel oil.

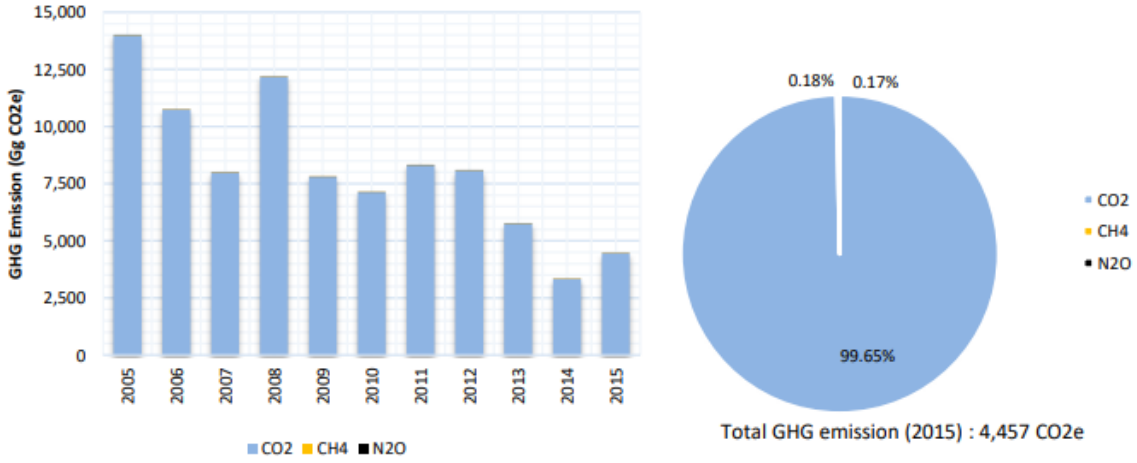
Additionally, the GHG from the fugitives is released from gas flaring and venting in the upstream oil and gas production. As can be seen from the Table 3, the highest GHG emissions of energy are fuel combustion for own use in oil & gas production facilities, followed by fuel combustion for road and water-borne transportation, and fuel combustion for the main activity of electricity production. Whereas GHG emissions from fuel combustion for Civil Aviation Transportation, fuel combustion for Residential, and fugitives from oil and gas production facilities are excluded from the National GHG Emission Inventory because their contribution to total GHG emissions from the energy sector is too small. Regarding GHG emissions of the energy sector by type of gas, Figure 3 shows that GHG emissions in 2015 is dominated by CO_2 (99, 65%), followed by CH_4 (0,18%) and N_2O (0,17%).

Table 3: Key category analysis for all sources of GHG emissions

Code	Category	Total GHG Emissions (Gg CO2e)	Level/Rank
1.A.1.b	Fuel Combustion for Own Use in Oil & Gas Production Facility	3,998	89.70%
1.A.3.b & d	Fuel Combustion for Road and Water-Borne Transportation	240	5.38%
1.A.1.a	Fuel Combustion for Main Activity Electricity Production	200	4.49%
1.A.3.a	Fuel combustion for Civil Aviation Transportation	11	0.25%
1.A.4.b	Fuel combustion for Residential	7	0.16%
1.B.2	Fugitives from Oil &Gas Production Facility	1	0.03%
Total		4,457	

Source: SNC, 2020

Figure 2: GHG emissions level by type of gas 2005 – 2015 (left) and share of GHG in 2015 (right)



Source: SNC, 2020

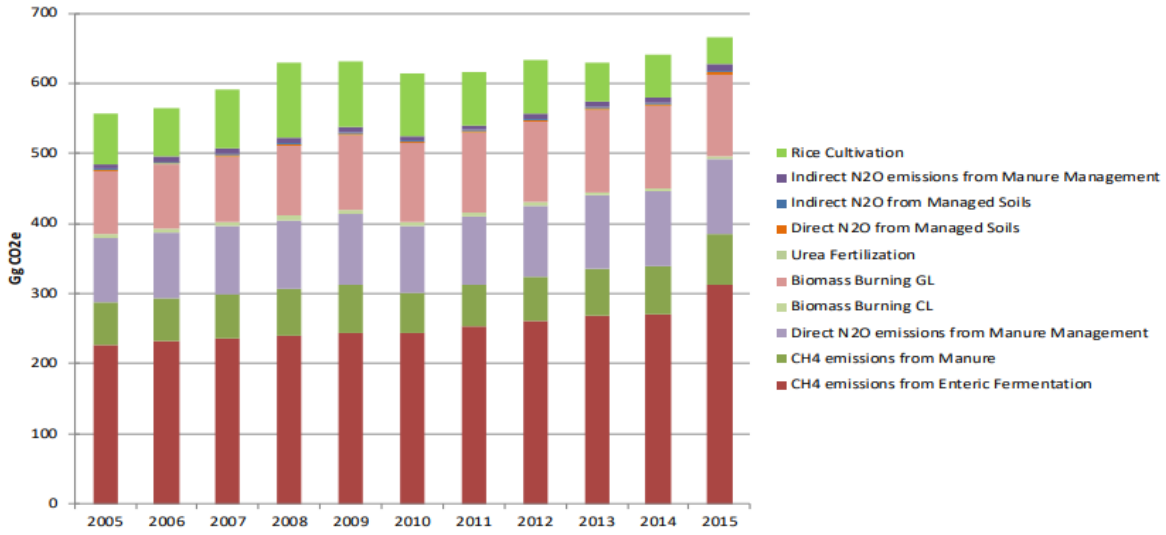
In the agriculture sector, the estimation shows that the total emissions of the three main GHGs (CO_2, CH_4, and N_2O) were 665.76 Gg CO_{2e} in 2015. As can be seen from Table 4, the highest GHG emissions from the agriculture sector are CH_4, which contributed to approximately 71.61% of the total emissions, while N_2O contributed 28.39% and CO_2 less than 0.1%. Additionally, Figure 3 illustrates the GHG emissions from agriculture by source category. The largest source of agriculture sector is enteric fermentation from livestock accounting for 47.03%. It is followed by emissions from biomass burning in grassland at 17.74%, direct N_2O emissions from manure management at 16.04%, methane emission from manure at 10.84%, and rice cultivation at 5.84%.

Table 4: GHG emissions from the agriculture sector from 2005 to 2015 by gas

Gas	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CH_4 (Gg)	19.07	19.35	20.46	21.98	21.78	21.11	21.00	21.56	21.16	21.59	22.70
N_2O (Gg)	0.50	0.51	0.52	0.54	0.56	0.55	0.57	0.58	0.60	0.60	0.61
CO2 (Gg)	0.08	0.08	0.10	0.08	0.30	0.15	0.09	0.09	0.08	0.03	0.03
Total in Gg CO_2e	556.54	565.59	591.98	630.12	631.63	614.25	616.42	633.08	629.96	640.98	665.76

Source: SNC, 2020

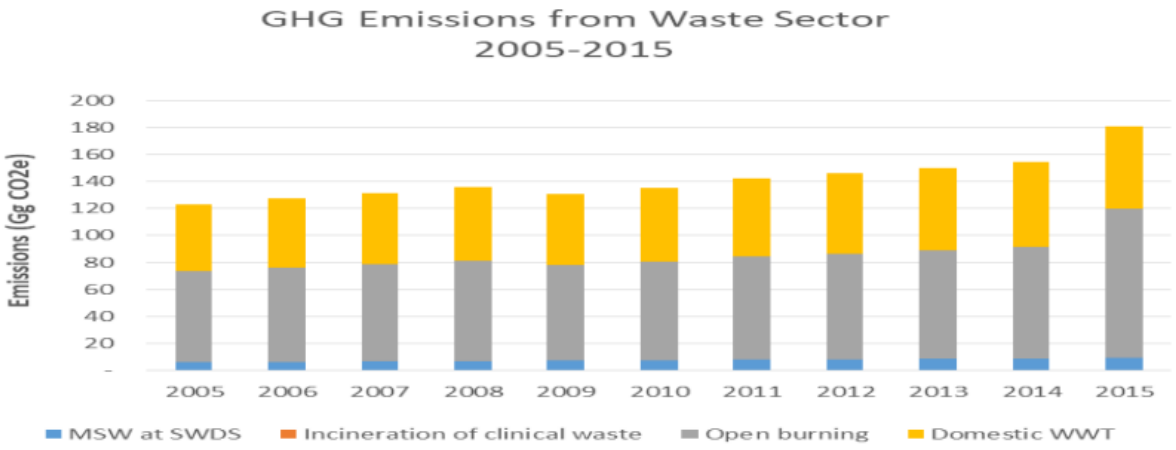
Figure 3: GHG emissions from the agriculture in 2005 – 2015 by source category



Source: SNC, 2020

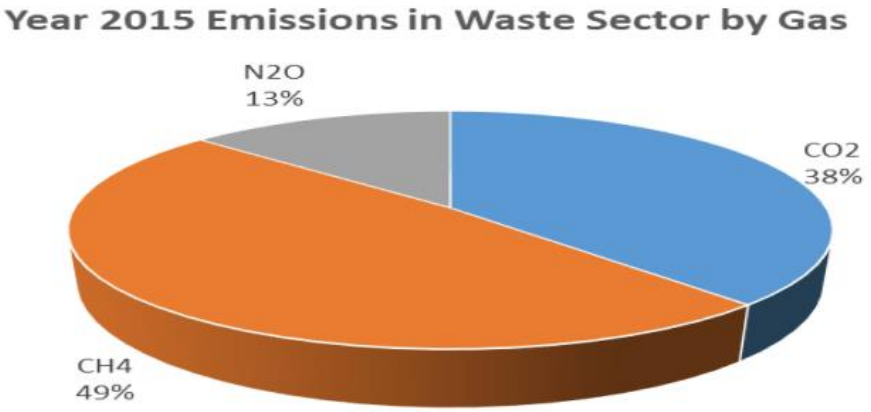
The source of GHG emissions from the waste sector is municipal solid waste (MSW) in un-categorized SWDS, MSW open burning, clinical incineration, and domestic wastewater treatment (WWT). There are also some activities identified as emission sources, including industrial solid waste and wastewater treatment. However, those sources were not included in the Second National Communication (SNC) because they were small or rarely implemented due to the limited number of industries in the country. As presented in Figure 4, the main source of GHG emission from the waste is MSW open burning, followed by domestic WWT. Hence, the GHG emission from the waste sector is dominated by CH_4 (49%), followed by CO_2 (38%) and CO_2 (13%) as illustrated in Figure 5. The large contribution of CH_4 is from domestic WWT while the CO_2 is from open burning.

Figure 4: GHG emissions from waste sector in Timor-Leste, 2005 – 2015



Source: SNC, 2020

Figure 5: The distribution of GHG emissions from the waste sector by type of gas



Source: SNC, 2020

1.3.2. Process and results of sector selection

Secretary of State for Environment (SSE) through the National Directorate of Climate Change (DNCC) decided on the sector selected process during the internal meeting among NDCC team which was organised by the TNA coordinator. The sectors were selected based on the Timor-Leste GHG emissions status (as mentioned above), including taking into account the mitigation measures listed in the current national documents such as NDC. Hence, the agreed sectors of mitigation to be included in the TNA process are:

1. Transportation sector
2. Agriculture, land use and forestry sector

Chapter 2: Institutional arrangement for the TNA and the stakeholder involvement

The National Directorate of Climate Change (NDCC) under the Secretary of State for Environment (SSE) has a mission to streamline and coordinate government participation in international organizations, prepare and issue positions on environmental topics that can be adopted in bilateral relations as well as international organizations, and promotes international cooperation to promote sustainable and environmentally friendly development.

The NDCC acts as the technical coordinating body and secretariat for the implementation of the National Climate Change Policy (NCCP), including Nationally Determined Contribution (NDC). As part of its roles, NDCC also has a task to coordinate the actions mitigating the effects of climate change in particular in the framework of NAMAs (Nationally Appropriate Mitigation Actions) and the Climate Technology Centre and Network (CTCN). Therefore, NDCC was chosen to be the contracting entity for the TNA project. The TNA will enable Timor-Leste to examine technologies that are essential for increasing both energy efficiency and economic efficiency, including boosting national carbon sequestration potential as a way to reduce net domestic emissions.

2.1. National TNA team

The institutional arrangement that has been set up to manage the TNA project is shown in Figure 6. The essential elements of the institutional arrangement include National Contracting Entity (NCE) - TNA Coordinator, Climate Change Working Group (CCWG), National Consultants/Experts, National TNA project Steering Committee, and Project assurance and Technical Support (UNEP-CCC and AIT). The roles and responsibilities of these different elements of the institutional structure are discussed below:

The National TNA Project Steering Committee

The National TNA Project Steering Committee was selected based on the selected sectors of mitigation. The role of the steering committee is to provide high-level guidance for the TNA process and the outcomes, including contributing with technical expertise and input to the technology prioritization. The senior government staffs and members from the following institutions are represented on the steering committee:

Table 5 : Roles and responsibility of the National TNA project steering committee

Government Ministry	**Portfolio**	**Aspect of portfolio mandate related to TNA**	**Key roles and responsibilities to TNA**
Ministry of Agriculture and Fisheries	Agriculture	• Develop and enforce policy and legislation of the agriculture	• Coordinate the development and implementation of

		sector. • Promote agricultural development, food production and food security, agricultural climate monitoring, land-use, and agricultural management system.	the national food security. • Develop and enforce agricultural policy and legislation on climate smart agriculture to improve agricultural production and productivity. • Provide climate information and analysis, including high resolution maps on land use and its potential, and agricultural production.
	Forestry	• Develop, implement, and enforce laws and regulations, including managing programmes for forest management and protection.	• Administer afforestation and reforestation programmes. • Implement forest conservation plans and promote sustainable practices for agroforestry throughout the territory, including mapping and developing inventories of forest species.
Ministry of Transport and Communication	Transport	• Responsible for land transport regulation and providing driver licensing and vehicle registration and inspection services, traffic management standards and operations, public transport permitting and terminal management, control of vehicle overloading, and sub-sector planning.	• Develop and enforce public transport regulation and management. • Control and enforce the decree-law No.30/2011 to prohibit the import of light passenger and mixed vehicles that are more than 5 years old. • Manage and improve all aspects of public transport services.
Ministry of Public Works	National Authority for Electricity - ANE,	• Responsible in the area of electricity in the national territory,	• Regulate renewable energy activities in Timor-Leste such as

	I.P (Renewable energy)	such as providing, monitoring, and enforcing national policy in the energy sector.	investment, licensing and certification to companies.

The National TNA Coordinator

The National TNA Coordinator, Mr. Abraão Joaquim de Sá was appointed by the contractor entity - the National Directorate of Climate Change (NDCC) to serve as the focal point of Timor-Leste, communicating progress and any questions or concerns to the regional centre.

Mr. Abraão is the Chief of the Department for Mitigation who has been working under the NDCC for many years. As a focal point, the National TNA coordinator also has the responsibility to provide administrative support for coordinating with the TNA key stakeholders and facilitating the consultation meeting or workshop. He is in charge of the overall management of the TNA project providing daily leadership and vision for the TNA process. Due to time constraints, the roles and responsibilities of the National TNA coordinator are also supported by the Assistant TNA Coordinator.

Climate Change Working Group

The Climate Change Working Group (CCWG) is the government mechanism for consulting stakeholders on climate change matters. This group is made up of ministries, international organizations, donor, civil societies, donors, universities, and institutions involved in climate change policy and programs. The CCWG contributed to the identification and prioritization of mitigation technologies.

National Consultants

The TNA process is carried out with the assistance of mitigation and adaptation consultants. Both consultants were recruited by the TNA coordinator in close consultation with the director of NDCC, including UNEP – CCC. National consultants are in charge of finalizing the TNA Report after rigorous identification and prioritization of technologies for the two sectors listed under climate change adaptation and mitigation. This is done after extensive consultation with the pertinent stakeholders and experts. The National Consultants also lead the consultation workshop and drive the process of Multi Criteria Analysis (MCA), as well as facilitating the process of technology prioritization.

Organizational Structure

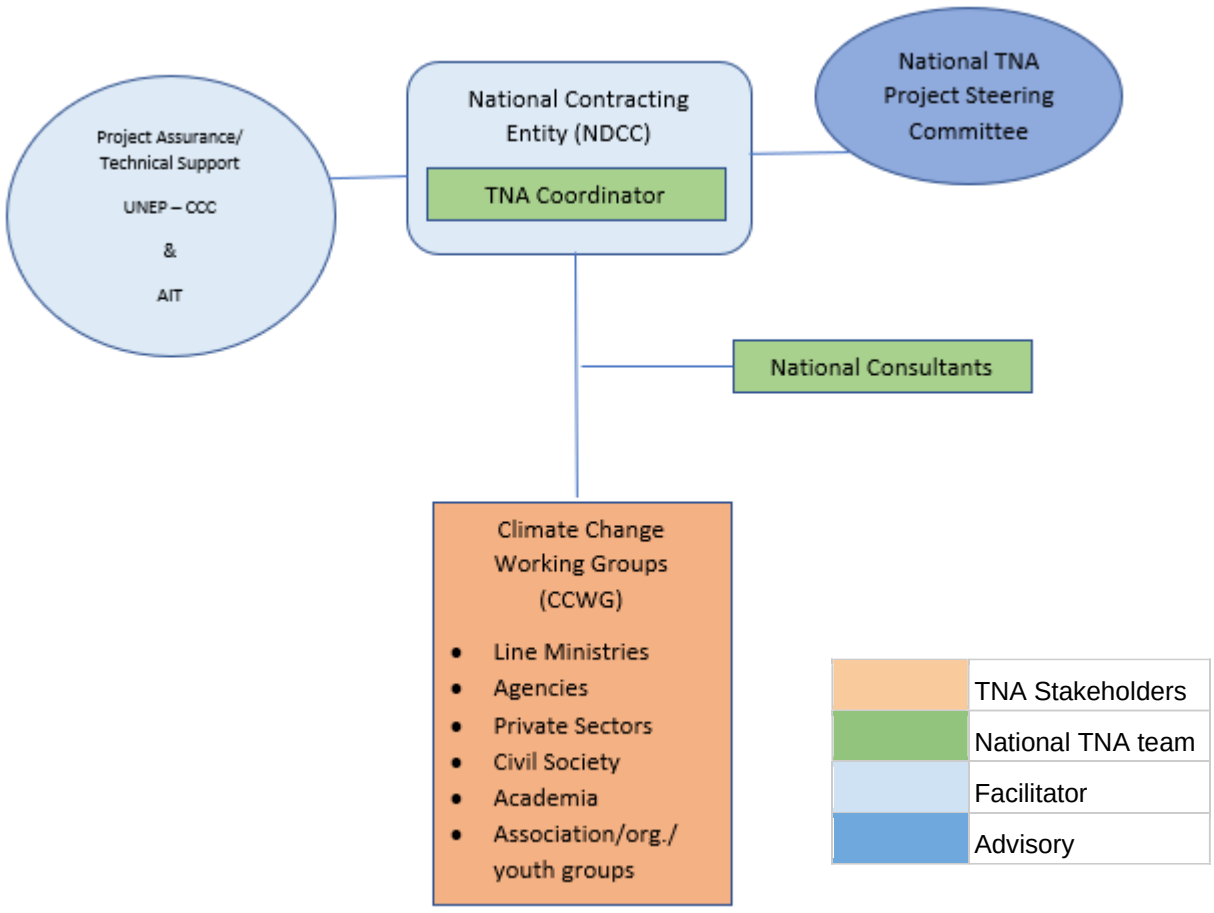


Figure 6: Institutional arrangement for the TNA project in Timor-Leste

2.2. Stakeholder Engagement Process followed in the TNA – Overall assessment

As part of the TNA work in Timor-Leste, the stakeholders' engagement process was conducted in accordance with the principles deliberated in the National Climate Change Policy (NCCP) such as national ownership, equity, and social inclusion, informed, impactful participation, commitment to sustainable development, long term capacity building, including science and technology-based policy and action. Consultations were conducted with a wide range of stakeholders, including government agencies, the private sector, non-government organisations, civil service organizations, academic institutions, and youth groups. Please see Annex II for a complete list of stakeholders participating in the one-on-one consultation and the workshop consultations.

There were two main objectives of stakeholder engagement: (1) to find out stakeholders' thoughts and opinions regarding the technology, and (2) to make transparent decisions of national interest together. The stakeholder engagement was done through a one-on-one consultation with the relevant line ministries, particularly those involved in the National TNA project Steering Committee. The consultation also included relevant local NGOs that have experience in implementing some of the identified technologies. It then continued with the email correspondence on the technology identification and details of the factsheet technology. Unfortunately, the Ministry of Transport and Communication through the National Directorate of Transport and the Land Transport Authority representatives were unable to participate in the process even though they are key stakeholders. They will be consulted on the remaining phase of the project.

Finally, the national consultation workshop with TNA stakeholders was organized to identify, review, and validate selected technologies. In order to present the list of prioritized technologies, the mitigation consultant developed a TNA factsheet. Despite the importance of engaging all stakeholders, time and resource constraints prevented us from engaging all stakeholders.

2.3. Consideration of Gender Aspects in the TNA process

Climate change is expected to affect men, women, children, and the elderly in different ways. Therefore, the government aims to increase its capacity to identify and respond to women's needs, which includes developing tools and approaches to ensure gender equality and social inclusion, strengthening coordination mechanisms that support gender considerations, and prioritizing programs based on demographics, gender, and social inclusion factor. Timor-Leste has made progress toward gender equality, rising to 64th place from 125th in the 2016 Global Gender Gap Index.

The TNA project considers gender differences throughout the entire process and its outputs in order to reduce or eliminate gender inequalities in activities and outcomes. The National TNA team considers the Secretary of State for Equality and Inclusion (SSEI), to be included during the consultation process. The representative of SSEI also participated in the technology prioritization workshop, along with 35% of women.

It will be possible to ensure that women and men have equal opportunities in relation to the Technology Action Plans (TAPs) that are planned to result from the TNAs, as well as contributing to the Timor-Leste Nationally Determined Contributions (NDCs) and the Sustainable Development Goals (SDGs). It is vital that a gender-sensitive approach should be incorporated into the mitigation technology assessments by the national TNA team.

Chapter 3: Technology prioritisation for the transportation sector

3.1. GHG emissions/cc vulnerabilities and existing technologies of transportation sector

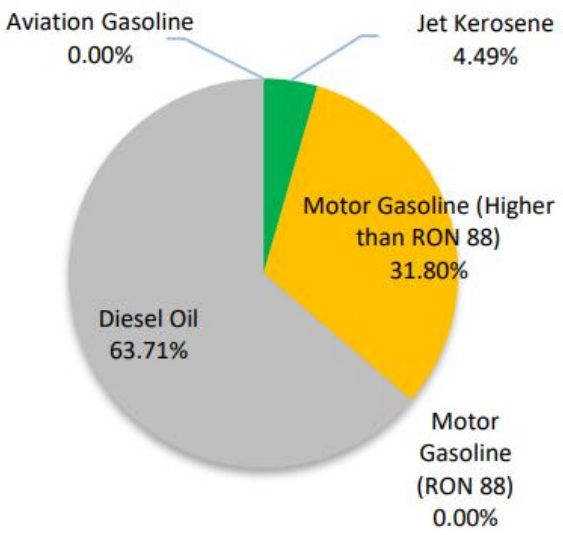
In 2015, the GHG emissions from transportation in Timor-Leste were 251 GgCO2-e, which represented a 67% increase in emissions from 2005. However, reported emissions have varied significantly from year to year over this time, therefore the reported numbers may not always be completely valid. According to SNC, GHG emissions from transportation in Timor-Leste are projected to increase over the period from 2015 – 2030 by 1357 percent under the BAU scenario, and 457 percent under the mitigation scenario. Road transportation and water transportation account for most of those increases.

The transportation sector generates GHG emissions through fuel combustion such as gasoline, diesel oil, and jet/kerosene fuel that are burnt. It is common to use gasoline for road transportation, whereas diesel oil is more common for waterborne vehicles, as well as for a few vehicles on the road. In 2015, GHG emissions from fuel oil (diesel oil and gasoline) combustion for road and waterborne transport accounted for 63.71% (diesel oil) and 31.80% (gasoline, higher than Ron 88) and from jet-kerosene combustion for civil aviation accounted for 4.49% (see Figure 7).

According to the SNC, the number of vehicles for each of the transportation modes is estimated using some assumptions regarding the average annual growth between 2003 and 2015. Between 2010 and 2017, the average annual growth of gasoline-consuming vehicles is projected to be around 8%, while from 2020 to 2030, it is projected to be 5%. Motorcycle use is projected to expand by 8%, while waterborne navigation and aviation are projected to grow by 6.5%. Regarding the increase in vehicle numbers, it is predicted that total fuel consumption would reach 677.4 million litters in 2030, with a share of gasoline of 59.7%, diesel oil of 36.7%, and jet kerosene of 3.7%, as presented in Figure 8.

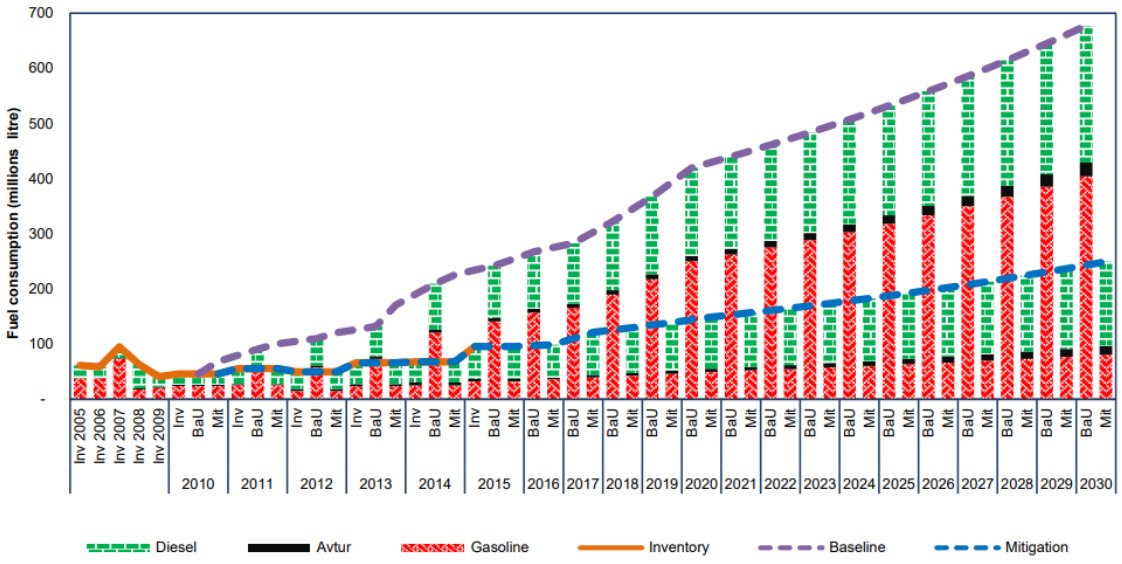
Due to the lack of relevant activity data, the GHG emissions from water and land transportation cannot be reported individually. In Timor-Leste, jet fuel and kerosene are mostly used for international flights and a small number of local flights (helicopter and charter plane). In the transportation sector, diesel oil combustion has been the main source of GHG emissions, and of course, it affects the overall amount of GHG emissions from transportation.

Figure 7: Total GHG emission in transportation (2015): 251 Gg CO_2e



Source: SNC, 2020

Figure 8: Fuels consumption in transportation sector



Source: SNC, 2020

As mentioned in the Second National Communication (SNC), several mitigation options have been identified based on key category analysis and input from the Working Group of National Communication and Government Programs. Regarding transportation, mitigations for reducing "mobile GHG emissions" is through the improvement of transport system efficiency, which includes:

- Encouraging 'mode shift' from private vehicles to public transport (bus/mini/microbus)
- Increasing efficiency of fuels combustions in transport by using more efficient vehicles through the restriction of vehicles with above 5-year age
- Replacing old cars with the new one for taxis through incentives
- Providing pedestrian and bicycle lanes to encourage people for walking or using the bicycle
- Replacing oil fuels with gas fuels (LPG, CNG, or LGV) through developing infrastructure for gas utilization in transport (conversion kits, gas station, gas supply infrastructures, etc.)

3.2. Decision context

Roads are the primary mode of transport, allowing for development and the delivery of resources. In Timor-Leste, the transport system is still largely being developed. Public transportation accounts for over 60% of all intercity travel, however, the service is poor, seats are not guaranteed, departure and arrival times are unpredictable, and onboard comfort is low. Motorcycles account for 20% more passenger trips than cars and trucks, which account for the remaining 20%. Overloading is the norm to allow the driver to maximize revenue. There are no terminals or waiting areas along the routes. There are no intercity bus services for tourists or locals who need to travel by bus. Additionally, Taxis are of poor quality and poorer service with no identification in the taxi, no price structure for travel displayed, and no emergency contact information provided.

On the other hand, the fleet of vehicles is rapidly growing. Initial registrations show a 28% annual rise between 2010 and 2013. Motorcycles, which rose at a 31% annual rate, make up three-fourths of all vehicles. There were 48,143 motorbikes and 8,788 personal vehicles in use at the end of 2013. The majority of cars, buses, and motorcyclists fail to follow the most basic driving rules, and safety is not a top priority. Moreover, it is common to load and upload on public streets.

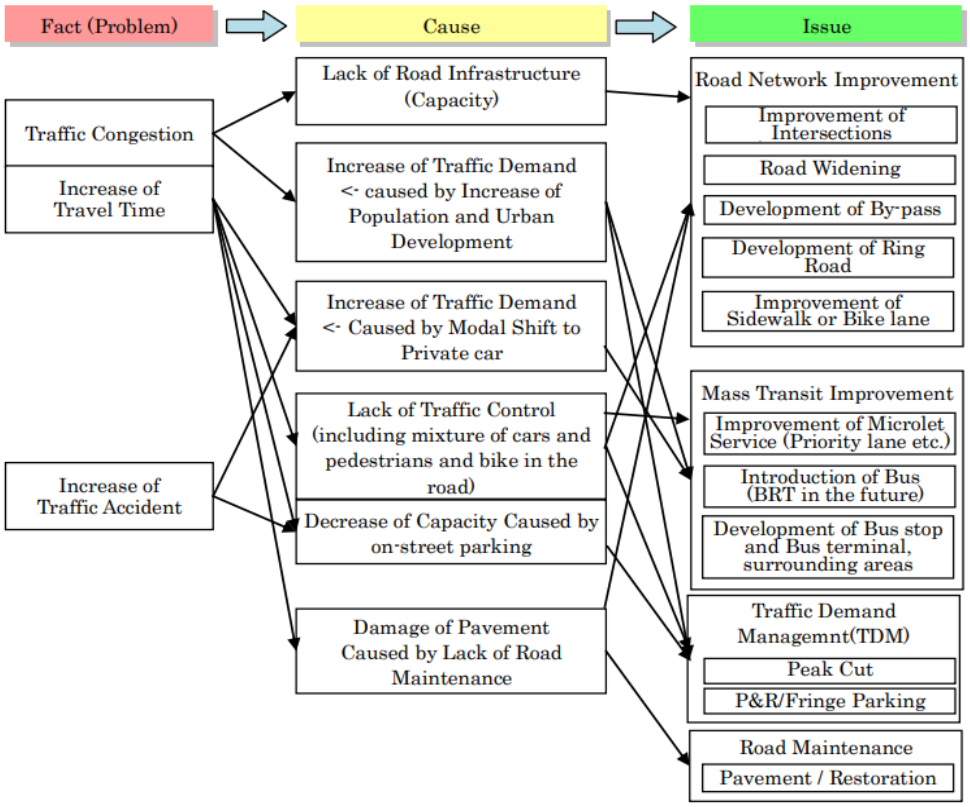
Congestion is getting worse in Timor-Leste, particularly in Dili city. As shown in Figure 9, the northern corridor has the highest traffic volumes, with an average daily traffic (ADT) of around 6,000 vehicles per day (VPD) on the portion immediately west of Dili, about 2,000 VPD further to the west, and about 1,600 VPD further to the east. According to traffic growth predictions, areas near Dili will grow by 10 percent, areas along the northern corridor by 3 to 6 percent, and most other areas will grow by 1 percent.

Figure 9: The distribution of traffic on Timor-Leste roads in 2013-2014

Source: Transport Sector Master Plan, 2018

As outlined in the Dili Urban Master Plan, the future problems and issues of transportation in Dili Metropolitan Area (DMA) can be seen in Figure 10.

Figure 10: Future problems and issues of transportation sector in DMA



Source: Dili Urban Master Plan, 2016

Based on the above rationale, improving the flow of traffic, better terminals, expanding infrastructure, and improving traffic management are urgently needed in Timor-Leste. These are policies supporting efficient transportation technologies and measures:

- Decree-Law No. 30/2011 – Conditions and Procedures to Observe Regarding the Importation of Motor Prohibitions: The import of light passenger and mixed vehicles that are more than 5 years old (from the date of their original manufacture to the date of import) is prohibited by this Decree-Law, while there are some exceptions for specific situations and vehicles.

- Timor-Leste Strategic Development Plan (SDP) 2011–2030 emphasizes investments in road infrastructure and prioritizes the rehabilitation and improvement (upgrading) of the existing road network. Road networks are necessary for promoting equity in national development, facilitating the transport of goods at a reasonable price, providing government services, and promoting agriculture and private sector growth.

- Transport System Master Plan: The Transport Sector Master Plan (TSMP) has been developed to build sector resilience and reduce emissions derived from the transport sector. This plan creates Strategies and Actions to promote and support climate-friendly public transport options, and non-motorized transport solutions where possible. The TSMP also has identified the public transport target as shown in Table 6.

Table 6: TSMP Targets – Public Transport

Item	Target	TSMP Timeframe
Dili Central City Bus Terminal	Dili Central Public Transport Terminal constructed and in operation	2023
Bus stops intercity	Marked and fixed with shelters at 7 to 10 km intervals	2023
Bus Lanes	Dedicated bus lanes as needed and as appropriate	2023
Safety of Vehicles and Drivers	Enforce regulations for taxi and public transport vehicles - vehicle condition and driver training	2020
Dili Taxis	Use of a fixed taxi rate protocol and safety features within taxis	2020
Improved passenger convenience	Improved Dili-municipal center linkage through hybrid scheduled and demand services	2023
	improved highway safety features including markings, signage, geometric design, maintenance and enforcement	2020
	provision of space as needed in municipal centers for pubic transport terminals	2021
	development of secondary services to rural areas as road access improves from municipal centers	2022

Source: Transport Sector Master Plan, 2018

Furthermore, the Transport Sector Master Plan (TSMP) also sets out the policy, strategy, institutional, management, and investment planning framework for Timor-Leste's land transport sub-sector. TSMP is part of the National Strategic Planning Framework which is centered on the SDP

2011-2030. In the land transport sub-sector, the plan priorities are to improve the efficiency and effectiveness of management by establishing:

1. A National Land Transport Authority
2. The standard for infrastructure, services, and facilities that are focussed on the needs of users, including accessibility, affordable, and safety
3. A competitive, fair, and sustainable environment for the Timor-Leste private sector to invest and operate within
4. Broad and effective cooperation between stakeholders with a responsibility or interest in improving road safety
5. Integration and cooperation between stakeholders with responsibilities for urban development and management

The transport development plan covers road and transportation plans including road network improvement and the promotion of mass transit. As a result of DMA's planning to address future problems and issues in the transportation sector, the following policies have been developed:

- Improvement of the capacity of the road network and traffic regulation (such as one-way streets)
- Promotion of mass transport use to reduce the number of private vehicles and motorbikes on the road (including the introduction of BRT development)
- Mass transit system improvement in conjunction with transit-oriented development (TOD) urban development
- Ensuring efficient traffic flow and improving safety by developing parking lots
- Enhancement of safety by providing smooth traffic and reduction of traffic volume

The main objective of TNA is to identify and analyse EST that have a synergetic relationship with the impact of climate change and GHG emissions in Timor-Leste within national development strategies. Analysis conducted under the TNA project helped identify technologies critical to the successful implementation of the country's NDC. Through a consultative approach, the TNA intends to identify and determine the most appropriate technologies for Timor-Leste's transportation sector through a set of country-driven activities.

3.3. An overview of possible mitigation technology options of transportation sector and their mitigation/vulnerability reduction potential and other co-benefits

Timor-Leste's transportation system focuses on allowing people to access both social and economic opportunities. As a primary mode of transport, road infrastructure has always been the priority of the country, allowing for development and the delivery of resources to urban as well as rural areas. The Timor-Leste Strategic Development Plan (SDP) 2011–2030 emphasizes investments in road infrastructure and prioritizes the rehabilitation and improvement (upgrading) of the existing road

network. There are no specific technologies mentioned in any national documents relating to transportation sector, but there are a number of targets outlined in the Transport Sector Master Plan (TSMP), which include:

1. National roads
2. Rural roads
3. Public transport
4. Dili city circulation
5. Road maintenance
6. Road Safety

With regards to mitigation options, the Government of Timor-Leste has been actively creating a variety of frameworks and plans to guide the country and its stakeholders towards low development carbon and will continue to seek ways to improve energy efficiency and the economic efficiency of national energy services. A variety of relevant actions, policies, programs, and strategies were created and implemented to address the concerns posed by climate change.

Potential mitigations outlined in the NDC about transportation sector are:

1. **Vehicle standard:** Timor-Leste will continue to use the Decree-Law No. 30/2011 on prohibiting the import of light passenger and mixed vehicles that are more than 5 years old (from the date of their original manufacture to the date of import).

2. **Transport system master plan:** A plan to be developed to build sector resilience and reduce GHG derived from the transport sector. It is the entry point for promoting the use of public transport by providing convenient (routes to all areas) and reliable access to bus or micro-bus, constructing appropriate facilities such as proper bus stops, terminals, and establish necessary regulations to control the transportation system.

The long list of technologies for transportation sector presented in Table 7 is gathered from various existing national policies and strategies such as NSDP 2011 – 2030, NDC 2022 – 2030, SNC, TSMP, and other project documents that have been implemented by both national and international agencies. Whereas the overview of technology for this sector and the climate change mitigation benefits are illustrated in Table 8.

The list was distributed to the TNA coordinator, the National Directorate for Climate Change (NDCC), and the National Electricity Authority. Additions to the list were discussed and accepted as appropriate during the consultation workshop. A list of eight (8) technologies has been agreed, and the prioritised technologies with a more comprehensive fact sheet attached in Annex I.

Table 7: Long list of technologies options and descriptions for transportation sector

No.	Technologies	Description
1.	Biofuel and Biomass potential	Biofuels are fuels that can be produced from any renewable biological resources, such as plant material. Advanced bio-hydrocarbons are second generation biofuels and are derived from lignocellulosic biomass such as trees, grasses, waste, agricultural or forest residues, or algae. These fuels are not produced using the agricultural commodities like corn, sugarcane, soybean, etc. Research will be undertaken to improve the understanding of the economics and potential of biofuel production (biodiesel and bioethanol) and the use of sustainable biomass as feedstock for bioenergy production in Timor-Leste. This also includes establishing regulation to promote biofuel production.
2.	Promotion of non-motorized transport	Non-motorised Transportation (NMT) includes walking and bicycling, and variants such as small-wheeled transport (cycle rickshaws, skates, skateboards, push scooters and hand carts) and wheelchair travel. It is especially important for short trips up to 7 kms, which account for the majority of urban trips. The use of NMT can be stimulated through investments in facilities, awareness campaigns, smart urban planning, improved public transportation, and disincentives to use private motor vehicles. Specific ways to improve non-motorised transportation are, inter alia: • Improve sidewalks, crosswalks, paths, bicycle lanes and networks • Public bicycle systems • Develop pedestrian oriented land use and building design • Increase road and path connectivity, with special non-motorised shortcuts • Traffic calming, streetscape improvements, traffic speed reductions, vehicle restrictions and road space reallocation • Safety education, law enforcement and encouragement programs • Bicycle parking and integration in transit systems

3.	Introduction of Bus rapid transit (BRT)	Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable, and cost-effective services at metro-level capacities. It does this by providing dedicated lanes, busways, and iconic stations typically aligned to the centre of the road, off-board fare collection, and fast and frequent service. The following are some features that an effective mass transit system should have: • Forming public transportation organization • Introduction of Priority Lane for Public Transportation • Improvement of exclusive lane for BRT bus vehicle from priority lane and bus priority signals • Introduction of large-sized bus • BRT stations, including station traffic square to assist transfer to feeder traffic mode such as feeder Microlet service • Pedestrian bridges across BRT street to enhance safety of BRT passengers and crossing pedestrians
4.	Low carbon development strategy	Low-carbon development plans also can be called green growth plans, climate change plans and strategies or low-emission development strategies (LEDS). A low-carbon development plan guides countries down a path towards low carbon green growth. Timor-Leste is fully engaged to take more ambitious climate actions on low carbon development path with no emission reduction target. The ambition would be primarily focusing on enhancing strategies, plans and actions for low carbon development reflecting its national circumstances based on Article 4.6 of the Paris Agreement.
5.	Develop Pollution Control Decree-law	Article 33 of the Environmental Basic Law (Decree-law no. 26/2012) states that "*The release of greenhouse gases and other polluting substances into the atmosphere shall be reduced, controlled and maintained within the limits of quality and environmental emissions standards and other legislation in force.*" Timor-Leste does not have vehicle emissions standard to

		reduce emissions and control pollution from vehicles in use. Currently, there is only a Decree-law no. 13/2011 that prohibits the import of light passenger and mixed vehicles that are more than 5 years old (from the date of their original manufacture to the date of import). Hence, the pollution control decree-law should have been in place before the vehicle emissions standard could be established.
6.	Public transportation maximization	Around 60% of all passenger trips in Timor-Leste involve public transport, whether by taxi, bus, microlet or angguna. A further 20% of passenger trips are by motorcycle and the 20% balance by car and truck. Mass transit improvements are essential to promoting public transportation and reducing modal-shift toward private cars. This technology involves optimizing the accessibility and availability of public transport modes (bus, angunna, microlet, taxi) from the perspective of both the users and the operators. Priorities will be set on services and facilities: 1. Safe, comfortable vehicles 2. Safe, competent drivers 3. Safe, convenient, and comfortable on-road facilities 4. Safe, convenient comfortable terminal facilities 5. Convenient, affordable, and reliable schedule services 6. Control overloading 7. Mode optimization
7.	Promotion of electric vehicle	Electric vehicles are about 2.5 times more energy efficient than their counterparts which are powered solely by internal combustion engines. This high energy efficiency is the main reason why electric vehicles can contribute to lower the CO_2 emission and energy consumption of traffic substantially. Electrical vehicles utilization is considered difficult in Timor-Leste, although recently there is some electrical motorcycle (ojek) operating to serve as public passenger's transport.

		Research will be taken to improve the understanding of electric vehicle technology in Timor-Leste.
8.	Research on installing solar system-based charging station	Renewable energy is an important resource, which is widely available in nature. Solar panel is considered to be the most replicated technology in Timor-Leste. Solar panels can generate electricity that you can use to charge the electric vehicle EV. Photovoltaic (PV) charging is when sunlight is converted directly into energy, a system that is rapidly increasing in popularity for electric vehicles (EV). Recently there are some electrical motorcycles (ojek) operating to serve as public passenger's transport, mainly in Liquiça, Manatuto and Lautem municipalities. Hence, research will be taken to analyse the power reliability, energy cost, and CO_2 emissions of a PV-powered charging station.

Table 8: Overview of technologies and the climate change mitigation benefits

No.	Technologies	Economic Benefits	Social Benefits	Environmental Benefits	Others
1.	Biofuel and Biomass potential	Promotion of Non-agricultural incomes. It is more profitable due to the higher social and environmental benefit.	Creating jobs and generating revenue for the underprivileged people in rural areas, including low-income women.	Bio-based fuels can provide an estimated 80% reduction in overall CO_2 life cycle emissions.	The technology aligns with Low Carbon technology's activities stated in the NDC.
2.	Promotion of non-motorized transport	High benefit to cost ratio from investment in facilities, access to market, reduced reliance on fossil fuel, and greater	Congestion reduction, health benefits due to exercise, including gender benefit, and social equality and	GHG emission reduction, improved air quality, noise, and congestion.	The technology aligns with Dili Urban Master Plan and NDC.

		economic inclusion.	poverty reduction.		
3.	Introduction of Bus rapid transit (BRT)	BRT can move large numbers of people at less cost to the individuals and society. Although the initial costs are relatively high, benefits are much higher in the long term.	More affordable, and more accessible for people who cannot drive or are too young. It also contributes to greater social inclusion and equality.	Less energy and emitting less GHG, less pollution and fewer traffic accidents, and it encourages walking and cycling.	The technology aligns with Dili Urban Planning, Transportation Master Plan, and NDC.
4.	Low carbon development strategy	It can be a tool for assessing and identifying financing priorities and the required sources of funding.	It can provide important signals to the private sector on the direction for future investments, research, and development.	It can be beneficial for prioritizing nationally appropriate mitigation actions, which are voluntary mitigation action proposals from developing countries to the UNFCCC for reducing CO_2 emissions.	The technology aligns with NDC in establishing an enabling environment for low carbon transition.
5.	Develop Pollution Control Decree-law	Supports efforts in environmental protection, addressing climate change, and improving efficiency of energy resource use.	Savings on medical expenses for air pollution-related health problems.	Controlling air pollution and reducing GHG emissions.	It is recommended by the National Directorate of Pollution control and accepted by stakeholders.
6.	Public	Maximizing	Cheaper	Reduction of	The

	transportation maximization	economic productivity, the efficient connection of wealth and labour to the marketplace, and maximizing opportunities for individuals, business, and government to increase income and asset value.	transport for the nation and for individuals, especially people on low incomes; a more pleasant city in which to live and move around; healthier and more connected residents.	carbon emissions, air pollution (which results in better air quality) and congestion on roads—including traffic.	technology aligns with NDC, SNC, Dili Urban Planning, and Transport Sector Master Plan.
7.	Promotion of electric vehicle	Low cost of travel along with energy and harmful emissions savings.	National security benefits, and better quality and health.	Reduction in GHG emissions, efficient energy use, gasoline savings, including reduction on oil dependency and improvement of the environment.	The technology aligns with SNC.
8.	Research on installing solar system-based charging station	Reducing fuel cost and shifting consumption away from imported oil to more locally produced electricity sources.	National security benefits, and job creation.	Safe, clean and environment friendly, including promoting renewable energy consumption and reduce CO_2.	The technology aligns with SND and NDC, which is promoting renewable energy in Timor-Leste

3.4. Criteria and process of technology prioritisation for transportation sector

The prioritization of the above-listed technologies was done at the one-day consultation workshop with TNA stakeholders, which was held on the 10th of January 2023. The technologies prioritization was conducted using the Multi-Criteria Analysis (MCA) method - a tool that is frequently used in the decision-making process, including to rank possibilities or narrow the field of potential choices. In this regard, the consultation workshop started with the presentation of the TNA project and the main outcome of the project, along with the definition and types of technologies. The entire process for prioritizing the technologies was established at the beginning of the workshop.

Prior to the MCA exercise, the stakeholders were split into two groups based on each sector of mitigation, and each group was introduced to the long list of technologies and factsheet of each technology. Under the transportation sector, there was a comprehensive discussion on each technology, which resulted in some changes in certain technologies. Once the long-list technologies were agreed upon, the stakeholders continued validating criteria and weighting them.

The consultant suggested the criteria that reflect country development priorities based on the desk review and one-on-one consultation. During the consultation workshop, the respective stakeholders discussed the identified criteria and indicators and validated them. Table 9 shows the criteria, indicators, and scoring scale used in the prioritizing technology exercised by the stakeholders. The performance matrix was established, and scoring was conducted by evaluating the performance of each technology against each of the criteria. All stakeholders involved in the transportation used Technology Fact Sheets (TFS) and their collective experiences to discuss each criterion. In the process of scoring , every group's stakeholder decided to score each technology based on the scoring scale presented in the Table 9 by discussing it together and reaching a consensus.

After the scoring phase was over, stakeholders continued working through the weighting criteria using a consensus-based decision-making process. The weighting criteria used for prioritising transportation sector is shown in Table 10. All of the technological factsheets as well as the experiences of the various stakeholders were discussed during the course of this process.

Table 9: Criteria, indicators, and scoring used for prioritising mitigation technologies in the transportation sector

Criteria	Indicators	Description	Scoring Scale
Cost of Technology	Capital	Costs associated with purchasing fixed assets.	0 – Very High
			25 – High
			50 – Moderate
			75 – Low
			100 – Very Low
	Operational & Management	Cost associated with operating and maintaining a technology, which may include, but not be limited	0 – Very High
			25 – High
			50 – Moderate

		to, the direct cost for regular maintenance, repair, spare parts, and administration.	75 – Low 100 – Very Low
Economic Benefits	Sustainability	Supporting long-term economic growth, and/or supporting affordable modes of transport, including electric and environmental friendly vehicle.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
	Trigger Investment	Attract government, private sector and/or donors' interest to invest in the implementation of respective technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Social Benefit	Social Inclusion and Equity	Fair access and equality of opportunity and advancement for everyone regardless their socio-economic.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
	Reliability	The respective technology is trustwhorty and believed because of working or performing well.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Environmental Benefit	Air quality improvement	Reduction of air pollution into the atmosphere from the respective introduced technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Climate-related Benefit	Reduce GHG Emission	Reduction the quantity of GHG emissions into the atmosphere from the respective introduced technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Institutional/implementation	Applicability and Replicability	The fact or quality of applying the technology to a local context, and ability	0 – Very Low 25 – Low 50 – Moderate

		of replicating to anywhere in the country.	75 – High 100 – Very High
Political	Relevance to national policies/plans and priority	The technology aligns with the national policies, plans and/or priorities.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High

Table 10: Weighting criteria used for prioritising mitigation technologies in the transportation sector

Criteria	Indicators	Weighting 1	Weighting 2
Cost of technology	Capital (C)	15%	10%
	Operational & Management (O&M)	5%	10%
Economic Benefits	Sustainability (S)	10%	10%
	Trigger Investment (TI)	5%	10%
Social Benefits	Social Inclusion and Equity (SIE)	10%	10%
	Reliability (R)	10%	10%
Environmental Benefits	Air Quality Improvement (AQI)	10%	10%
Climate-related	Reduce GHG Emission (RGHGE)	15%	10%
Institutional/implementation	Applicability and Replicability (A&R)	10%	10%
Political	Relevance to National Policies/Plans and/or Priority (RNP)	10%	10%
Total		100%	100%

3.5 Results of technology prioritisation for transportation sector

The results of the MCA exercise to prioritise technologies for transportation sector using weighting 1 are shown in Table 11. Meanwhile, the scoring matrix showing scores and weights is presented in Table 21 (Annex III). Due to the lack of data, the team decided to provide a scoring scale (see Table 9) for stakeholders to score, instead of using normalization.

Hence, scores are given based on the TFS and experiences using the scoring scale, then the final score (or result) given is the sum of its scores for each criterion multiplied by the corresponding weights (see Table 10). Technologies with the highest final score are the preferred option. The scoring process was conducted at the TNA consultation workshop on the 10 January 2023.

During the participatory process, the sensitivity analysis of technology ranking was carried out as some stakeholders requested to consider re-weighting the criteria. The procedure consisted of involved stakeholders experimenting with changes to criteria weight and evaluating their effects on previous results. Hence, the result of prioritization exercise for transportation sector using weighting 2 is presented in Table 12.

As part of the selection process, the involved stakeholders agreed to discuss together and reached an agreement. Hence, the technologies that are prioritized for carrying out Barrier Analysis and Enabling Framework (BAEF) and developing Technology Action Plan (TAP) are:

1. Develop pollution control Decree-Law
2. Low carbon development strategy
3. Research on installing solar system-based charging stations
4. Public transport maximization

Table 11: Results of the prioritisation exercise for transportation sector using Weighting 1

Technologies	Cost		Benefits						Local Context		Total Score	Ranking
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political		
Indicators	C	O & M	S	TI	SIE	R	AQI	RGHGE	A & R	RNP		
Biofuel and Biomass potential	750	500	250	125	250	250	750	1125	500	500	5000	**8th**
Promotion of non-motorized transport	750	375	500	250	750	500	1000	1500	750	750	7125	**5th**
Introduction of Bus rapid transit (BRT)	375	250	500	375	750	750	750	1125	750	750	6375	**6th**
Low carbon development	1500	500	500	500	750	750	1000	1500	500	1000	8500	**2nd**

strategy												
Develop Pollution Control Decree-Law	1500	500	750	375	750	1000	1000	1500	1000	1000	9375	**1st**
Public transportation maximization	375	375	750	375	1000	1000	750	1125	1000	1000	7750	**4th**
Promotion of electric vehicle	1125	500	250	125	250	500	750	1125	500	250	5375	**7th**
Research on installing solar system-based charging station	1500	500	500	250	500	750	1000	1500	1000	1000	8500	**3rd**

Table 12: Results of the prioritisation exercise for transportation sector using Weighting 2

Technologies	Cost		Benefits						Local Context		Total Score	Ranking
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political		
Indicators	C	O & M	S	TI	SIE	R	AQI	RGHGE	A & R	RNP		
Biofuel and Biomass potential	500	1000	250	250	250	250	750	750	500	500	5000	**8th**
Promotion of non-motorized transport	500	750	500	500	750	500	1000	1000	750	750	7000	**5th**
Introduction of Bus rapid transit (BRT)	250	500	500	750	750	750	750	750	750	750	6500	**6th**
Low carbon development strategy	1000	1000	500	1000	750	750	1000	1000	500	1000	8500	**2nd**
Develop	1000	1000	750	750	750	1000	1000	1000	1000	1000	9250	**1st**

Pollution Control Decree-Law												
Public transportation maximization	250	750	750	750	1000	1000	750	750	1000	1000	8000	**4th**
Promotion of electric vehicle	750	1000	250	250	250	500	750	750	500	250	5250	**7th**
Research on installing solar system-based charging station	1000	1000	500	500	500	750	1000	1000	1000	1000	8250	**3rd**

Chapter 4: Technology prioritisation for agriculture, land use and forestry sector

4.1. GHG emissions/cc vulnerabilities and existing technologies of agriculture, land use and forestry sector

The 2006 IPCC GL classifies the Agriculture, Forestry, and Other Land Use (AFOLU) sector into three categories: 3A Livestock, 3B Land, and 3C Aggregate sources and non-CO2 emissions sources on land. This section only focuses on category 3B, which is Forestry and Other Land Use (FOLU) sector.

In this sector, GHG emission/removal was classified into the six IPCC land use categories, in which land is categorized, lands remaining in a land use category, and lands converted. Therefore, 12 categories are used to classify the emission/removal from Land Use Change and Forestry (LUCF):

1. Forest land remained as forest
2. Land converted to forest land
3. Cropland remained cropland
4. Land converted to cropland
5. Grassland remained grassland
6. Land converted to grassland
7. Wetlands remained wetlands
8. Land converted to wetlands
9. Settlements remained settlements
10. Land converted to settlements
11. Other land remained other lands
12. Converted to other lands

The IPCC GL identified three (3) GHGs that fall under the category of LUCF: CO_2, CH_4, and N_2O. However, only the estimated CO_2 emissions will be discussed in this section.

The estimated GHG emissions and removals from LUCF can be seen in Figure 11. Between 2005 and 2015, CO_2 emissions and removal fluctuated with an annual average emission of 1,635 Gg CO_2. Emissions took place in 2005 and the period of 2007–2013, however, there was a net sink in 2006, 2014, and 2015 since there were no further forest degradations on the remaining forest land from 2005–2006, 2013–2014, and 2014–2025.

In 2015, the net sink for CO_2 was 1,479 Gg, it increased by 1,781 CO_2 since 2005, increase by 1,7581 CO_2 compared to 2010, and increased by 34 CO_2 compared to the previous year. Without forests and other land use, the net GHG emissions in Timor-Leste in 2015 would have been approximately 40 percent more.

Figure 11: GHG emissions and removal from forestry and other land use (Gg CO_{2e}) for the 2000-2015 period

Source: SNC, 2020

Additionally, Table 13 provides a summary of the key category analysis for the forestry and other land use (FOLU) sector. According to the table, GHG emissions from forest remaining forest lands converted to grass, and lands converted to other lands as key categories because their total contribution to total GHG emissions reaches 95%.

Table 13: Key category analysis for all sources in forestry and other land use (FOLU) sector

Code	Category	Total GHG Emissions (Gg CO2e)	Level/Rank	Cumulative
3B1a	Forest remaining Forest	1,607.24	92.59%	92.59%
3B3b	Lands to Grassland	118.98	6.85%	99.45%
3B6b	Lands to Otherland	8.35	0.48%	99.93%
3B2b	Lands to Cropland	1.19	0.07%	100.00%
3B1b	Lands to Forest	0.02	0.00%	100.00%
3B2a	Cropland remaining Cropland	0.00	0.00%	100.00%
3B3a	Grassland remaining Grassland	0.00	0.00%	100.00%
3B4a	Wetland remaining Wetland	0.00	0.00%	100.00%
3B4b	Lands to Wetland	0.00	0.00%	100.00%
3B5a	Settlement remaining Settlement	0.00	0.00%	100.00%
3B5b	Lands to settlement	0.00	0.00%	100.00%
3B6a	Otherland remaining Otherland	0.00	0.00%	100.00%
Total		666		

Source: SNC, 2020

4.2. Decision context

Most of the land in Timor-Leste is covered with forest ecosystems. According to the National Directorate for Forestry, Watershed Management, and Reforestation's (NDFWMR) 2010 land use and cover assessment, the forest continues to be the greatest land cover in the nation, accounting for roughly 932 thousand ha or 60% of the total land area (see Table 14). Grassland and shrubs come in second place, accounting for around 27% of the total land area. The settlement only makes up 0.2% of the entire land area; the rest areas are barren ground, rice fields, and dry farms, which together make up around 3.3%, 2.8%, and 1.5% of the total land area, respectively.

Table 14: Land use and land cover of Timor-Leste in 2010

IPCC Category	Land Cover	Area (ha)	Percent
Forest Land	Dense Forest[a]	312,930.67	21.2%
	Sparse Forest[a]	556,199.74	37.7%
	Very Sparse Forest[a]	63,173.45	4.3%
Grassland	Grassland/Shrubs	403,247.22	27.4%
Crop Land	Rice Field	41,387.36	2.8%
	Dry Farm	22,152.57	1.5%
Settlement	Settlement	2,988.57	0.2%
Other Lands	Water Body	22,877.31	1.6%
	Bare Land	48,717.01	3.3%

Source: SNC, 2020

At this time, there is still a good proportion of dense forest remaining, but relatively large areas are rare, with the remaining dense forest being primarily scattered across the country. There are almost half of the total lands are classified as mosaic land uses with distributed forest lands and non-forest lands, including grasslands, cultivation lands, and residential areas. As a result, the majority of forest areas, including dense forests in Timor-Leste, are easily accessible, and therefore susceptible to logging. The majority of forests have suffered significant degradation due to intensive logging, firewood extraction, and grazing. Land degradation and deforestation have affected Timor-Leste's indigenous trees, including teak, mahogany, and sandalwood. This condition also causes soil degradation, a decrease in groundwater, threats to wildlife, and decreases in food sources.

In Timor-Leste, 70% of the land area has a slope of over 26%, which is home to the majority of rural households. In most cases, soil erosion and limited moisture retention lead to degrading land resources. This increases the likelihood of food shortages and adds to low yields. Moreover, the majority of farmers still engage in unsustainable agricultural practices such as cultivation on steep slopes, shifting cultivation or slash-and-burn, uncontrolled grazing on public land, and recurring forest fires. These practices result in leaching, which eventually causes land degradation due to water and wind erosion, excessive runoff, and other factors.

Timor-Leste's soils have been degraded for many years because of long-term 'slash and burn' agriculture, in which practically all organic matter on the surface of the soil is burned before planting. In general, forest loss and land cover changes are primarily caused by deforestation by farmers in order to expand their crop production areas.

The Timor-Leste Strategic Development Plan (2011 – 2030) highlights that "the sustainability of Timor-Leste's forests is essential for families who rely on forests for firewood for income generation, for farmers who suffer as a result of erosion caused by deforestation and damage to water catchments, and for all Timorese who value their natural beauty." Additionally, the National Policy on Forest of Timor-Leste 2017 – 2030 also emphasizes that "the protection of national forests and their ecological services is a fundamentally important aspect of land-use planning since effective and lasting forest protection cannot be achieved in relation to other aspects of forest development."

Furthermore, Article 26 of Environment Basic Law (Decree-Law NO 26/2012) requires States "by setting out and implementing an integrated policy, to ensure the conservation, protection, sustainable use and rehabilitation of the soil and subsoil to prevent its degradation, erosion and contamination and to ensure its productive capacity." In establishing an integrated soil and subsoil management plan, it is important to consider:

a) The prevention and reduction of land degradation
b) The rehabilitation of partially degraded land
c) The recovery of degraded land.

Based on the above rationale, the government of Timor-Leste will promote effective agricultural practices, climate-smart agriculture, agroforestry, composting, and community-led rehabilitation of degraded land. This will entail continual multi-stakeholder collaboration, stable financial support, and best practices developed to promote agricultural productivity, livelihoods, and food security. This commitment is mentioned in the Nationally Determined Contribution (NDC) and aligned with the Second National Communication (SNC) which also states that potential mitigations in the Forestry and Other Land Use (AFOLU) sector are:

- Reducing GHG emissions from livestock through biogas and composting activities
- Reducing slash-and-burn practices by introducing permanent agriculture with improved management practices, while in forestry are mainly from the development of agroforestry and community forestry on degraded land.

As mentioned in the previous chapter, the main objective of TNA is to identify and analyse EST that have a synergetic relationship with the impact of climate change and GHG emissions in Timor-Leste within national development strategies. Hence, as part of a country-driven approach, the TNA intends to identify and determine the most appropriate technologies for Timor-Leste's agriculture, land use and forestry.

4.3. An overview of possible mitigation technology options in the agriculture, land use and forestry sector and their mitigation/vulnerability reduction potential and other co-benefits

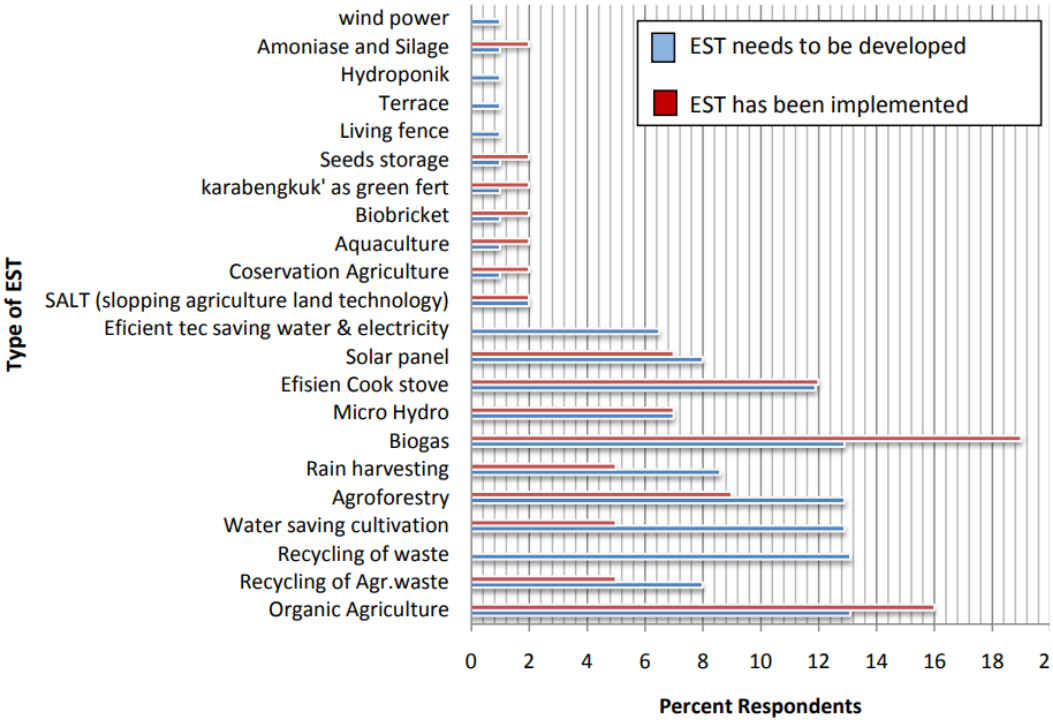
Timor-Leste's forests and other land uses offer the greatest potential for mitigating climate change, while at the same time providing high levels of climate resilience. According to the SNC, the amount of GHG emissions is predicted to reach 254 Gg CO_{2e}, and this pace of emissions might be decreased by roughly 30% (1,565 Gg CO_{2e}) through policies. One of the key mitigation measures proposed in the SNC document is the development of agroforestry and community forestry on degraded land.

As stated in the Timor-Leste Strategic Development Plan (2011 – 2030), measures to improve sustainable land management, conserve and rehabilitate forests, and develop sustainable forestry practices include:

- Implementing programs to reduce forest or grass burning during the dry season
- Undertaking reforestation in all degraded areas, particularly in sloping areas around Dili
- Controlling actions that cause the degradation of forests through enforcing environmental and forest regulations

Additionally, Timor-Leste has conducted a survey on Environmentally Sound Technology (EST) that covers various aspects of the methodology used for assessing technology needs and analysing the survey's responses such as technology needs, enabling conditions for technology transfer, the needs for capacity building for technology transfer, international support for Timor-Leste in technology transfer, and the status of Research and Systematic Observation (RSO) in Timor-Leste. Figure 12 shows a list of technologies that need to be developed and the one that has been implemented by the responding institutions. Several technologies related to the agriculture, land use and forestry are also included in this figure.

Figure 12: Type of EST need to be developed and the one that has been implemented by the responding institutions



Source: Survey of environmental sound technology transfer and research and systematic observation on climate, 2013

According to the Final Country Report of the Land Degradation Neutrality Target Setting Programme in Timor-Leste (2018), Timor-Leste is willing to move toward a national and international commitment within the context of land degradation neutrality with an emphasis on forests. Timor-Leste's forests have been an important resource for its communities, and the declining forest cover undermines efforts toward sustainable development.

Timor-Leste government has been implementing various projects and programs to reduce land degradation, including conserving natural resources and providing alternative livelihoods for rural communities. These projects and programs include:

- Reforestation
- Forest rehabilitation
- Protection and management of forest products and resources
- Establishment and management of watershed and protected areas
- Sustainable agroforestry and intercropping of fruit trees

For the TNA project, the long list of technologies for the agriculture, land use and forestry sector illustrated in Table 15 are gathered from various existing national policies and strategies such as NSDP 2011 – 2030, NDC 2022 – 2030, SNC, Final Country Report of the Land Degradation Neutrality Target Setting Programme in Timor-Leste, and other project documents that have been implemented by both national and international agencies. Moreover, the overview of technology for this sector and the climate change mitigation benefits are shown in Table 16. The list was shared with the TNA coordinator, the National Directorate for Climate Change (NDCC), and the General Directorate of Agriculture and its line directors. A list of additions was discussed and approved as appropriate during the consultation workshop. A list of seven (7) technologies was agreed, and the prioritised technologies with a more comprehensive fact sheet attached in Appendix I.

Table 15: Long list of technologies options and descriptions for the agriculture, land use and forestry sector

No.	Technologies	Description
1.	Cover crop	Cover crops are fast growing crops that are planted between periods of regular crop cultivation. They prevent soil from eroding by covering the soil's surface, and if they are leguminous, they also fix nitrogen. When ploughed under, they provide humus and carbon to the soil, as well as nitrogen for the subsequent crop. The measure involves cultivating subtropical legumes like velvet beans (*Lehe* in tetum). Lehe is a robust vine that grows in the area. It has been proven to provide effective ground cover and organic mulch for subsequent crops, which can significantly cut down on weeding time. The vines and leaves also provide organic matter to the soil, while the beans are a normal part of the Timorese diet. Additionally, the leaf can serve as a source of protein for animal feed.
2.	Afforestation and reforestation	Reforestation is a powerful tool to mitigate climate change as forests reduce the amount of CO_2 in the atmosphere. Plants capture it during photosynthesis and hold it in their tissue, leaves, and roots, putting oxygen back into the atmosphere. By doing this, it helps regenerate the earth and increase soil nutrients; it combats desertification and promotes biodiversity**.** In Timor-Leste, Afforestation and reforestation programmes mainly in the most disaster-prone and degraded areas involve: - **Nursery establishment**: Use the local material such as bamboo, palm leaves, woods for construction of nursery in the demonstration plots. - **Nursery operation and seedling production**

		- **Tree planting** Eight potential mitigation measures have been assessed namely (i) planting of teak, (ii) rosewood, (iii) sandalwood, (iv) mahogany, (v) coffee and (vi) Candlenut for rotational management in shrub areas; (vii) bamboo for anticipation of high slope and landslide potential in Timor-Leste; and (viii) mangrove restoration on swampy shrub lands.
3.	Participatory land use planning	Participatory Land Use Planning (PLUP) is an interactive process in which local communities could discuss and determine how to manage the land and other natural resources in their locality. PLUP aims to encourage local communities to: • Develop village regulations/by-laws including rules on natural resource management in writing in addition to a future land use plan • Assist local communities in holding a traditional ceremony to institutionalize the village regulations in a traditional manner • Assist village leaders in monitoring the enforcement and implementation of the village regulations and future land use plan, to enable local communities to be a real manager of natural resources in their locality In Timor-Leste, PLUP has been successfully implemented by a number of local and international organizations.
4.	Sustainable terracing	Terrace is a soil conservation practice applied to prevent rainfall runoff on sloping land from accumulating and causing serious erosion. It includes drainage channels and vegetative reinforcement. About 60% of the land in Timor-Leste is sloping, so farming on an incline is a necessity. Without terracing and drainage systems the heavy rains wash away crops and cause large-scale erosion. Terraces help prevent landslides and ensure hillside farms have moist. Hence, it restores degraded land.
5.	Strengthening the Implementation of extension services	Agricultural extension refers to the services that provide rural people with the access to the knowledge and information they need to improve their production systems' productivity and sustainability, as well as their quality of life and livelihood. The agriculture extension services have been implementing in Timor-Leste for many years. However, the services need to be more strengthened by:

		• Providing basic equipment required for technical service • Providing training rural extension agents • Ongoing technical support and evaluation • Providing knowledge refreshers courses
6.	Agroforestry	Timor-Leste, the newest country and one of the least developed counties, has faced multidimensional challenges on land use management, including deforestation, land degradation, and poverty. The agroforestry system is recognized as one of the viable options for balancing the socio-economic needs and ecological functions of the lands in Timor-Leste. According to the UNDP, four different agroforestry models are common in Timor-Leste: 1. **Alley cropping** involves planting in the alley between rows of hedges/trees arranged according to contour lines. 2. **The trees-along border** pattern involves planting trees/shrubs along the border (hedgerow). 3. **Random mixers** involve irregularly spacing trees while planting and simultaneously growing the annual crop in stratum underneath. 4. **Alternate rows** involve planting trees in regular alternate rows and seasonal cultivation done in the space in between the rows
7.	SALT (Slopping Agricultural Land Technology)	SALT is a package technology on soil conservation and food production integrating different soil conservation measures in just one setting. This technology involves SALT 3 (Sustainable Agroforest Land Technology), which is a cropping system in which a farmer can incorporate food production, fruit production, and forest trees that can be marketed. The farmer first develops conventional. **The 10 steps of SALT:** 1. Make an A-frame 2. Locate contour lines 3. Prepare the contour lines 4. Plant seeds of nitrogen fixing hedge rows or shrubs 5. Cultivate alternate strips 6. Plant permanent crops 7. plant short – term crops 8. Trim nitrogen fixing hedge rows 9. Practice crop rotation

		10. Build green terraces

Table 16: Overview of technologies and the climate change mitigation benefits

No.	Technologies	Economic Benefits	Social Benefits	Environmental Benefits	Others
1.	Cover crop	Farmers' incomes will increase as food production increases.	Increase food security.	Restore degraded soil fertility after several cycles of slash and burn.	The technology aligns with Ministry of Agriculture and Fisheries (MAF) plans.
2.	Afforestation and reforestation	Contribution to economic growth and job creation.	Improve livelihood for people working in the forestry sector.	Rehabilitate degraded land and reduce GHG emissions.	The technology aligns with SNC, NDC and NCCP.
3.	Participatory land use planning	Job creation and increase farmer's profit.	Inclusive land-use decision making.	Protect existing forest and land resources.	The technology aligns with NDC.
4.	Sustainable terracing	Farmers' incomes will increase as crop productivity increases.	Increase food security.	Prevent landslides by keeping the soil moist and healthy with compost and mulch.	The technology aligns with the NDC and EST survey.
5.	Strengthening the Implementation of extension services	Increase profitability and promote job creation.	Increase local farmers knowledge in increase productivity.	Train farmers on how to deal with climate change and solutions to help GHG emissions.	The technology aligns with the SNC and MAP's priorities.
6.	Agroforestry	Increase profits by increasing plant diversity	Increase soil carbon greatly benefits	Increase carbon sequestration	The technology aligns with the

		and improving agricultural productivity.	agricultural productivity and sustainability.	and prevent land degradation and soil erosion.	NSDP 2011-2030, SNC, NDC.
7.	SALT (Slopping Agricultural Land Technology)	Increase Job creation and increase farmer's income.	Increase productivity of slopy land, and improved use of land by using hillside farms.	Enrich the soil and reduce soil erosion and replace the eroded hillside with terraced green landscape.	The technology aligns SNC and NDC.

4.4. Criteria and process of technology prioritisation for agriculture, land use and forestry sector

The above long-listed technologies were prioritized during the one-day workshop of TNA stakeholders, on the same date as the previous sector. The technology prioritization was conducted using the Multi-Criteria Analysis (MCA) method - a tool that is frequently used in the decision-making process, including to rank possibilities or narrow the field of potential choices. The entire process for prioritizing the technologies follows the same method as mentioned in sub-section 3.4. In the agriculture, land use and forestry sector, each technology was comprehensively discussed, and some changes were made to some technologies. Two technologies (urban forestry and ecosystem restoration) that were on the long list of technologies were eliminated after discussion by the stakeholders since they are not entirely relevant to the sector. Once the long-list technologies were agreed upon, the stakeholders continued to validate and weigh the criteria.

The consultant suggested the criteria that reflect country development priorities based on the desk review and one-on-one consultation. During the consultation workshop, the respective stakeholders discussed the identified criteria and indicators and validated them. Table 17 shows the criteria, indicators, and scoring scale used in the prioritizing technology exercise by the stakeholders. The performance matrix was established, and scoring was conducted by evaluating the performance of each technology against each of the criteria. All stakeholders involved in the agriculture, land use and forestry sector used Technology Fact Sheets (TFS) and their collective experiences to discuss each criterion. All stakeholders involved in the scoring technologies process made the decision to consult one another and reach a decision.

Stakeholders continued to develop the weighting criteria after the scoring phase by using a consensus-based decision-making approach. Table 18 displays the weighting factors that were

utilized to prioritize mitigation technologies. Throughout this process, all of the technology factsheets as well as the experiences of the different stakeholders were discussed.

Table 17: Criteria, indicators, and scoring used for prioritising mitigation technologies in transportation sector

Criteria	Indicators	Description	Scoring Scale
Cost of Technology	Capital	Costs associated with purchasing fixed assets.	0 – Very High 25 – High 50 – Moderate 75 – Low 100 – Very Low
	Operational & Management	Cost associated with operating and maintaining a technology, which may include, but not be limited to, the direct cost for regular maintenance, repair, spare parts, and administration.	0 – Very High 25 – High 50 – Moderate 75 – Low 100 – Very Low
Economic Benefits	Job creation	New employment opportunities created by the introduction of a particular technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
	Improve economic performance	Aspects of increasing productivity as well as generating interest and demand in the market for its output.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Social Benefit	Food security	Reliable access to a sufficient safe and nutritious food by the introduction of a particular technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
	Capacity development	Level of knowledge and skills of national workforce required to sustain satisfactory operation of specific technologies.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High

Environmental Benefit	Restore and protect ecosystem services	The ecosystem services are restored and protected to benefit people and planet by the introduction of a respective technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Climate-related	Reduce GHG Emission	Reduction the quantity of GHG emissions into the atmosphere from the respective introduced technology.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Institutional/implementation	Applicability and Replicability	The fact or quality of applying the technology to a local context, and ability of replicating to anywhere in the country.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High
Political	Relevance to national policies/plans and priority	The technology aligns with the national policies, plans and/or priorities.	0 – Very Low 25 – Low 50 – Moderate 75 – High 100 – Very High

Table 18: Weighting criteria used for prioritising mitigation technologies in the agriculture, land use and forestry sector

Criteria	Indicators	Weighting 1	Weighting 2
Cost of technology	Capital (C)	15%	10%
	Operational & Management (O&M)	10%	10%
Economic Benefits	Job Creation (JC)	5%	10%
	Improve Economic Performance (IEP)	10%	10%
Social Benefits	Food Security (FS)	10%	10%
	Capacity Development (CD)	15%	10%
Environmental Benefits	Restore and Protect Ecosystem Services (RPES)	15%	10%
Climate-related	Reduce GHG Emission (RGHGE)	5%	10%
Institutional/implementation	Applicability and Replicability (A&R)	5%	10%
Political	Relevance to national policies/plans and priority (RNP)	10%	10%
Total		100%	100%

4.5. Results of technology prioritisation for agriculture, land use and forestry sector

The results of the MCA exercise to prioritise technologies for agriculture, land use and forestry sector using criteria weight are shown in Table 19. Meanwhile, the scoring matrix showing scores and weights is presented in Table 23 (Annex III). Due to the lack of data, the team decided to provide a scoring scale (see Table 17) for stakeholders to score, instead of using normalization.

The score was determined based on the TFS and stakeholder's experiences using the scoring scales, and then the final score (or result) is the summation of its scores for each criterion multiplied by the corresponding weights (see Table 18). The preferred technological option essentially has the highest score. The scoring process was conducted at the TNA consultation workshop on the 10 January 2023.

During the participatory process, the sensitivity analysis of technology ranking was not carried out during stakeholders meeting as they agreed on their chosen weight and preference allocation. In the end, the consultant decided to perform sensitivity analysis using the weighting 2 and the result is presented in Table 20. Similarly, the scoring matrix showing the scores and weights are listed in Table 24 (Annex III).

As part of the selection process, the involved stakeholders agreed to discuss together and reached an agreement. Hence, the technologies that are prioritised for carrying out Barrier Analysis and Enabling Framework (BAEF) and developing Technology Action Plan (TAP) are:

1. Agroforestry
2. Participatory Land Use Planning
3. SALT (Slopping Agricultural Land Technology)
4. Cover Crop

Table 19: Results of the prioritisation exercise for agriculture, land use and forestry sector using weighting 1

Technologies	Cost		Benefits						Local Context		Total Score	Ranking
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political		
Indicators	C	O & M	JC	IEP	FS	CD	RPES	RGHGE	A & R	RNP		
Cover crop	375	750	375	750	750	1125	1500	500	500	500	7125	4th
Afforestation and reforestation	375	250	375	750	750	750	1500	500	375	1000	6625	5th
Participatory land use planning	750	500	250	750	750	1500	1500	500	375	1000	7875	2nd
Sustainable terracing	375	250	375	750	750	1125	1125	375	375	1000	6500	6th
Strengthening the Implementation of extension	375	250	375	750	750	1125	1125	375	375	1000	6500	6th

services												
Agroforestry	750	500	375	1000	1000	1500	1125	375	375	1000	8000	1st
SALT (Slopping Agricultural Land Technology)	375	250	375	1000	1000	1125	1500	375	375	1000	7375	3rd

Table 20: Results of the prioritisation exercise for agriculture, land use and forestry sector using Weighting 2

Technologies	Cost		Benefits						Local Context		Total Score	Ranking
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political		
Indicators	C	O & M	JC	IEP	FS	CD	RPES	RGHGE	A & R	RNP		
Cover crop	250	750	750	750	750	750	1000	1000	1000	500	7500	4th
Afforestation and reforestation	250	250	750	750	750	500	1000	1000	750	1000	7000	5th
Participatory land use planning	500	500	500	750	750	1000	1000	1000	750	1000	7750	2nd
Sustainable terracing	250	250	750	750	750	750	750	750	750	1000	6750	6th
Strengthening the Implementation of extension	250	250	750	750	750	750	750	750	750	1000	6750	6th

services												
Agroforestry	500	500	750	1000	1000	1000	750	750	750	1000	8000	1st
SALT (Slopping Agricultural Land Technology)	250	250	750	1000	1000	750	1000	750	750	1000	7500	3rd

Chapter 5: Summary and Conclusions

The Technology Needs Assessment (TNA) is a process of identifying and analysing priority technology needs while meeting national sustainable development goals and priorities. It was a country-driven participatory, gender-inclusive process involving relevant stakeholders. Multiple factors were considered when prioritizing climate change mitigation technologies. For each of the main sectors that were selected, Timor-Leste's policies, plans, and strategies provided direction on which sectors and technologies should be chosen.

The sectors were selected based on the Timor-Leste GHG emissions status, including taking into account the mitigation measures listed in the NDC. Hence, the agreed sectors of mitigation to be included in the TNA process are:

1. Transportation sector
2. Agriculture, land use and forestry sector

The long list of technologies per sector was elaborated by reviewing and revising the existing institutional framework, policies, plans, and strategies, as well as by consulting with key stakeholders. The technologies were discussed and approved during the consultation workshop before confirming the criteria and assigning weights for the identified criteria for the MCA process. The process relied greatly on the expertise and experiences of the stakeholders who established a common understanding of how technologies should be evaluated.

For each sector, the following technologies were identified as the most preferred options;

Transportation sector

1. Develop pollution control decree-law
2. Low carbon development strategy
3. Research on installing solar system-based charging stations
4. Public transport maximization

Agriculture, land use and forestry sector

1. Agroforestry
2. Participatory Land Use Planning
3. SALT (Slopping Agricultural Land Technology)
4. Cover Crop

The eight (8) technologies selected for the two sectors were validated by stakeholders participating at the TNA consultation workshop on the 10 January 2023. The Barrier Analysis and Enabling Framework (BAEF) and the development of Technology Action Plans (TAP) will be conducted for the deployment and diffusion of the prioritized technologies.

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Annexes

Annex I: Technology Factsheets for selected technologies

I. Transportation Sector

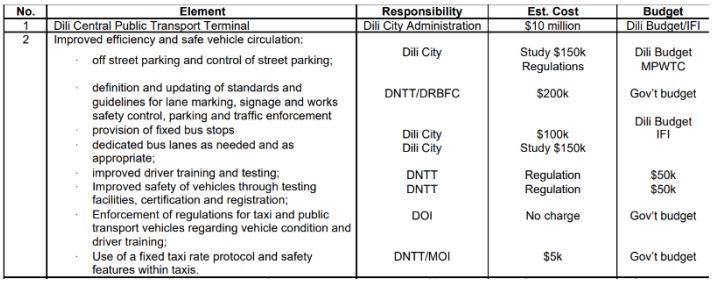
Technology	Low Carbon Development Strategy
Introduction	Low-carbon development plans also can be called green growth plans, climate change plans and strategies or low-emission development strategies (LEDS). A low-carbon development plan guides countries down a path towards low carbon green growth. Having national targets and goals for low carbon green growth sends a signal of credibility and reliability, which attracts investment, promotes technology innovations, improves energy efficiency, encourages clean energy sources, and creates jobs and business opportunities as a result.
Features	Timor-Leste is fully engaged to take more ambitious climate actions on low carbon development path with no emission reduction target. The ambition would be primarily focusing on enhancing strategies, plans and actions for low carbon development reflecting its national circumstances based on Article 4.6 of the Paris Agreement. Although the components of a low-carbon development plan will differ due to the country context and its development priorities, these plans may consider inclusion of the following elements: • Vision – a long-term and shared vision is required to guide policies over the long run and to gather actors around a common purpose • Assessments – this may include greenhouse gas inventories and projections to understand which are the major emitting sectors, vulnerability assessments to understand what the impacts of climate change and mitigation potential and costs would be • Short- to long-term targets and goals (economy-wide or sector specific) • Policy measures • Specific programmes and projects • Implementing plans • Funding mechanisms • Investment plans

	• Institutional capacity and coordinating mechanisms • Monitoring and evaluation plans The process for developing and implementing a low-carbon development plan requires many steps and the involvement of many actors.
Cost to implement mitigation options/operation/maintenance cost	Cost associated with consultants, workshop and consumables which is approximately 25- 30K.
GHG Mitigation Potential	It will support the Timor-Leste's development goals in alignment with the Paris Agreement and the 1.5 degrees Celsius temperature goal.
Environmental Benefits	Low-carbon development strategies can be beneficial for prioritizing nationally appropriate mitigation actions, which are voluntary mitigation action proposals from developing countries to the UNFCCC for reducing CO2 emissions.
Economic benefits	- Promoting low carbon development path and to make finance flow for low carbon development and climate resilience development. - Low-carbon development plans can be a tool for assessing and identifying financing priorities and the required sources of funding.
Social Benefits	Low-carbon development strategies can provide important signals to the private sector on the direction for future investments, research, and development.
Institutional/implementation	Feasible
National status of technology/ Coherence with national development policies and priority	It aligns with NDC 2020 - 2030
Acceptability to local stakeholders	It was accepted by key stakeholders during consultation workshop.

Technology	Develop Pollution Control Decree-Law
Introduction	Article 33 of the Environmental Basic Law (Decree-law no. 26/2012) states that "*The release of greenhouse gases and other polluting substances into the atmosphere shall be reduced, controlled and maintained within the limits of quality and environmental emissions standards and other legislation in force."* The article of this law also outlines that "*All installations, machinery, equipment, methods of transport, construction or any other activity which may affect air quality shall be equipped with filters and specific devices to reduce and neutralise polluting substances, in accordance with the law."*
Features	Timor-Leste does not have vehicle emissions standard to reduce emissions and control pollution from vehicles in use. Currently, there is only a Decree-law no. 13/2011 that prohibits the import of light passenger and mixed vehicles that are more than 5 years old (from the date of their original manufacture to the date of import. The pollution control decree-law should have been in place before the vehicle emissions standard could be established. Therefore, the proposed pollution control decree-law must consider the provision of vehicle emission standard program that aims to reduce emissions and control pollution from motor vehicles in use. Stricter vehicle emission standards will promote higher efficiency.
Cost to implement mitigation options/operation/maintenance cost	Associated cost includes consultants, workshops, consultation, consumables, and public information and dissemination of decree-law. The estimated cost is around 30K.
GHG Mitigation Potential	The Decree-law will improve local air quality and/or to regulate the production of greenhouse gases in Timor-Leste, especially from transportation.
Environmental Benefits	Supports efforts in environmental protection, addressing climate change, and improving efficiency of energy resource use.
Economic benefits	- Net improvement in economic welfare - Savings on medical expenses for air pollution-related

	health problems.
Social Benefits	Reduced air pollution will improve public health and improve environmental conditions.
Institutional/implementation	Feasible
National status of technology/ Coherence with national development policies and priority	It aligns with NDC 2020 - 2030
Acceptability to local stakeholders	The initial technology was Vehicle Emission Standard, but it was changed during consultation workshop.

Technology	**Public Transport Maximization**
Introduction	An adequate public transportation system is essential to the smooth operation of any city, town, or rural area. Mass transit improvements are essential to promoting public transportation (at present, Microlet provides the service) and reducing modal-shift toward private cars.
Features	Around 60% of all passenger trips in Timor-Leste involve public transport, whether by taxi, bus, microlet or angguna. A further 20% of passenger trips are by motorcycle and the 20% balance by car and truck. This technology involves optimizing the accessibility and availability of public transport modes (bus, angunna, microlet, taxi) from the perspective of both the users and the operators. Priorities will be set on services and facilities: 1. Safe, comfortable vehicles, 2. Safe, competent drivers 3. Safe, convenient, and comfortable on-road facilities 4. Safe, convenient comfortable terminal facilities 5. Convenient, affordable, and reliable schedule services 6. Control overloading 7. Mode optimization

Cost to implement mitigation options/operation/maintenance cost	**Table 7 Public Transport Budget and Sources**  This estimated cost retrieved from Transport Sector Master Plan (2018, p.41).
GHG Mitigation Potential	Mitigate GHG emissions (CO, SOx,NOx, particulates, CO2). The more passengers that are riding a bus or microlet, the lower the emissions per passenger mile.
Environmental Benefits	Reduction of carbon emissions, air pollution (which results in better air quality) and congestion on roads—including traffic.
Economic benefits	- Maximising economic productivity - The efficient connection of wealth and labour to the marketplace - Maximising opportunities for individuals, business, and government to increase income and asset value
Social Benefits	- Cheaper transport for the nation and for individuals, especially people on low incomes; a more pleasant city in which to live and move around; healthier and more connected residents. - Equality of access to employment and services
Institutional/implementation	It is possible to achieve if there is a great coordination among government and operators, and financial resources.
National status of technology/ Coherence with national development policies and priority	- It aligns with NDC, SNC, Dili Urban planning, Transport sector master plan's priorities. - Supports the viewpoint of "Sustainability" in DMA Vision 2030
Acceptability to local stakeholders	It was accepted by the stakeholders

No.	Element	Responsibility	Est. Cost	Budget
1	Dili Central Public Transport Terminal	Dili City Administration	$10 million	Dili Budget/IFI
2	Improved efficiency and safe vehicle circulation:			
	· off street parking and control of street parking;	Dili City	Study $150k Regulations	Dili Budget MPWTC
	· definition and updating of standards and guidelines for lane marking, signage and works safety control, parking and traffic enforcement	DNTT/DRBFC	$200k	Gov't budget
	· provision of fixed bus stops	Dili City	$100k	Dili Budget IFI
	· dedicated bus lanes as needed and as appropriate;	Dili City	Study $150k	
	· improved driver training and testing;	DNTT	Regulation	$50k
	· Improved safety of vehicles through testing facilities, certification and registration;	DNTT	Regulation	$50k
	· Enforcement of regulations for taxi and public transport vehicles regarding vehicle condition and driver training;	DOI	No charge	Gov't budget
	· Use of a fixed taxi rate protocol and safety features within taxis.	DNTT/MOI	$5k	Gov't budget

Technology stations	Research on installing solar system-based charging
Introduction	Renewable energy is an important resource, which is widely available in nature. Timor-Leste has a range of renewable energy resources, such as solar, wind, hydro, and bioenergy. If properly managed, these resources could greatly contribute to TL's energy supply and consumption. Solar panel is considered to be the most replicated technology in Timor-Leste. The Ministry of Public Works, responsible for the area of electricity, during the period from 2020 to 2021, is installing 3,000 units of solar panels in family homes in remote and isolated areas of the country. Recently there are some electrical motorcycles (ojek) operating to serve as public passenger's transport, mainly in Liquiça, Manatuto and Lautem municipalities. Hence, Specific solar system-based charging stations should be developed to encourage the use of renewable energy and lower CO_2 emissions.
Features	Timor-Leste has been implemented and replicated environmentally sound technology as part of mitigation activities in sector energy. Solar panels can generate electricity that can use to charge the electric vehicle (EV). Photovoltaic (PV) charging is when sunlight is converted directly into energy, a system that is rapidly increasing in popularity for EV. Before installing a PV charging station, the charging station's feasibility must be studied. The proposed study also analyses the power reliability, energy cost, and CO2 emissions of a PV-powered charging station.
Cost to implement mitigation options/operation/maintenance cost	Associated cost include research (study), required materials/tools, consultants, workshop, consultation, and consumables. The estimated budget is in the range of 25K – 50K
GHG Mitigation Potential	Reduction in greenhouse gas (GHG) emissions, including CO2, CO, SO2, and NOX
Environmental Benefits	- Safe, Clean and Environmentally Friendly - Promote renewable energy consumption and reduce CO_2 emissions

Economic benefits	- Reducing fuel costs and shifting consumption away from imported oil to more locally produced electricity sources - Creating additional jobs in the municipality level - Energy-efficient, sustainable, and inexpensive method of using renewables, paving the way for increased usage of EVs and E-bikes
Social Benefits	- Convenience of charging at nearby stations - Provide a solution to the world's power shortage concerns, particularly in developing countries whose electricity infrastructure is not sufficiently resilient.
Institutional/implementation	The study can be implemented.
National status of technology/ Coherence with national development policies and priority	This complements the plans and recommendation mentioned in the NSDP 2011-2030, SNC, NDC
Acceptability to local stakeholders	It was accepted by key stakeholders

II. Agriculture, land use and forestry sector

Technology	**Cover Crop**
Introduction	Cover crops are fast growing crops that are planted between periods of regular crop cultivation. They prevent soil from eroding by covering the soil's surface, and if they are leguminous, they also fix nitrogen. When ploughed under, they provide humus and carbon to the soil, as well as nitrogen for the subsequent crop. In tropical climates like Timor-Leste, organic matter decomposes quickly, so it is important to produce very significant amounts and slowly decomposing soil surface cover materials (biomass) in order to produce enough and continuous organic mulch. Various cover crops have been tested by MAF in Timor-Leste, with the support of FAO. Based on the tests, Velvet bean (Mucuna pruriens), locally known as "lehe", is the only plant capable of producing adequate biomass to serve as a permanent soil cover – mulch. As a result, Lehe is the main cover crop promotes in its efforts to scale up the technology.
Features	This technology involves cultivating subtropical legumes like velvet beans (*Lehe* in tetum). Lehe is a robust vine that grows in the area. It has been proven to provide effective ground cover and organic mulch for subsequent crops, which can significantly cut down on weeding time. The vines and leaves also provide organic matter to the soil, while the beans are a normal part of the Timorese diet. Additionally, the leaf

	can serve as a source of protein for animal feed. These are the three main steps to consider when cultivating Lehe to open a grass land into cultivation without burning or ploughing: 1. **December - January:** *Lehe* seeds are planted (50 cm x 50 cm) at the beginning of the main rainy season into soko grassland, when the soil is already humid - *Lehe* grows fast and vines rapidly cover and suppress the soko grass; o Without sunlight, the grass eventually dies; 2. **May-June:** *Lehe* field is rolled using a 2-wheel or 4-wheel knife blade roller or slashed, when all the soko grasses have been suppressed; o *Lehe* grass dies and provides a thick mulch cover; 3. **June:** A food crop such as corn, beans or vegetables can be planted through the mulch (June). In this sequence, a grassland can be opened for cultivation without burning or ploughing. Besides, lehe does it at very low cost as labour is minimal, and tractor costs are minimal and can be dispensable.
Cost to implement mitigation options/operation/maintenance cost	Associated costs include equipment that is needed to carry out farming. operations that include direct seeding and crop residue conditions: - Direct seeding: Planting stick and/or rolling injector planter - Managing Lehe as an intercrop: Small sickle - Crop residue management: Knife rollers for 2- and 4-wheel tractors According to RAEBIA, the total cost is approximately $250 to $500 per hectare.
GHG Mitigation Potential	The cover crops help mitigating climate change. When main crops are not cultivated, they can absorb carbon and reduce emissions compared to keeping lands fallow.
Environmental Benefits	- Absorb carbon dioxide through photosynthesis and store the carbon in the soil - Restore degraded soil fertility after several cycles of slash and burn - Increase soil fertility: Increased yield without the use of additional farming inputs (such as fertilizers) is a proximate sign of fertile soil - Increased biodiversity and water quality - Allowed permanent cultivation of agricultural land
Economic benefits	- Creating new job opportunities - Farmers' incomes will increase as food production increases - Increased net benefits: higher yields with lower cost of production - Reduced fuel costs: fuel consumption for mechanized land preparation

	- Private sector investment in agricultural crops will be encouraged
Social Benefits	- Increased farmers income and food diversity - Increase food security: Using an improved maize variety and under-planting with Lehe will improve maize yields in the first year and almost double them in the second - Velvet beans are a normal part of the Timorese diet - Avoiding slash-and-burn practices and shifting cultivation
Institutional/implementation	Easy to implement
National status of technology/ Coherence with national development policies and priority	Introduction of velvet bean is one of the top priorities of Ministry of Agriculture and Fishery (MAF). The Technology aligns with SDP 2011-2030 and NDC.
Acceptability to local stakeholders	It was recommended by the Director general of MAF and agreed among stakeholders.

Technology	**Participatory Land Use Planning (PLUP)**
Introduction	Slash-and-burn, or swidden, agriculture poses one of the Timor-Leste's most serious threats to its natural resources. Once part of a sustainable rotational agriculture system used by local communities, it is now banned because of concerns surrounding its widespread and frequent use. However, due to weak government institutions and national laws, the practice persists. Indiscriminate and often uncontrolled burning in rural Timor-Leste contributes greatly to greenhouse gases and poor air quality. In rural Timor-Leste, indiscriminate and frequently unregulated burning is a major source of greenhouse gases and poor air quality. PLUP supports the sharing of knowledge and technology so that communities can set their own goals and objectives. PLUP aims to encourage local communities to: - Develop village regulations/by-laws including rules on natural resource management in writing in addition to a future land use plan. - Assist local communities in holding a traditional ceremony to institutionalize the village regulations in a traditional manner; and - Assist village leaders in monitoring the enforcement and implementation of the village regulations and future land use plan, to enable local communities to be a real manager of natural resources in their locality.
Features	PLUP is an interactive process to create an enabling environment in which village leaders can manage natural resources in a sustainable

	way with i) developments of Future Land Use Plan and village regulations, ii) official inauguration of the village regulations by Tara Bandu ceremony, and iii) regular monitoring on the enforcement of the village regulations. PLUP constitutes the following 10-step activities in the target villages. **Step 1:** Formation of a working group and preparation of a work plan **Step 2:** Exposure visit **Step 3:** Present land use mapping **Step 4:** Future land use planning **Step 5:** Review of traditional rules in the past **Step 6:** Preparation of draft village regulations **Step 7:** Consultation with local communities about a future land use plan and draft village regulations **Step 8:** Coordination with the relevant government offices for approval/endorsement **Step 9:** Traditional ceremony to announce the village regulations and future land use plan to local communities in and around the village **Step 10:** Monthly monitoring of the enforcement and implementation of the village regulations and future land use plan.
Cost to implement mitigation options/operation/maintenance cost	Depending on the type of work being done and where the village is located, the cost might be between US$ 15,000 and US$ 20,000 for Steps 1 through 9, and US$ 10,000 for 2-year monitoring and evaluation (Step 10) if national NGOs are being used for implementation.
GHG Mitigation Potential	Production forests, coffee plantations and/or orchards which can help mitigating GHG emissions.
Environmental Benefits	- Increase soil productivity, and prevent or minimize landslides - Protect the existing dense natural forests - Improve the degraded natural forests with a medium density by planting new seedlings - Convert the existing shifting cultivation farms into coffee plantations, orchards, and permanent farms with soil conservation measures/agroforest techniques
Economic benefits	- Creating new job opportunities - Farmers' incomes will increase as food production increases
Social Benefits	- Communities are building on traditional practices to achieve greater resilience and sustainability - prevent or resolve land use conflicts, to defend against land grabs - Inclusive land-use decision making
Institutional/implementation	PLUP is applicable to rural villages. It has been implemented by: - JICA: The Project for Community-Based Sustainable Natural

	Resource Management in the Democratic Republic of Timor-Leste - NGO RAEBIA - SeedChange partner
National status of technology/ Coherence with national development policies and priority	It aligns with Nature-Positive Growth and Transition (mainly in land used planning) listed in the NDC and MAF's plans.
Acceptability to local stakeholders	It was accepted by stakeholders.

Technology	**Agroforestry**
Introduction	Agroforestry is a land management system that integrates trees, agriculture crops, and animal farming in order to provide a diverse range of ecosystem services. In agroforestry, trees are integrated into farms and agricultural landscapes as part of a dynamic, ecologically based natural resources management system that increases social, economic, and environmental benefits for a wide range of land users. Agroforestry offers great potential for carbon sequestration. Timor-Leste, the newest country and one of the least developed counties, has faced multidimensional challenges on land use management, including deforestation, land degradation, and poverty. The agroforestry system is recognized as one of the viable options for balancing the socio-economic needs and ecological functions of the lands in Timor-Leste.
Features	According to the UNDP, four different agroforestry models are common in Timor-Leste: 1. Alley cropping involves planting in the alley between rows of hedges/trees arranged according to contour lines. 2. The trees-along border pattern involves planting trees/shrubs along the border (hedgerow). 3. Random mixers involve irregularly spacing trees while planting and simultaneously growing the annual crop in stratum underneath. 4. Alternate rows involve planting trees in regular alternate rows and seasonal cultivation done in the space in between the rows Agroforestry has been around in Timor-Leste for many years. For example, the Xpand Foundation and its local partner Ho Musan Ida Foundation established the Ho Musan Ida (With One Seed) model over the course of the last nine years (HMIF). It is a 30-year self-sustaining community involvement program that helps rural Baguia

	administrative post's subsistence farmers reforest their land, store carbon in new trees, and sell the carbon on the global carbon market. Another example is Ai ba Futuru (Partnership for Sustainable Agroforestry – PSAF) - project co-financed by the EU and the German Federal Ministry for Economic Cooperation and Development, in collaboration with the Ministry of Agriculture and Fisheries (MAF). This 5-year project is targeting 4,000 marginalised households in 40 selected villages from the 4 municipalities, planting 3 million trees on approx. 6,000 hectares of land over the next 4 years.
Cost to implement mitigation options/operation/maintenance cost	Ai ba Futuru (Partnership for Sustainable Agroforestry – PSAF) 5-year project: €13.000.000.00.
GHG Mitigation Potential	Increased C sequestration - important element of a comprehensive strategy to reduce GHG emissions.
Environmental Benefits	- Improve land cover in agricultural fields in addition to providing carbon inputs (root biomass, litter and pruning) to the soil - Prevent land degradation and soil erosion
Economic benefits	- Increase profits by increasing plant diversity - Improve agricultural productivity - Increase carbon offset - Reduce the risk of crop failure and the need for fertilizers
Social Benefits	- Increasing soil carbon greatly benefits agricultural productivity and sustainability - contributes the supply of fodder for domesticated livestock and fuelwood for household energy - Local communities commonly prefer fruit trees such guava, avocado, etc. for domestic consumption as well as to generate cash income by selling in rural markets
Institutional/implementation	Ease to implement and replicability.
National status of technology/ Coherence with national development policies and priority	NDC, NSDP 2011-2030, SNC (replicated)
Acceptability to local stakeholders	It was accepted by stakeholders

<table>
<tr><th>Technology</th><th>SALT (Slopping Agricultural Land Technology)</th></tr>
<tr><td>Introduction</td><td>SALT is a package technology on soil conservation and food production integrating different soil conservation measures in just one setting.

Basically, SALT is a method of growing field and permanent crops in 3-meter to 5-meter-wide band between contoured rows of nitrogen fixing trees are tickly planted in double rows to make hedgerows. When a hedge is 1.5 to 2 meters tall, it is cut down to about 40 centimetres and cutting (tops) are placed in alleyways to serve as organic fertilisers.</td></tr>
<tr><td>Features</td><td>Characteristics of various SALT models
<table><tr><th>Production sys</th><th>SALT1</th><th>SALT 2</th><th>SALT 3</th><th>SALT 4</th></tr><tr><td>Also called</td><td></td><td>Small Agro-livestock Land Technology</td><td>Sustainable Agroforest Land Technology</td><td></td></tr><tr><td>Base crop</td><td>Staple food crops</td><td>Fodder crops</td><td>Trees</td><td>Fruit crops</td></tr><tr><td>Major product</td><td>Food grains</td><td>Meat, milk, manure</td><td>Fodder, fuel, timber</td><td>Fruits</td></tr><tr><td>Planting area</td><td></td><td></td><td></td><td></td></tr><tr><td>a. Staple food crop</td><td>75%</td><td>20%</td><td>20%</td><td>40%</td></tr><tr><td>b. Cash crop</td><td>25%</td><td>20%</td><td>20%</td><td>60%</td></tr><tr><td>c. Forage, fodder</td><td>-</td><td>40%</td><td>-</td><td>-</td></tr><tr><td>d. Forestry</td><td>-</td><td>20%</td><td>60%</td><td>-</td></tr></table>Source: Pratap and Watson (1994), ICIMOD

SALT 3 (Sustainable Agroforest Land Technology) is a cropping system in which a farmer can incorporate food production, fruit production, and forest trees that can be marketed. The farmer first develops conventional.

The 10 steps of SALT:
11. Make an A-frame
12. Locate contour lines
13. Prepare the contour lines
14. Plant seeds of nitrogen fixing hedge rows or shrubs
15. Cultivate alternate strips
16. Plant permanent crops
17. plant short – term crops
18. Trim nitrogen fixing hedge rows
19. Practice crop rotation
20. Build green terraces</td></tr>
<tr><td>Cost to implement mitigation options/operation/maintenance cost</td><td>Low-cost: The cost of implementing SALT will depend on the type of land, especially the slope of land and form of SALT being implemented. The cost will vary from USD 100 to USD 200 per hectare. Besides, implementation, appropriate funds are required for the purpose of capacity development and technology diffusion.</td></tr>
</table>

	JICA's experience with CBNRM projects suggests that a series of training courses targeting 30 farmers would cost around US$ 5,000, assuming that each training course included food and snacks. Additionally, the expenses for trainers and other operational expenditures will be needed for conducting the training courses. Based on NGO Raebia's experiences, the estimated cost will be around $20.000 – $30.000 for two years project, implementing in 5 villages.
GHG Mitigation Potential	Reduce the impact of agriculture (e.g. slash and burn technique) on climate and land & environment degradation.
Environmental Benefits	- To enrich the soil and reduce soil erosion and replace the eroded hillside with terraced green landscape - To conserve soil moisture
Economic benefits	- Job creation - increase farmer's income
Social Benefits	- To increase productivity of slopy land - Improved use of land by using hillside farms. Stabilizes and enriches the soil for crop production.
Institutional/implementation	It is a simple, applicable, low-cost, and timely method of farming upland. Simple to duplicate with little labour required, with an emphasis on small family farms. guarantees environmentally friendly, economically viable, and sustainable food production.
National status of technology/ Coherence with national development policies and priority	SNC
Acceptability to local stakeholders	It was accepted by stakeholders

Annex II: List of stakeholders involved and their contacts

I. One-on-one Consultation Stakeholders

No.	Name	Institution	Position	Email Contact
1.	Mr. Deolindo de Oliveira	National Directorate of Research, Ministry of Agriculture and Fishery (MAF)	National Director	deolindooliveira52@gmail.com
2.	Dr. Maria Odete do Ceú Guterres	General Directorate of Agriculture, Ministry of Agriculture and Fishery (MAF)	Director General	
3.	Mr. Rofino Soares Gusmão	National Directorate for Food Security and cooperation, Ministry of Agriculture and Fishery (MAF)	National Director	gerrandogusmao@gmaiil.com
4.	Mr. Zacarias Bosco & Mr. Mercuides de Sousa	The National Authority for Electricity (ANE, IP)	Technical Staffs	zacarias.bosco@ane.tl / desousamercuides@gmail.com
5.	Mr. Mateus Maia	NGO Raebia	Deputy	xistomartins@raebia.org / xmartins@up.edu.ph
6.	Arlindo Silveiro	Environmental Planning and Management, National Directorate of Pollution Control	Chief Department	arlindosilveira642@gmail.com / silveiralindu@yahoo.co.id
7.	Mr. Ego Lemos	Permatil	Executive Director	ego.lemos72@gmail.com
8.	Mr. Adão Soares Barbosa	Ministry of Foreign Affairs and Cooperation	Special Envoy and Ambassador for Climate Change	adaosoaresb@yahoo.com

II. Participants of Consultation Workshop

No.	Name	Institution	Type of Stakeholder
1.	Isaura Baptista Barros	Laudato Si Animators Timor-Leste (LSA-TL)	Youth group
2.	Flavia Padua	Laudato Si Animators Timor-Leste (LSA-TL)	Youth group
3.	Mercuides de Sousa	The National Authority for Electricity (ANE, IP)	Public Institution
4.	Zacarias Bosco	The National Authority for Electricity (ANE, IP)	Public Institution
5.	Julio R. S. da Cruz	The National Authority for Electricity (ANE, IP)	Public Institution
6.	Joana Belo	The Food and Agriculture Organization (FAO) Timor-Leste	UN Agency
7.	Carlos da Costa Ribeiro	National Centre for Professional Training (CNFP - Becora)	Vocational Training Centre
8.	Cristovão da Silva	HIVOS Timor-Leste	NGO
9.	Atanasio M. Pires	National Directorate of Biodiversity (NDB)	Government Institution
10.	Teresinha F. Ximenes	Laudato Si Animators Timor-Leste (LSA-TL)	Youth Group
11.	Arlindo Silveira	National Directorate for Pollution Control	Government Institution
12.	Americo S. de Carvalho	GDGA - SEA	Government Institution
13.	Dirce Freitas Mendes	Timorese Youth Initiative for Development (TYIFD)	Youth Group
14.	Ejalina Marques Cabral	LCOY Timor-Leste	Youth Group
15.	Justina dos Santos Gonçalves	National Directorate of Biodiversity (NDB)	Government Institution
16.	Dulce Gusmão	Delegation of the European Union to Timor-Leste	International Organization
17.	Ego Lemos	Permatil	NGO

18.	Jose Barros	TOMAK, Ministry of Agriculture and Fishery (MAF)	Programme
19.	Rob Williams	AI-COM, Ministry of Agriculture and Fishery (MAF)	Programme
20.	Joaquina da Costa	AI-COM, Ministry of Agriculture and Fishery (MAF)	Programme
21.	Thalia Soares	Plan International	NGO
22.	Nelson C. Magalhães	Hasatil	NGO
23.	Widya Setiab	World Vision Timor-Leste	NGO
24.	Orlando do Carmo de Araujo	World Vision Timor-Leste	NGO
25.	Natividade Rodriges	Similie	Private Sector
26.	Ana Paula da C. Xavier	Similie	Private Sector
27.	Nelson Madeira	National Directorate for Pollution Control	Government Institution
28.	Eulalia da C. Amaral	National Directorate of the Urban Organization (DGOU – MSA)	Government Institution
29.	Rogerio da Silva Amaral	National Directorate of the Urban Organization (DGOU – MSA)	Government Institution
30.	Antonio Vicente	National Directorate for Food Security and cooperation, Ministry of Agriculture and Fishery (MAF)	Government Institution
31.	Shelya B. Gomes Pinto	Mercy Corps	NGO
32.	Herminio Xavier	Secretary of State for Equality and Inclusion (SSEI)	Government Institution
33.	Fabiola Ximenes	Conservation International Timor-Leste	NGO
34.	Angelo Ximenes	Water Aid Timor-Leste	NGO
35.	Almeida Boavida	Bee Timor-Leste (BTL, E.P)	Public enterprise
36.	Antonio Abel	National Designated Authority, I.P	Public Institution
37.	Cris Caetano	Oxfam	NGO
38.	Elvis A. Sarmento	International Organization for Migration (IOM)	UN Agency
39.	Filomeno de Araujo	Timor-Leste Red Cross (CVTL)	NGO
40.	Apolonia Barreto	UNICEF	UN Agency

41.	Raimundo da Costa	Mercy Corps	NGO
42.	José R. O. Fernandes	Directorate General for Forests, Coffee and Industrial Plants	Government Institution
43.	Antonio de O. da Cruz	DNI GUA - MAF	Government Institution
44.	Sabastião da Costa	National Authority for Water and Sanitation (ANAS.IP)	Public Institution
45.	Isac Fontes Pereira	National Authority for Water and Sanitation (ANAS.IP)	Public Institution
46.	Antonio Lelo Tasi	National Environmental Licensing Authority, I.P. (ANLA)	Public Institution
47.	Joselino G. R. da Silva	National Environmental Licensing Authority, I.P. (ANLA)	Public Institution
48.	Leonildo S. J. da Costa	National Designated Authority, I.P	Public Institution
49.	Sofia Sagram	National Directorate for Climate Change	Government Institution
50.	Osorio Ximenes	National Directorate for Climate Change	Government Institution
51.	Leonardo da Rosa	National Directorate for Climate Change	Government Institution
52.	Maria dos Reis	National Directorate for Climate Change	Government Institution
53.	Luis dos Santos Belo	National Directorate for Climate Change	Government Institution
54.	Justina Aurea Belo	National Directorate for Climate Change	Government Institution
55.	Oscar Belo Soares	National Directorate for Climate Change	Government Institution
56.	Armando Barreto	National Directorate for Climate Change	Government Institution
57.	Zelia A. Maria	National Directorate for Climate Change	Government Institution

Annex III: Summary of Scoring Matrix

1. Scoring matrix of transportation sector

Table 21: Scoring matrix of transportation sector using weighting 1

Technologies	Cost		Benefits						Local Context	
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political
Indicators	C	O & M	S	TI	SIE	R	AQI	RGHGE	A & R	RNP
Criterion weight	15%	5%	10%	5%	10%	10%	10%	15%	10%	10%
Biofuel and Biomass potential	75	100	25	25	25	25	75	75	50	50
Promotion of non-motorized transport	50	75	50	50	75	50	100	100	75	75
Introduction of Bus rapid transit (BRT)	25	50	50	75	75	75	75	75	75	75

Low carbon development strategy	100	100	50	100	75	75	100	100	50	100
Develop Pollution Control Decree-Law	100	100	75	75	75	100	100	100	100	100
Public transportation maximization	25	75	75	75	100	100	75	75	100	100
Promotion of electric vehicle	75	100	25	25	25	50	75	75	50	25
Research on installing solar system-based charging station	100	100	50	50	50	75	100	100	100	100

Table 22: Scoring matrix of transportation sector using weighting 2

Technologies	Cost		Benefits						Local Context	
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political
Indicators	C	O & M	S	TI	SIE	R	AQI	RGHGE	A & R	RNP
Criterion weight	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Biofuel and Biomass potential	75	100	25	25	25	25	75	75	50	50
Promotion of non-motorized transport	50	75	50	50	75	50	100	100	75	75
Introduction of Bus rapid transit (BRT)	25	50	50	75	75	75	75	75	75	75
Low carbon development strategy	100	100	50	100	75	75	100	100	50	100

Develop Pollution Control Decree-Law	100	100	75	75	75	100	100	100	100	100
Public transportation maximization	25	75	75	75	100	100	75	75	100	100
Promotion of electric vehicle	75	100	25	25	25	50	75	75	50	25
Research on installing solar system-based charging station	100	100	50	50	50	75	100	100	100	100

2. Scoring matrix of agriculture, land use and forestry sector

Table 23: Scoring matrix of agriculture, land use and forestry sector using weighting 1

Technologies	Cost		Benefits						Local Context	
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political
Indicators	C	O & M	JC	IEP	FS	CD	RPES	RGHGE	A & R	RNP
Criterion weight	15%	10%	5%	10%	10%	15%	15%	5%	5%	10%
Cover crop	75	75	75	75	75	75	100	100	100	50
Afforestation and reforestation	25	25	75	75	75	50	100	100	75	100
Participatory land use planning	50	50	50	75	75	100	100	100	75	100
Sustainable terracing	25	25	75	75	75	75	75	75	75	100
Strengthening the Implementation of extension	25	25	75	75	75	75	75	75	75	100

services										
Agroforestry	50	50	75	100	100	100	75	75	75	100
SALT (Slopping Agricultural Land Technology)	25	25	75	100	100	75	100	75	75	100

Table 24: Scoring matrix of agriculture, land use and forestry sector using weighting 2

Technologies	Cost		Benefits						Local Context	
			Economic		Social		Environmental	Climate Related	Institutional/implementation	Political
Indicators	C	O & M	JC	IEP	FS	CD	RPES	RGHGE	A & R	RNP
Criterion weight	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Cover crop	75	75	75	75	75	75	100	100	100	50
Afforestation and reforestation	25	25	75	75	75	50	100	100	75	100
Participatory land use planning	50	50	50	75	75	100	100	100	75	100
Sustainable terracing	25	25	75	75	75	75	75	75	75	100
Strengthening the Implementation of extension services	25	25	75	75	75	75	75	75	75	100

Agroforestry	50	50	75	100	100	100	75	75	75	100
SALT (Slopping Agricultural Land Technology)	25	25	75	100	100	75	100	75	75	100