Environmental and Social Management Framework

Enhancing energy access by generating energy from the waste to mitigate climate change

Alternative Energy Promotion Center
Tahachal, Kathmandu
Tel: +977 1 4598013; email: info@aepc.gov.np
Website: www.aepc.gov.np

This page is left intentionally blank.

Table of Contents

ACRONYMS AND ABBREVIATIONS

ADB	:	Asian Development Bank
AE	:	Accredited Entity
B2B	:	Business-to-business
BES	:	Brief Environmental Study
BTR	:	Biennial Transparency Report
CAGR	:	Compounded Annual Growth Rate
CNG	:	Compressed Natural Gas
CTEVT	:	Council of Technical Education and Vocational Training
DPR	:	Detail Project Report
EIA	:	Environmental Impact Assessment
ESIA	:	Environment and Social Impact Assessment
ESMF	:	Environmental and Social Management Framework
ESMP	:	Environmental and Social Management Plan
ESS	:	Environmental and Social Safeguards
FPIC	:	Free, Prior, informed Consent
GAP	:	Gender Action Plan
GCF	:	Green Climate Fund
GHG	:	Greenhouse Gas
GRM	:	Grievance Redress Mechanism
IEE	:	Initial Environmental Examination
LDC	:	Least Developed Country
LMP	:	Labour Management Procedure
LPG	:	Liquified Petroleum Gas
MoALD:		Ministry of Agriculture and Livestock Development
MoFAGA:		Ministry of Federal Affairs and General Administration
MoFE	:	Ministry of Forests and Environment
MSW	:	Municipal Solid Waste
NBSM	:	Nepal Bureau of Standards and Metrology
OHS	:	Occupational Health and Safety
PMU	:	Programme Management Unit
PPE	:	Personal Protective Equipment
PPP	:	Public-Private-Partnership
RBF	:	Results Based Financing
RDF	:	Refuse Derived Fuel
SDG	:	Sustainable Development Goals
SEP	:	Stakeholder Engagement Plan
SOP	:	Standard Operating Procedure
SREP	:	Scaling-Up Renewable Energy Program
TNA	:	Training Needs Assessment
TPD	:	Tons per Day
VGF	:	Viability Gap Fund
W2E	:	Waste to Energy
WaSH	:	Water Sanitation and Hygiene

1. Executive Summary & Introduction

This Environmental and Social Management Framework (ESMF) has been prepared for the proposed municipal solid waste-to-energy (W2E) programme in Nepal. The programme seeks to strengthen climate-resilient municipal solid waste management through an integrated waste-to-resource approach, including bio-methanation, production of bio-CNG, refuse-derived fuel (RDF), and organic fertilizers, together with associated waste handling, storage, transport, market development, and capacity-building activities. Because the exact locations and designs of future subprojects will be finalized during implementation, the ESMF provides the overarching framework for identifying, assessing, managing, monitoring, and reporting environmental and social risks and impacts in a consistent manner across all supported investments.

The programme is expected to generate significant environmental and social benefits. By diverting organic and combustible waste from open dumping and uncontrolled disposal, it will contribute to greenhouse gas emission reduction, reduced methane generation, improved urban sanitation, reduced open burning, and enhanced resource recovery. The programme is also expected to support renewable energy generation, reduce dependence on imported fossil fuels, create green employment opportunities, and strengthen circular economy practices within municipalities. At the same time, construction and operation of W2E facilities may generate site-specific environmental and social risks that require appropriate management.

The ESMF identifies the principal risk areas associated with waste collection, transfer, sorting, bio-methanation, RDF production, composting and digestate handling, transport, storage, and associated infrastructure. Key environmental risks include odour, dust, noise, wastewater and leachate generation, surface and groundwater contamination, residual waste management, air emissions, traffic impacts, and fire or explosion hazards. Key social risks include occupational health and safety, community health and safety, labour and working conditions, stakeholder acceptance, potential impacts on informal waste workers, traffic safety, nuisance impacts on nearby communities, and risks related to gender equality and social inclusion. These impacts are expected to be largely site-specific, reversible, and manageable through established mitigation measures and good operational practices.

The framework adopts a risk-based approach to subproject management. All proposed investments will be screened against defined exclusion criteria and environmental and social screening procedures. Based on the screening results, subprojects will be assigned an appropriate risk category and required safeguard instruments. These may include site-specific Environmental and Social Management Plans (ESMPs), Labour Management Procedures (LMPs), Stakeholder Engagement Plans (SEPs), Gender Action Plans (GAPs), occupational health and safety plans, traffic management plans, emergency preparedness measures, and other specialized studies where warranted. No subproject may proceed to construction until the required assessments, consultations, approvals, and mitigation measures have been completed.

The ESMF also establishes institutional responsibilities for environmental and social management. AEPC, through the Programme Management Unit (PMU), will have overall responsibility for implementation of the framework, including screening, review and approval of safeguard instruments, supervision, monitoring, reporting, and corrective actions. Municipalities, private developers, contractors, and facility operators will be responsible for implementing approved mitigation measures, maintaining compliance with applicable permits and standards, and submitting periodic environmental and social performance reports. Capacity building, training, and technical support are included to strengthen implementation at national, municipal, and facility levels.

Meaningful stakeholder engagement is a central element of the framework. The programme will engage municipalities, affected communities, informal waste workers, women's groups, farmers, cooperatives, industries, private developers, and other interested stakeholders throughout planning, construction, and operation. Information disclosure, consultations, and grievance management procedures are designed to ensure transparency, participation, and timely resolution of concerns. Particular attention will be given to the inclusion of women, Dalits, Janajati groups, low-income households, persons with disabilities, and other vulnerable or marginalized groups. A project-level grievance redress mechanism will provide accessible channels for receiving, tracking, and resolving complaints from workers, communities, and other stakeholders.

Monitoring and evaluation arrangements are included to ensure that environmental and social commitments are implemented effectively. Monitoring will cover compliance with ESMPs and other safeguard instruments, occupational health and safety performance, waste handling practices, pollution control measures, stakeholder engagement activities, grievance resolution, labour conditions, and gender and social inclusion outcomes. Significant incidents, accidents, or non-compliance events will be reported promptly and corrective actions will be tracked to completion. The framework emphasizes both compliance monitoring and adaptive management so that lessons learned can improve implementation over time.

To support implementation, an indicative ESMF budget has been allocated for preparation of project-specific environmental assessments and ESMPs, safeguard implementation, training and capacity building, and occupational health and safety measures. Additional mitigation, compensation, or site-specific safeguard costs identified through future screening and assessment processes will be incorporated into individual subproject budgets as required. When implemented effectively, the framework will help ensure that the programme achieves its objectives while protecting workers, communities and the environment and promoting inclusive and sustainable development outcomes.

2. Baseline Situation

2.1 Geography and climate

Nepal is a landlocked country located in South Asia, characterized by diverse topography ranging from the lowland Terai plains to the Himalayan mountain range. Climate here is shaped by strong monsoon dynamics in the region and its inherent altitudinal variation, resulting in significant spatial and seasonal heterogeneity. The country spans climatic zones from subtropical conditions in the Tarai (<500 m) to alpine and arctic conditions in the high Himalayas (>5000 m), with average annual temperatures ranging from above 24°C in the south to sub-zero levels in the mountains. Nepal recorded an average annual temperature of 14.5°C and annual precipitation of approximately 1,336 mm, with pronounced seasonality, based on the baseline data (1981-2010). Around 80% of annual rainfall (1050 mm) occurred during the monsoon season, with minimal (58 mm) winter precipitation[1].

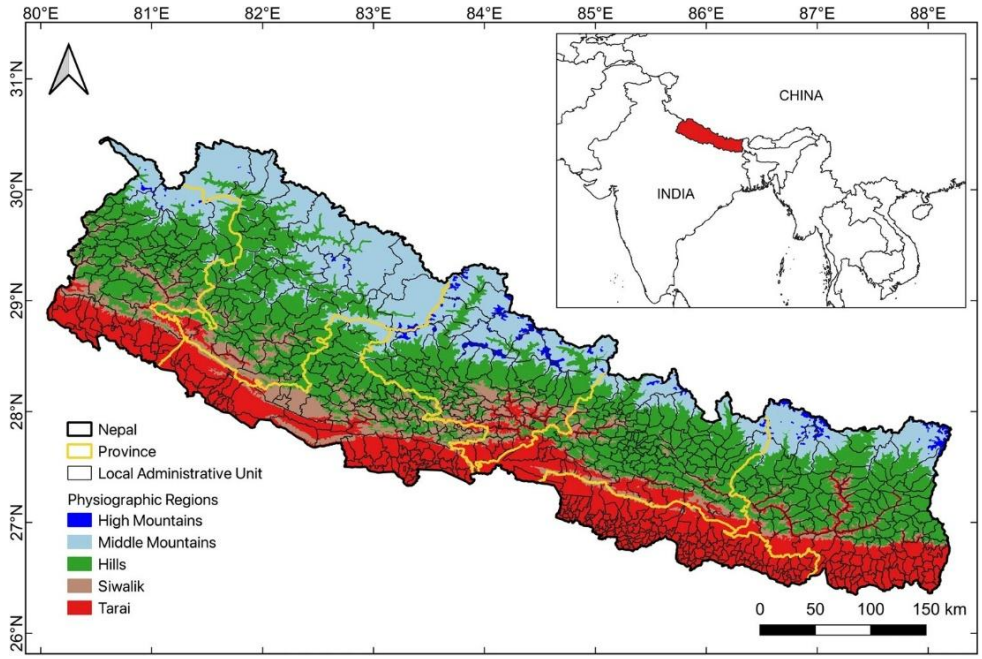


Figure 1: Local administrative units and physiographic regions of Nepal

(Source: https://doi.org/10.1007/s10113-022-01903-5*)*

Long-term observations indicate a consistent warming trend alongside increasingly variable precipitation patterns. Analysis of data from 1951–2020 shows that mean annual temperatures have increased by approximately 0.2°C per decade, with high statistical significance, confirming a robust warming signal. More recent periods (1971–2020 and 1991–2020) also reflect sustained warming at 0.17°C and 0.15°C per decade, respectively. In contrast, precipitation trends are less uniform. While the long-term data suggests a slight decline (-23.75 mm per decade), recent decades show an increasing trend, reaching 87.03 mm per decade (1991–2020) with strong statistical significance. Spatially, precipitation decline is more evident in high mountain regions, while extreme rainfall events are becoming more frequent. Climate projections reinforce the likelihood of intensified risks, with all scenarios indicating continued warming and increasingly erratic rainfall patterns. Future climate models suggest rising temperatures across all seasons, alongside increased precipitation variability, with reductions in pre-monsoon rainfall and intensification during monsoon and post-monsoon periods.

[1] DHM (2024). Update of Climate Change Study of Nepal. Department of Hydrology and Meteorology, Government of Nepal, Singhadurbar, Kathmandu.

2.2 Demography and socio-economic overview

Nepal has been experiencing very rapid demographic changes in the last few decades as a result of transition from a high-mortality, high-fertility society to a low-mortality, low-fertility society within a relatively short span of time.[2] Population census is undertaken in Nepal at the interval of ten years; according to the recent census held in 2021, Nepal recorded a total population of 29.16 million. The average household size shrunk to 4.37 person/household (HH), a decline in the average household size during previous census (4.88 person/HH). Table 1 highlights the population and household characteristics based on findings from 2021 census.

Table 1: Key demographic indicators of Nepal

Demographic Parameter	Unit	Value
Total population	no.	29,164,578
Male population	%	48.87
Female population	%	51.13
Annual population growth rate	%	0.92
Population density	person/Km^2	198
Households	No.	6,666,937
Household size	person/HH	4.37
Urban population	%	66.17

Across the ecological zones, the Terai region holds the highest proportion of the population at 53.61% and the highest annual population growth rate (1.52%) indicating continued settlement and development in the plains. The Hilly region, home to 40.31% of the population has slow growth rate of 0.30% per year, while the Himalayan region, hosting 6.08% of the population recorded a negative population growth at the rate of -0.50% per year. The average population density stands at 198 person/Km^2 ranging from 34 person/Km^2 in mountain to 460 person/Km^2 in terai regions. Moreover, a shift in urban and rural population distribution is observed from census 2021, where a majority of population (66.17%) was found to be residing in the urban areas.

In contrast to the overall population growth rates, which has gradually moderated over time; the urban population has significantly expanded in Nepal, particularly after 2001. Urban population remained relatively low and stable until the 1990s, after which it began to rise sharply, reaching a pronounced increase between 2011 and 2021. The recent census reports around two-third (66.17% to be precise) population reside in the urban areas; and that the intercensal urban population grew at a staggering rate of 15.1%. In contrast, total population growth rates show a declining trend, suggesting that urbanization has been is the dominant demographic driver in the intercensal decade. Beyond demography, other social progression have also occurred over the intercensal decade and beyond. Over this period, Nepal's economy has decoupled further from its agriculture base; the agriculture sector contribution to gross domestic product (GDP) has declined from 35.1% in fiscal year (FY) 2011/12[3] to 25.2% in FY 2024/25[4] as informed by the Economic Surveys. Meanwhile, Nepal's average per capita income also increased from USD 785.5 in 2011 to 1447.3 in 2024[5]. This socio-economic transition is conducive to accelerated resource consumption, resulting in higher per capita waste generation and changes in waste composition.

[2] GoN (2017). Demographic Changes of Nepal: Trends and Policy Implications. National Planning Commission, Government of Nepal, Singhadurbar, Kathmandu.
[3] MoF (2012). Economic Survey 2068/69. Ministry of Finance, Singha Durbar, Kathmandu.
[4] MoF (2025). Economic Survey 2081/82. Ministry of Finance, Singha Durbar, Kathmandu.

[5] World Bank (2025). GDP per capita (current US$) – Nepal. World Development Indicators. Retrieved on May 1, 2026.

A defining characteristic of municipal waste in Nepal is its high organic content, which constitutes a significant proportion of the total waste stream; therefore, any increase in total quantity of solid waste corresponds to an increased volume of organic wastes to be handled. In the absence of systematic treatment and recovery systems, this organic fraction is typically disposed of in unmanaged or poorly managed sites, where it undergoes anaerobic decomposition releasing methane, a powerful greenhouse gas (GHG).

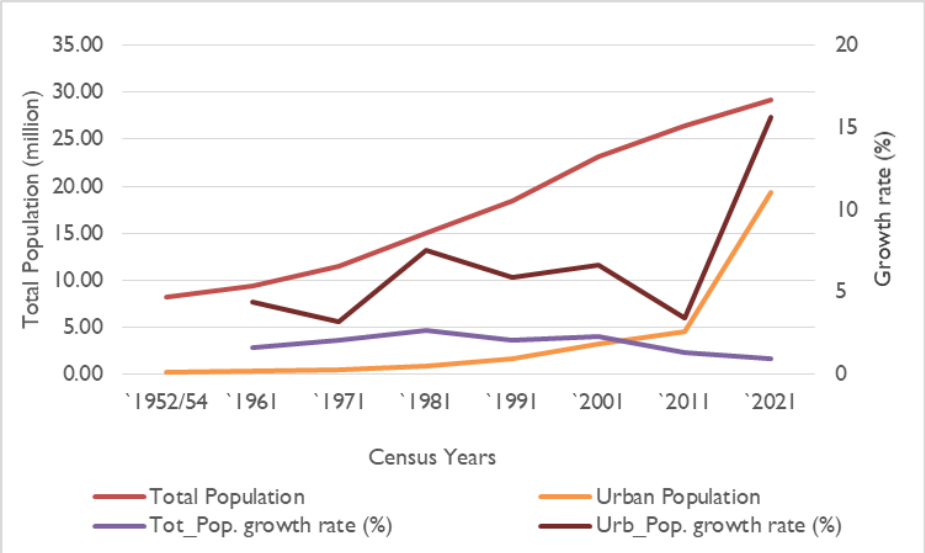


Figure 2: Dynamics of urban population and growth across the censuses

(Source: Census Reports)

2.3 Policy and Governance

Nepal's policy and legal framework for solid waste management provides an enabling basis for decentralized waste management systems, with increasing emphasis on resource recovery and environmental sustainability. Constitution of Nepal mandates the local level with the functional role to maintain the cleanliness and hygiene inside their jurisdiction. The framework is anchored in sector-specific legislation, local governance mandates, environmental safeguards, and climate policy directions that collectively support the development of waste-to-energy interventions.

Solid Waste Management Act (2011) serves as the primary legislative instrument governing waste management in Nepal. The Act clearly assigns responsibility for the collection, processing, and disposal of municipal solid waste to local bodies, including municipalities and other local government units. It explicitly mandates local governments to develop and operate waste management infrastructure such as transfer stations, landfill sites, composting facilities, and biogas plants. This provision establishes a strong legal basis for the deployment of bio-methanation systems and other waste processing technologies at the municipal level, positioning local governments as key stakeholders in the implementation of waste-to-energy projects.

The Local Government Operation Act (2074) further reinforces the role of municipalities in solid waste management by defining their functional responsibilities in sanitation, waste collection, recycling, and disposal. The Act empowers local governments to set tariffs, regulate waste services, and engage in partnerships with the private sector and non-governmental organizations. It also assigns ward-level responsibilities for household waste management and local sanitation services. Importantly, the Act provides a legal basis for public-private partnerships (PPP) in waste management, which is critical for enabling private sector participation in capital-intensive waste-to-energy systems.

The National Climate Change Policy (2019) provides strategic direction for integrating climate considerations into sectoral planning and development. Within the policy, waste management is recognized as an important area for climate mitigation, with specific emphasis on the segregation of waste at source and the utilization of biodegradable waste for energy production. This policy direction aligns directly with the objectives of biomethanation-based interventions, as it promotes the conversion of organic waste into energy while reducing greenhouse gas emissions, particularly methane.

The Environment Protection Act (2019) establishes overarching framework for environmental governance in Nepal, including provisions for pollution control, environmental standards, and impact assessment. The Act mandates environmental assessments such as Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) for infrastructure projects, including waste management facilities. It also enforces the "polluter pays" principle and sets regulatory standards for emissions and environmental performance. These provisions are critical for ensuring that waste-to-energy projects are designed and operated in compliance with environmental safeguards, including the management of emissions and potential impacts on public health and ecosystems.

Sustainable Development Goals (2016–2030), particularly Nepal's commitment to Goal 11 on sustainable cities and communities, reinforces the importance of effective municipal waste management. Target 11.6 calls for reducing the environmental impact of cities, including through improved waste management practices. National targets related to waste segregation and service coverage reflect a policy intent to strengthen municipal systems and promote sustainable waste practices. Waste-to-energy interventions contribute to these goals by improving waste treatment outcomes while generating renewable energy.

Despite the legal and policy priorities outlined as an enabling policy and institutional framework, the current waste management system continues to rely on unmanaged disposal practices, resulting in significant methane emissions.

2.4 MSW Generation & Composition

To establish the trend in Nepal's municipal solid waste (MSW) sector, key parameters including population growth, per capita waste generation, collection efficiency and waste composition were analyzed using nationally reported datasets. The analysis indicates that the primary driver of increasing waste volumes is demographic expansion, particularly urbanization, rather than changes in waste characteristics. While total population has grown at a modest 0.96% annually, this rate has been applied for projection to avoid distortions arising from administrative reclassification of urban areas, despite the observed intercensal urban population surge (15.61%). At the same time, per capita MSW generation has increased steadily at 1.95% per annum, suggesting a gradual rise in consumption levels. When combined with a relatively low and static collection efficiency of 62.3%, this results in a growing volume of waste entering the unmanaged or disposal stream. Importantly, waste composition remains broadly stable, with organic waste consistently averaging 57%, indicating that the methane generation potential of the waste stream remains structurally high over time.

Table 2: Trend analysis in generation of municipal solid waste

SN	Parameters	Unit	Available/calculated Values		Value applied	Remarks
1	Population		**2011**	**2021**		
	Total Population	No.	26494504	29164578		Values taken from respective national censuses of 2011 and 2021
	Urban Population	No.	4523820	19296788		
	CAGR	%	Total Population: 0.96% Urban Population: 15.61%		0.96%	Compounded annual growth for the intercensal period. Annual growth rate of 0.96% is considered account for abrupt

SN	Parameters	Unit	Available/calculated Values		Value applied	Remarks
						changes in urban population due to designation of urban areas.
2	Waste Generation		**2011**	**2020**		For waste generation and composition related analysis, the reports on Solid Waste Management published by ADB (2013) and MoFAGA (2020) were considered
	MSW generated	Kg/capita/day	0.317	0.37		
	CAGR	%		1.95%	1.95%	
	Collection efficiency	%	62.3%	-	62.3%	
3	Waste Composition		**2011**	**2020**	**Average**	
	Organic waste	%	56	58	57.00	
	Plastic	%	16	12	14.00	
	Paper	%	16	17	16.50	
	Glass	%	3	4	3.50	
	Metal	%	2	3	2.50	
	Others	%	7	6	6.50	

2.5 Energy Consumption Trend

In order to assess the trend in coal and liquefied petroleum gas (LPG) consumption in Nepal, time-series data from the country's Biennial Transparency Report (BTR) was analyzed for the period 2011–2022. The historical consumption data was plotted and linear trendlines were derived to understand the underlying growth pattern and support forward-looking projections. During this period, both coal and LPG consumption in Nepal exhibit a clear and sustained upward trajectory over the period 2011–2022, indicating a structural increase in fossil fuel dependence. Coal consumption rises from roughly ~500 Gg in 2011 to nearly ~1,800–1,900 Gg by 2022, with a strong linear trend, suggesting that growth is not sporadic but systematically linked to expanding industrial activity; particularly in cement, brick kilns, and other energy-intensive sectors. Despite some year-to-year fluctuations, the overall trend remains firmly upward, reinforcing the role of coal as a backbone fuel for industrial production.

A similar but more consistent pattern is observed for LPG consumption, which increases from approximately ~150 thousand tons in 2011 to over ~530 thousand tons in 2022, with an even stronger linear fit. This reflects a steady transition in household energy use, particularly in urban areas, where LPG has increasingly substituted traditional biomass fuels such as firewood. The near-linear growth suggests that LPG demand is closely tied to urbanization, rising incomes, and improved access to modern energy services. Taken together, these trends contribute to the rising dominance of the energy sector in Nepal's GHG emissions profile.

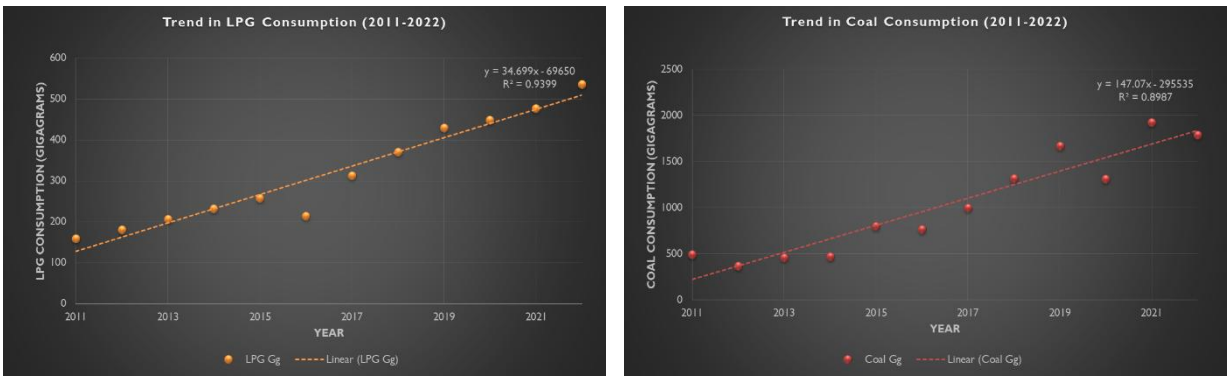


Figure 3: Trend in consumption of (a) LPG and (b) Coal in Nepal from 2011-2022

(*Source:* Annex V of BTR)

3. Program description

3.1 Programme Objective and Approach

The proposed project seeks to strengthen climate-resilient municipal solid waste management in Nepal through an integrated waste-to-energy (W2E) approach that converts organic and combustible waste fractions into marketable products, including bio-CNG, refuse-derived fuel (RDF), and organic fertilizers. The programme combines policy and regulatory support, technical capacity development, market strengthening, and catalytic financing to address key barriers limiting private sector investment and large-scale adoption of waste-to-resource solutions. Implementation will be undertaken through public-private partnership (PPP) models in selected municipalities, with investments in waste processing infrastructure, quality assurance systems, and market development mechanisms. The project is expected to reduce greenhouse gas emissions from unmanaged waste, improve urban environmental conditions, enhance resource recovery, and contribute to Nepal's low-emission and climate-resilient development objectives.

Nepal's rapidly growing urban population has placed increasing pressure on municipal solid waste management systems that were originally designed to serve much smaller populations. Urban areas now accommodate approximately two-thirds of the national population, resulting in a steady increase in waste generation volumes, changing waste composition, and growing demand for collection, transport, treatment, and disposal services. However, municipal investments in waste management have not kept pace with this growth. Collection systems remain constrained by limited equipment, inadequate segregation practices, insufficient treatment infrastructure, and difficulties in securing and operating sanitary landfill facilities. Consequently, a large proportion of municipal waste continues to be disposed of in open dumps, unmanaged landfill sites, or through informal burning, creating significant environmental, public health, and climate-related risks.

At present, municipal waste management in Nepal remains predominantly collection-and-disposal oriented. While collection coverage has improved in larger urban centers, source segregation is limited, material recovery remains largely informal, and only a small fraction of waste is processed through composting, recycling, biomethanation, or other resource recovery systems. Most municipalities continue to rely on landfill disposal as the primary waste management strategy, despite growing challenges associated with land scarcity, community opposition to disposal facilities, rising transportation costs, and recurring operational disruptions.

The financing challenge is expected to become more pronounced following the completion of major donor-supported interventions in the sector. In particular, the World Bank-supported Scaling-Up Renewable Energy Program (SREP) played a catalytic role in demonstrating the technical and commercial viability of large-scale biogas systems and provided critical investment support to emerging waste-to-energy initiatives. With the closure of this programme, a significant financing gap has emerged between the capital requirements of waste-to-resource infrastructure and the willingness of commercial financiers to invest in a sector perceived as high risk. Without new mechanisms to de-risk investments and mobilize private capital, municipalities are likely to face increasing difficulty in developing the infrastructure needed to manage growing waste volumes while simultaneously addressing climate, environmental, and public health objectives.

In this backdrop, the proposed programme involves the establishment of municipal-scale W2E facilities for the production of bio-CNG, RDF and organic fertilizers from segregated municipal solid waste, together with associated waste handling, storage, transportation, and market development infrastructure. Similar municipal and commercial biogas projects implemented under the World Bank-supported SREP and the Extended Biogas Project demonstrated that such interventions can be implemented with

manageable environmental and social risks when supported by appropriate mitigation measures, operational procedures, and monitoring systems. The proposed project does not involve large-scale industrial processes, significant conversion of natural habitats, major pollution sources, or activities expected to cause irreversible environmental or social impacts. Rather, its principal environmental objective is to reduce waste disposal, methane emissions, open burning, and associated public health risks through resource recovery and circular economy approaches.

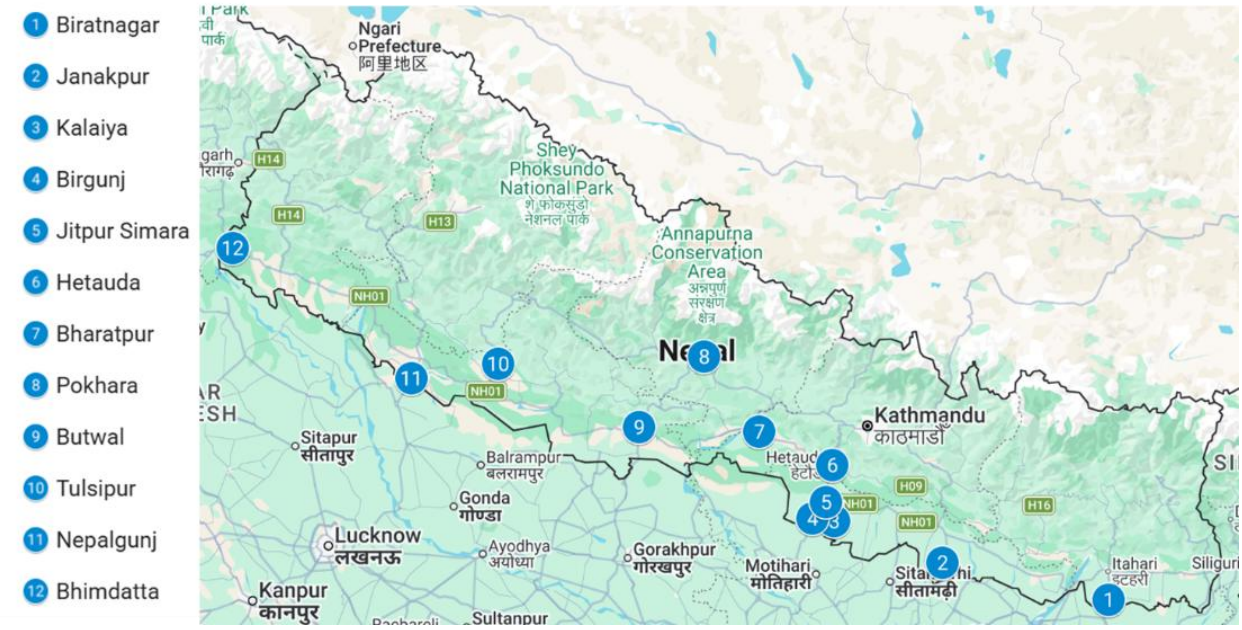
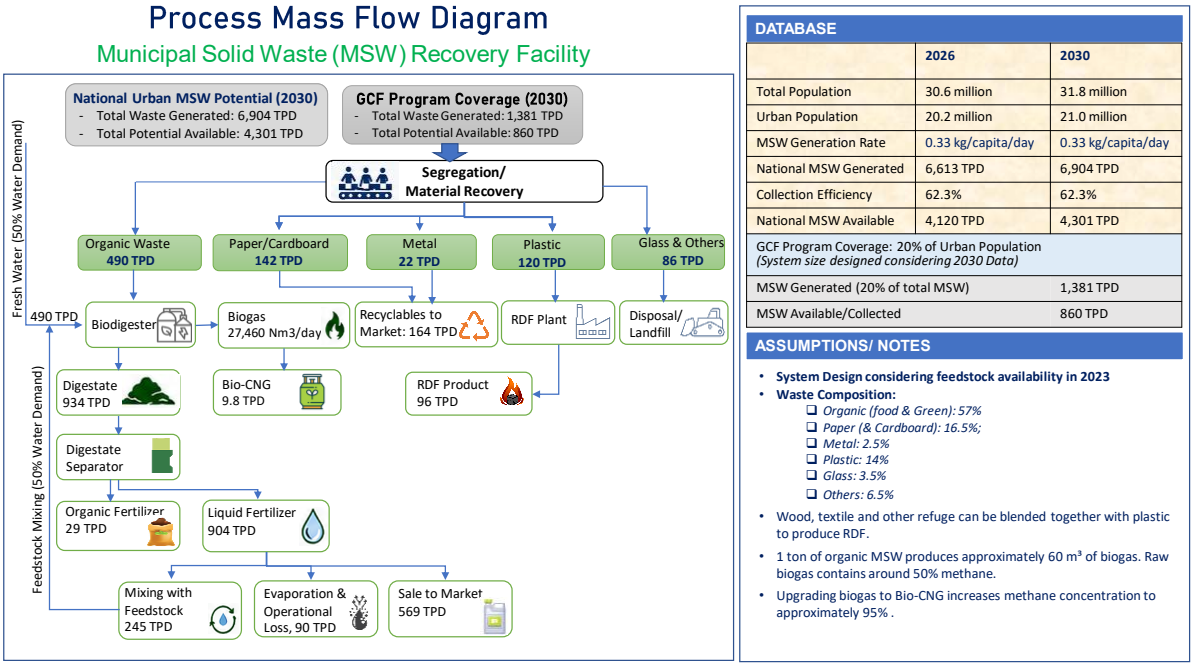


Figure 4: Tentative location of potential municipalities that will be included in the programme

3.2 Detail Activities

The proposed GCF program is designed to cater 20% of Nepal's urban population with 2030 as the benchmark year. This is estimated to cover the waste management solutions in 12 municipalities. The project will processes an intake of 860 Tons per Day (TPD) of municipal solid waste. The incoming feedstock will systematically be received as five primary material streams; organic waste (490 TPD), paper and cardboard (142 TPD), plastic (120 TPD), metal (22 TPD), and residuals/glass (86 TPD). By diverting the majority of these fractions into dedicated processing lines, the facility aims to maximize the diversion of the waste from the landfill.

The project will process these raw inputs into high-value energy and agricultural commodities, though it features a heavily liquid-dominant output profile. The dry processing line combines plastics and dry refuse to yield 96 TPD of RDF, while traditional metals and paper feed a 164 TPD dry recycling stream for direct market sale. Concurrently, the organic line undergoes anaerobic digestion supported by equal parts freshwater mixing, generating 27,460 Nm^3/day of raw biogas upgraded into 9.8 TPD of commercial bio-CNG. Critically, the remaining digestate produces a minor 29 TPD of solid organic fertilizer alongside a massive 569 TPD of marketable liquid fertilizer after accounting for system losses and liquid recirculation loops. This heavy volume of liquid byproduct underlines a key commercial dependency, as the project's ultimate financial sustainability relies on the stable market absorption of these liquid agricultural outputs. Mass flow diagram is presented in Figure 5.



DATABASE		
	2026	2030
Total Population	30.6 million	31.8 million
Urban Population	20.2 million	21.0 million
MSW Generation Rate	0.33 kg/capita/day	0.33 kg/capita/day
National MSW Generated	6,613 TPD	6,904 TPD
Collection Efficiency	62.3%	62.3%
National MSW Available	4,120 TPD	4,301 TPD
GCF Program Coverage: 20% of Urban Population *(System size designed considering 2030 Data)*		
MSW Generated (20% of total MSW)		1,381 TPD
MSW Available/Collected		860 TPD

ASSUMPTIONS/ NOTES

- **System Design considering feedstock availability in 2023**
- **Waste Composition:**
  - *Organic (food & Green): 57%*
  - *Paper (& Cardboard): 16.5%;*
  - *Metal: 2.5%*
  - *Plastic: 14%*
  - *Glass: 3.5%*
  - *Others: 6.5%*
- Wood, textile and other refuge can be blended together with plastic to produce RDF.
- 1 ton of organic MSW produces approximately 60 m^3 of biogas. Raw biogas contains around 50% methane.
- Upgrading biogas to Bio-CNG increases methane concentration to approximately 95% .

Figure 5: Process mass-flow diagram

Component 1: Technical Assistance for Capacity Building and National Framework Mechanisms for W2E in Nepal

Output 1.1: Policy and legal framework for end-to-end management of W2E system and market & end-use of W2E products are established

Activity 1.1.1- Establish national standard, standard operating procedure (SOP) and quality control system of W2E technology & products (bio-CNG, compost & RDF): To build unified quality controls, the program will immediately convene and operationalize an interagency task force [Sub-activity 1.1.1.1] comprising the Alternative Energy Promotion Centre (AEPC), the Nepal Bureau of Standards & Metrology (NBSM), and the Ministry of Agriculture and Livestock Development (MoALD) to coordinate standards development and monitor policy enforcement. This body will formulate formal chemical, physical, and thermodynamic purity standards for bio-CNG, moisture-controlled organic compost pellets, and densified plastic refuse-derived fuel (RDF) [Sub-activity 1.1.1.2]. To ensure alignment with global metrics, the task force will coordinate technical knowledge exchanges to adopt mature international experience regarding waste-derived alternative fuels [Sub-activity 1.1.1.3]. Finally, the team will draft and implement comprehensive Standard Operating Procedures (SOPs) defining quality assurance and quality control (QA/QC) validation benchmarks for decentralized plant operators to provide total process clarity [Sub-activity 1.1.1.4].

Activity 1.1.2- Develop results-based-financing (RBF) policy for compost and RDF: The project will design a structured fiscal disbursement policy that links public support directly to the verified metric tonnages of bio-CNG, RDF, and organic fertilizer successfully sold to commercial off-takers [Sub-activity 1.1.2.1]. This framework will function as a temporary price cushion to bridge the cost-recovery deficit. To maintain macroeconomic alignment against volatile international coal and imported petroleum rates, the interagency task force will conduct annual reviews and updates of the RBF framework to optimize subsidy disbursement metrics [Sub-activity 1.1.2.2].

Activity 1.1.3- Design PPP model of waste management ensuring buy-in from public and private sector: To streamline private investment, the program will build standard public-private partnership (PPP)

contract templates featuring clear concession terms, balanced risk profiles, and consolidated municipal feedstock delivery guarantees [Sub-activity 1.1.3.1]. These standardized project agreements will undergo continuous legal reviews and updates to ensure they remain fully aligned with any national policy revisions or changes in Nepal's Public-Private Partnership and Investment Act (PPPIA) [Sub-activity 1.1.3.2].

***Activity 1.1.4- Policy advocacy to legitimize bio-CNG as transport fuel**:* The program will execute a detailed policy review and regulatory gap assessment within the Department of Transport Management to formally recognize and legalize biomethane as a mainstream commercial transport fuel [Sub-activity 1.1.4.1]. To overcome institutional hesitation, the project will partner with national research and academic institutes to run fleet demonstration pilots, generating the empirical safety and emissions evidence needed for formal certification [Sub-activity 1.1.4.2]. This data will back up targeted awareness-raising workshops and capacity-building seminars for automotive, municipal, and financial sector stakeholders to accelerate market adoption [Sub-activity 1.1.4.3].

Output 1.2: Knowledge products are developed and technical capacity of value chain actors for better service delivery

Activity 1.2.1- Establish proof-of-concept for W2E as viable market solutions to MSWM through peer learning and best-case analysis: The task force will organize international study tours and technical peer-learning exchanges to review mature international waste-to-energy models and processing operations [Sub-activity 1.2.1.1]. These insights will guide localized field trials applying the project's RDF-5 pellets in industrial cement kilns and organic fertilizers on cash-crop test plots [Sub-activity 1.2.1.2]. The empirical performance metrics, fuel-burning properties and agricultural yield results will be compiled into formal technical briefs to establish a definitive, regional proof-of-concept for industrial off-takers [Sub-activity 1.2.1.3].

Activity 1.2.2- Develop & disseminate knowledge products to enhance the acceptance of waste to energy products: To build trust in waste-derived commodities, the program will maintain digital portals, mobile applications, and mass media public information campaigns (TV, radio, and print) to publish regular quality-testing metrics and project safety updates [Sub-activity 1.2.2.1]. Parallel community-level behavioral change workshops will be implemented to improve household source segregation and waste reduction habits [Sub-activity 1.2.2.2]. This will be reinforced by educational seminars on climate change, circular economies, and waste management tailored for local government representatives, schools, and private industrial developers [Sub-activity 1.2.2.3].

Activity 1.2.3- Collaborate with TVET institutions to design curriculum for O&M of W2E systems & develop certified expert pool: The project will collaborate with Council for Technical Education and Vocational Training (CTEVT) institutions to complete a comprehensive national Training Needs Assessment (TNA) and develop formal training modules for flatbed CSTR and RDF-5 plant operations [Sub-activity 1.2.3.1]. This specialized curriculum will be reviewed and updated annually based on real-world operational feedback from the field [Sub-activity 1.2.3.2]. To maintain a reliable pool of local experts, the program will organize annual technical certification and refresher courses for green energy developers and facility engineers [Sub-activity 1.2.3.3].

Activity 1.2.4- Design and implement skill transfer mechanism to the local value chain actors: The program will conduct an operator Capacity Needs Assessment to design specialized mechanical repair and maintenance modules tailored for local value chain actors, local machine workshops, and electrical repair vendors [Sub-activity 1.2.4.1]. Localized service centers will undergo mandatory hands-on technical training and annual refresher courses to build a robust domestic network of certified technicians capable

of troubleshooting plant instrumentation [Sub-activity 1.2.4.2]. To eliminate extended plant downtime, the project will provide direct institutional support to service providers to establish and maintain localized spare-parts and equipment inventories [Sub-activity 1.2.4.3].

Component 2: Market Strengthening for Establishing the Market System for Off-Taking of the W2E Products

Output 2.1: Market system is established for B2B off-takes for W2E products under RBF mechanism

Activity 2.1.1- Develop product marketing strategy and materials based on need assessment of targeted segment of consumer: The marketing team will execute localized market demand assessments and aggregate commercial buyers (hotels, cement kilns, tea cooperatives) within a immediate 15 km transport radius of each planned hub to minimize logistical friction [Sub-activity 2.1.1.1]. Based on these segment needs, technical information sheets and marketing materials will be prepared and distributed through regional marketplace channels to verify product quality compliance [Sub-activity 2.1.1.2].

Activity 2.1.2- Implement business-to-business (B2B) approach for demand activation and deploy RBF with take-and-pay arrangement: To activate downstream industrial demand, the program will deploy the GCF-backed RBF window as a market enabler for RDF and organic fertilizer from year 1 to year 5 [Sub-activity 2.1.2.1]. This subsidy will utilize a linear degressive approach, reducing the price incentive by 20% each year to drive rapid early adoption by commercial off-takers while allowing the facilities to smoothly reach independent, long-term commercial viability as operations mature.

Component 3: De-risking High Capital Expenditure through VGF in W2E Plant Deployment

Output 3.1: Financial flows for the MSWM through W2E system deployment is realized with increased engagement of BFIs

Activity 3.1.1- Improve project bankability through PPP model and predictable revenue stream: To establish a secure environment for private sector investment, the program will finance and execute site-specific Detailed Project Reports (DPRs), geotechnical investigations, and localized waste characterization tests for onboarding municipalities [Sub-activity 3.1.1.1]. This technical modeling will be supported by independent Environmental and Social Safeguards (ESS) risk assessments to establish comprehensive, site-specific Environmental and Social Management Plans (ESMPs) [Sub-activity 3.1.1.2]. Concurrently, the project teams will complete detailed Gender Assessments and draft binding Gender Action Plans (GAP) to safely integrate local informal waste-picking networks into the facility sorting lines with standardized wages and safety protocols [Sub-activity 3.1.1.3].

Activity 3.1.2- Mobilize viability gap fund (VGF) grants to de-risk high CAPEX exposure and enhance viability of appropriate technology: The Alternative Energy Promotion Centre (AEPC) will disburse capital-matching VGF sub-grants to directly finance the procurement and construction of modular flatbed CSTR and high-density RDF pellet facilities, de-risking the high initial investment costs for developers [Sub-activity 3.1.2.1]. Dedicated funding within this window will be ring-fenced to implement the protective environmental mitigation measures defined in the site-specific ESMPs [Sub-activity 3.1.2.2]. Parallel funding will track and implement the operational integration, occupational safety gear, and technical skills training mandated in the project's Gender Action Plan [Sub-activity 3.1.2.3]. Finally, specialized engineering technical assistance will be deployed to help participating local governments design

and operationalize climate-resilient, low-carbon municipal collection and routing networks to secure steady-state organic inputs [Sub-activity 3.1.2.4].

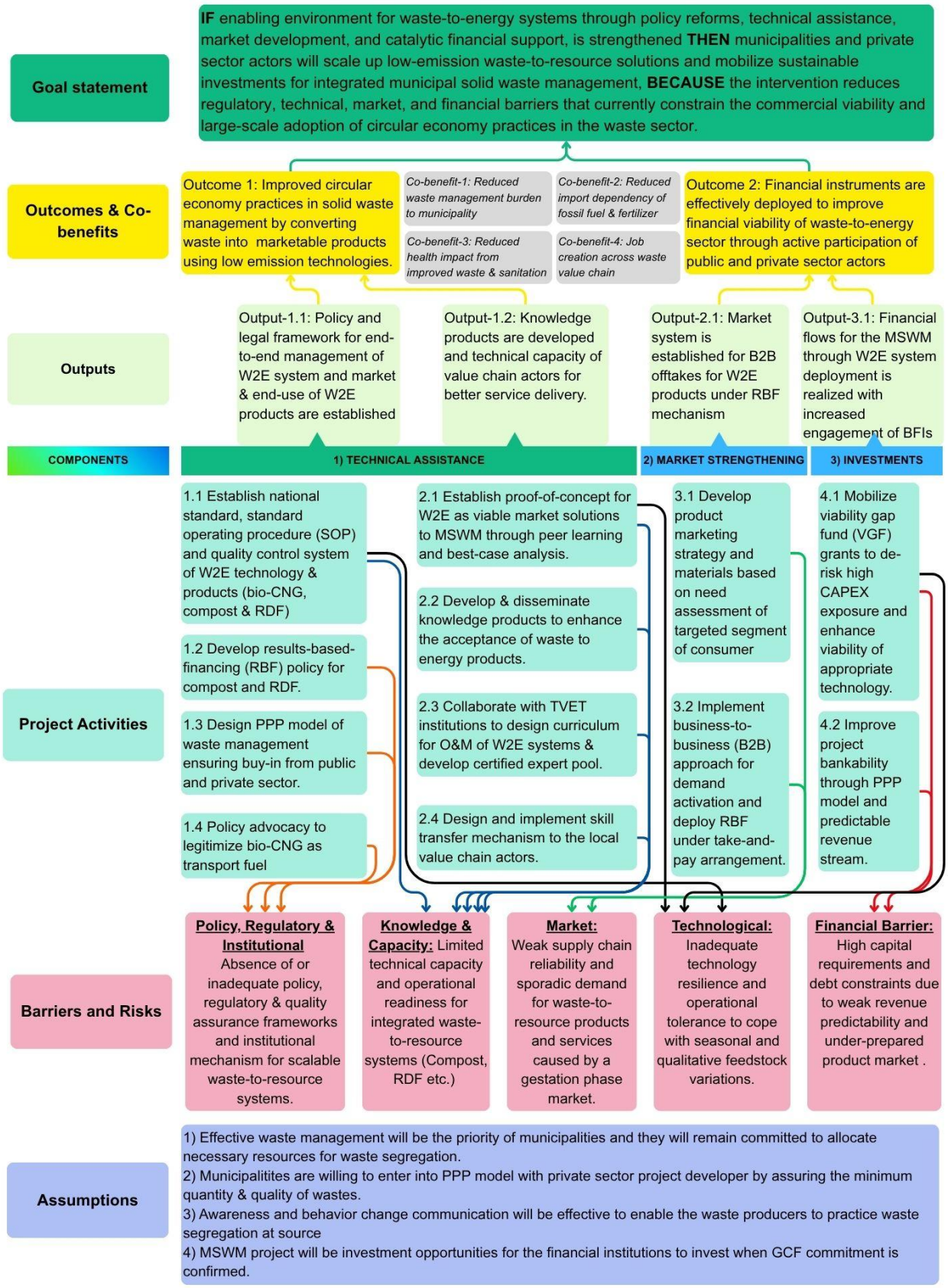


Figure 6: Theory of Change diagram

4 Potential Environmental and Social Risks

4.1 Contribution to Sustainable Development

The proposed programme contributes to multiple Sustainable Development Goals (SDGs) by simultaneously addressing climate change, sustainable urban development, resource efficiency, clean energy generation, and inclusive economic growth. Its strongest contribution is to SDG 13 (Climate Action) through the reduction of methane emissions from municipal waste, displacement of fossil fuels, and enhancement of resilience to climate-sensitive health risks. The programme also advances SDG 11 (Sustainable Cities and Communities) by improving municipal waste management systems, reducing environmental pollution, and supporting cleaner and more resilient urban environments. Through the recovery of waste resources into bio-CNG, RDF, and organic fertilizers, the programme supports SDG 12 (Responsible Consumption and Production) by promoting circular economy principles and reducing reliance on landfilling, while contributing to SDG 7 (Affordable and Clean Energy) through increased production of domestic renewable energy. In addition, the intervention supports SDG 8 (Decent Work and Economic Growth) by creating green jobs and mobilizing private investment, SDG 5 (Gender Equality) through targeted inclusion of women and marginalized groups, and SDG 3 (Good Health and Well-being) by reducing exposure to waste-related environmental hazards and climate-sensitive diseases. The table below summarizes the programme's contribution to the relevant SDGs.

Table 3: SDG indicators and project activity linkages

SDG	Relevant Indicator	Linkage
SDG 7: Affordable and Clean Energy	7. b.1Installed renewable energy-generating capacity	Production of renewable energy in form of Bio-CNG from municipal organic waste and substitution of fossil fuels (LPG and coal) with waste-derived energy products.
SDG 11: Sustainable Cities and Communities	11.6.1 Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities	Improved municipal solid waste management, reduced landfill dependence, cleaner urban environments, and enhanced urban resilience to climate-sensitive health risks.
SDG 12: Responsible Consumption and Production	12.5.1 National recycling rate, tons of material recycled	Resource recovery from waste streams, circular economy approaches, conversion of waste into energy and fertilizer, and reduction in disposal-oriented waste management practices.
SDG 13: Climate Action	13.2.2 Total greenhouse gas emissions per year	Methane emission reduction from organic waste, fossil fuel displacement, climate adaptation through reduction of waste-related health vulnerabilities, and strengthened climate resilience.
SDG 8: Decent Work and Economic Growth	8.5.1 Average hourly earnings of female and male employees, by occupation, age and persons with disabilities	Creation of direct and indirect green jobs, formalization of informal waste workers, promotion of private sector investment, and development of green enterprises.
SDG 3: Good Health and Well-being	3.9.2 Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene (exposure to unsafe Water, Sanitation and Hygiene for All (WASH) services)	Reduced exposure to waste-related pollutants, landfill fires, disease vectors and occupational hazards; improved public and worker health outcomes.

4.2 AE's Risk Assessment Approach

However, there are some environmental and social risks associated with the project following AE's ESS screening guidance based on the ESS policy. The significance of each risk, based on its probability of occurrence and extent of the impact, has been estimated against established risk criteria taking into consideration the magnitude, extent and duration of the risks. Depending on the severity of the impact, the projects are classified into the following risk category:

Table 4: Project categories based on ESS risk

SN	Category	Description	ESS Instrument to be prepared
1	Category "A"	Projects with the potential to cause significant adverse social and/or environmental impacts that are diverse, irreversible or unprecedented.	GoN requirement: project categories listed in Schedule-3 of EPR 2077-Environmental Impact Assessment (EIA) If not in threshold under GoN requirement - Environmental and Social Impact Assessment (ESIA)
2	Category "B"	Projects with the potential to cause limited adverse social and/or environmental impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.	GoN requirement: project categories listed in Schedule-2 of EPR 2077-Initial Environmental Examination (IEE) If not in threshold under GoN requirement - ESIA
3	Category "C"	Projects that include activities with minimal or no risks of adverse social and environmental consequences	GoN requirement: project categories listed in Schedule-1 of EPR 2077- Brief Environmental Studies If not in threshold under GoN requirement - Environmental and Social Management Plan (ESMP)

(Source: AEPC's Updated ESS Policy, 2017)

Safeguards risks under the programme will be screened using a likelihood–consequence matrix and classified as Low, Medium, High, or Severe. Low-risk activities are expected to have minimal or negligible environmental and social impacts. Medium-risk activities may generate limited, site-specific, and largely reversible impacts that can be effectively managed through good international practice, mitigation measures, and stakeholder engagement. High-risk activities involve more significant or uncertain impacts requiring additional assessment and management planning, while Severe-risk activities are associated with potentially irreversible, unprecedented, or highly contentious impacts. In line with AEPC's accreditation scope and Category B environmental and social risk rating, only Low- and Medium-risk activities will be eligible for support under the programme. Any activity assessed as High or Severe risk will be excluded from financing and implementation.

		Consequence				
		Insignificant	Minor	Moderate	Major	Critical
Likelihood	Almost Certain	Low	Medium	High	Severe	Severe
	Likely	Low	Medium	Medium	High	Severe
	Possible	Low	Low	Medium	High	Severe
	Unlikely	Low	Low	Low	Medium	High
	Rare	Low	Low	Low	Medium	High

Figure 7: The risk matrix

(Source: ESS Policy, 2017)

4.2 E&S Risk Assessment at Programmatic Level

There are some environmental and social risks associated with the project following AE's ESS screening guidance based on the ESS policy. The significance of each risk, based on its probability of occurrence and extent of the impact, has been estimated against established risk criteria taking into consideration the magnitude, extent and duration of the risks. Depending on the severity of the impact, the projects are classified into the following risk category:

4.2.1 Environmental Risks

For a programme focused on municipal waste collection, transfer, RDF production, bio-methanation, composting/digestate utilization, and associated transport and storage infrastructure, the following environmental risks are considered as the most material at programme level.

a) Odour, Air Emissions and Dust Pollution

Waste handling, storage of organic feedstock, bio-methanation operations, composting activities, and RDF production can generate nuisance odours, dust, bioaerosols and gaseous emissions. Poorly managed waste storage may result in anaerobic decomposition and release of methane, hydrogen sulphide, ammonia and volatile organic compounds, affecting nearby communities and workers. RDF processing activities may also generate dust and particulate matter, particularly during shredding, drying, and pelletizing operations. These impacts can lead to community complaints, occupational health concerns and reduced social acceptance of project facilities. Given the nature of the proposed facilities, the likelihood of occurrence is High, while the significance is assessed as Moderate, as impacts are generally localized and can be effectively managed through established engineering and operational controls.

b) Leachate Generation and Water Pollution

Improper handling of mixed municipal waste, digestate, organic feedstock, and composting residues may generate leachate containing organic pollutants, nutrients, pathogens, and suspended solids. If not adequately collected and treated, leachate may contaminate nearby surface water bodies, drainage systems, groundwater resources and agricultural land. Extreme rainfall events and flooding may further increase the risk of uncontrolled runoff from waste processing sites. The likelihood of occurrence is Moderate to High, particularly during monsoon periods, while the significance is considered Moderate to High due to the potential impacts on water quality and public health.

c) Fire and Explosion Hazards

Municipal waste processing facilities inherently handle combustible materials such as plastics, paper, textiles and methane-rich biogas. RDF storage areas may be susceptible to combustion, particularly under high temperatures and poor storage conditions. Similarly, bio-methane generation, storage, compression and transport systems present risks of gas leakage, fire, or explosion if safety systems fail. Such incidents can result in significant environmental damage, worker injury, and disruption of facility operations. While modern engineering designs substantially reduce these risks, the likelihood remains Moderate, and the significance is assessed as High due to the potentially severe consequences.

d) Improper Digestate and Compost Utilization

The programme intends to promote utilization of digestate and compost as organic fertilizers. However, inadequate feedstock quality control, contamination of municipal waste streams, or insufficient treatment processes may result in compost or digestate containing pathogens, heavy metals, plastics, or other contaminants. Application of contaminated products could affect soil quality,

agricultural productivity, food safety, and water resources. The likelihood of occurrence is Moderate, while the significance is Moderate, provided quality assurance protocols and product standards are enforced.

e) Increased Transport-Related Environmental Impacts

The programme will require regular transportation of waste feedstock, RDF, bio-CNG, compost, and digestate between municipalities, processing facilities, and end-users. Increased vehicle movements may contribute to traffic congestion, fuel consumption, dust generation, noise, and localized air emissions. Although these impacts are generally temporary and dispersed, they may become more pronounced around processing facilities and transport corridors. The likelihood of occurrence is High, but the overall significance is considered Low to Moderate because impacts are localized and manageable through route planning and operational controls.

f) Residual Waste and Secondary Waste Management

Even after resource recovery, a portion of incoming municipal waste will remain unsuitable for bio-methanation, composting, recycling or RDF production. In addition, the facilities may generate screening rejects, contaminated plastics, sludge, spent filters and maintenance waste. Inadequate management of these residual waste streams could undermine the environmental benefits of the programme and create localized pollution risks. The likelihood of occurrence is High, as residual waste generation is inevitable, while the significance is assessed as Moderate because appropriate disposal arrangements can effectively mitigate impacts.

4.2.2 Social Risks

a) Occupational Health and Safety Risks

Workers involved in waste collection, segregation, transportation, RDF production, bio-methanation operations, and fertilizer handling may be exposed to physical, biological, chemical, and mechanical hazards. These include injuries from machinery, exposure to pathogens, contact with sharp objects, dust inhalation, heat stress, noise exposure, and accidents associated with handling compressed biogas systems. Informal waste workers may face particularly elevated risks due to limited awareness of occupational safety procedures and inadequate use of personal protective equipment. The likelihood of occurrence is High, while the significance is assessed as Moderate to High, depending on the effectiveness of workplace safety measures.

b) Community Health and Safety Risks

Communities residing near waste processing facilities may experience nuisance impacts arising from odour, dust, noise, increased traffic movement, accidental waste spillage, or occasional fire incidents. Improperly managed waste storage may also contribute to proliferation of disease vectors such as flies, rodents, and mosquitoes, potentially affecting nearby settlements. In addition, increased movement of waste transport vehicles may increase road safety risks, particularly in densely populated urban areas. The likelihood of occurrence is Moderate, while the significance is considered Moderate due to the localized nature of impacts.

c) Impacts on Informal Waste Workers and Livelihoods

The programme aims to improve municipal waste management systems and increase formal resource recovery activities. While this may create new employment opportunities, it could also affect the livelihoods of informal waste pickers who currently depend on access to municipal waste streams for

income generation. If not properly managed, the formalization of waste recovery systems may unintentionally exclude vulnerable groups from existing livelihood opportunities. The likelihood of occurrence is Moderate, while the significance is assessed as Moderate, particularly in municipalities with a substantial informal waste sector.

d) Gender and Social Inclusion Risks

Women, Dalits, marginalized communities, and other socially excluded groups may face barriers to participation in project-supported employment, training, decision-making processes, and economic opportunities. Without targeted inclusion measures, project benefits may be disproportionately captured by better-connected stakeholders or private operators. There is also a risk that occupational roles may reinforce existing gender inequalities within the waste management sector. The likelihood of occurrence is Moderate, while the significance is considered Moderate given the programme's emphasis on employment creation and community engagement.

e) Labor and Working Conditions Risks

Private sector operators, contractors, and subcontractors engaged under the programme may employ temporary, casual, or contracted labour. Potential risks include inadequate occupational safety provisions, unfair employment conditions, excessive working hours, discrimination, insufficient grievance mechanisms, or non-compliance with national labour regulations. These risks may become more pronounced during facility construction and early operational phases. The likelihood of occurrence is Moderate, while the significance is assessed as Moderate, as impacts are generally manageable through appropriate labour management systems.

f) Stakeholder Acceptance and Social Conflict Risks

Waste management infrastructure often faces resistance from nearby communities due to concerns regarding odour, pollution, traffic, property values, and perceived health risks. In some municipalities, disputes may also arise regarding facility siting, allocation of municipal land, waste supply agreements, benefit-sharing arrangements, or employment opportunities. If stakeholder expectations are not adequately managed, these concerns may delay implementation and reduce project effectiveness. The likelihood of occurrence is Moderate, while the significance is assessed as Moderate, particularly during site selection and facility establishment stages.

g) Sexual Exploitation, Abuse and Harassment (SEAH) Risks

The programme will involve interactions between project workers, contractors, municipal officials, private operators, community members, waste workers, trainees, and vulnerable groups during project implementation. Although the programme does not involve labour camps, large-scale workforce influx, or activities commonly associated with elevated SEAH risks, there remains a possibility of inappropriate behaviour, workplace harassment, abuse of authority, discriminatory practices, or sexual harassment occurring in project-supported workplaces, training events, consultations, recruitment processes, or community engagement activities. Women, informal waste workers, young workers, and socially marginalized groups may be particularly vulnerable to such risks due to existing social and economic inequalities. The likelihood of occurrence is assessed as Low to Moderate, while the significance is considered Moderate given the potential consequences for affected individuals and the reputational risks to the programme.

5 Environmental and Social Risks Management Process

5.1 Exclusion List

The Exclusion List constitutes the first step of the programme's Environmental and Social Risk Management Process. Prior to detailed environmental and social screening, all proposed subprojects will be assessed against the exclusion list to determine their eligibility for financing. Activities included in the exclusion list will not be supported under the programme irrespective of their potential benefits, as they are considered incompatible with the programme's environmental and social commitments, exceed the environmental and social risk management capacity of the AE, or are inconsistent with applicable national legislation and GCF Environmental and Social Policy requirements. Only activities that successfully pass the exclusion screening will proceed to subsequent stages of environmental and social risk assessment and categorization.

5.1.1 Environmental & Social Exclusions

The programme will not support the projects that will entail the activities that entail the following environmental and social exclusions:

Table 5: Environmental and Social Exclusions

Environmental Exclusions	Social Exclusions

a) Activities classified as high-risk (Category A/I-1) under applicable GCF environmental and social risk categorization frameworks.
b) Construction or operation of facilities located within:
  a. Protected Areas, National Parks, Wildlife Reserves, Conservation Areas, or Ramsar Sites;
  b. Critical natural habitats;
  c. Areas of high biodiversity value or ecological significance.
c) Activities requiring involuntary conversion or significant degradation of natural habitats, forests, wetlands, rivers, or other ecologically sensitive ecosystems.
d) Construction of new sanitary landfills, open dumping sites, or waste disposal facilities that primarily rely on landfilling as the waste management solution.
e) Construction of incineration facilities.
f) Activities involving the manufacture, trade, storage, transport, or use of:
  a. Persistent Organic Pollutants (POPs);
  b. Ozone-depleting substances;
  c. Hazardous chemicals prohibited under national legislation or international conventions.
g) Activities involving the treatment, storage, transport, or disposal of:
  a. Medical and infectious waste;
  b. Radioactive waste;
  c. Hazardous industrial waste;
  d. Electronic waste.
h) Activities resulting in significant abstraction or contamination of surface water or groundwater resources.
i) Activities involving significant generation of hazardous emissions, toxic residues, or contaminated effluents.
j) Procurement of equipment containing asbestos, polychlorinated biphenyls (PCBs), or other internationally prohibited materials.
	a) Activities requiring physical displacement, involuntary resettlement, or economic displacement of households, businesses, or informal livelihood groups.
	b) Activities requiring acquisition of private land through compulsory acquisition or eminent domain.
	c) Activities resulting in adverse impacts on Indigenous Peoples, local communities, or vulnerable groups that cannot be mitigated through Free, Prior and Informed Consent (FPIC) or meaningful consultation processes, where applicable.
	d) Activities involving child labour, forced labour, bonded labour, or any form of labour exploitation.
	e) Activities associated with significant occupational health and safety risks that cannot be adequately managed through standard industry practices.
	f) Activities that may increase risks of Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH), human trafficking, or other forms of abuse without adequate prevention and response mechanisms.
	g) Activities causing damage to cultural heritage sites, archaeological resources, religious sites, or areas of cultural significance.
	h) Activities that restrict public access to essential services, natural resources, or community infrastructure.

5.1.2 Financial and Governance Exclusions

The programme will also not support the projects that will entail any activity that promotes mal-practices, corruption and non-compliances related to the prevailing laws. Specifically, on the financial and governance grounds, the following are identified as exclusion criteria:

a) Activities involving corruption, fraud, coercive practices, collusion, money laundering, or financing of illegal activities.
b) Activities undertaken by entities that have been convicted of serious environmental, labour, social, or governance violations and have not demonstrated corrective actions.
c) Activities inconsistent with Nepal's environmental laws, labour laws, waste management regulations, climate policies, or international obligations.
d) Any activity that would result in non-compliance with the GCF Environmental and Social Policy, Gender Policy, Indigenous Peoples Policy, or applicable ESS requirements.

Given the nature of the programme, financing shall be limited to waste recovery, bio-methanation, RDF production, resource recovery, composting, associated logistics and supporting infrastructure. The programme shall not finance:

a) Fossil fuel production, extraction, processing, storage, or distribution;
b) Coal-based energy infrastructure;
c) Waste-to-energy facilities based on mass-burn municipal waste incineration;
d) Activities involving hazardous waste treatment;
e) Expansion of existing open dumpsites;
f) Projects requiring environmental impact assessments equivalent to high-risk Category A developments.

5.2 Environmental and Social Risk Screening

Based on the screening results (**Table 6**), the proposed programme presents an overall moderate E&S Risk Profile, broadly consistent with a Category B risks consistent to AEPC's accreditation scope. The screening indicates that the programme is unlikely to result in significant, irreversible or unprecedented environmental or social impacts, primarily because all facilities will be developed within or adjacent to existing municipal waste disposal sites and the programme explicitly excludes activities involving protected areas, critical habitats, cultural heritage sites, land acquisition, involuntary resettlement, forest clearance, or other high-risk activities. The programme therefore avoids the principal risk factors that typically elevate waste management projects into higher-risk categories.

The screening further indicates that most identified risks are site-specific, manageable, and capable of being mitigated through established engineering controls, operational procedures, stakeholder engagement measures, and environmental management plans. Environmental risks primarily relate to occupational health and safety, odour emissions, accidental methane leakage, wastewater and leachate management, transportation-related nuisances, and potential localized impacts on nearby water bodies, wetlands, forests, or settlements. These risks are largely predictable and can be effectively addressed through appropriate site selection criteria, compliance with national environmental standards, implementation of pollution prevention measures and routine monitoring during construction and operation. From a social perspective, the programme does not trigger displacement, loss of livelihood, or restriction of access to community resources. However, there remains a possibility of impacts associated with labour management, worker health and safety, community concerns regarding waste processing facilities, interactions between workers and neighbouring communities, and the inclusion of vulnerable groups, informal waste workers, women,

and socially marginalized populations. These risks are similarly manageable through stakeholder consultations, implementation of labour management procedures, grievance redress mechanisms, occupational health and safety plans, and gender and social inclusion measures.

The screening also identifies several risks that cannot be fully assessed at the programme level due to the future selection of municipalities and project sites. These include proximity to settlements, forests, wetlands, water bodies, and the presence of vulnerable populations. Consequently, each subproject will require a site-specific environmental and social screening and, where necessary, further assessment proportionate to the identified risks before financing approval. The programme-level ESMF therefore serves as a risk management framework that establishes exclusion criteria, screening procedures, mitigation requirements, monitoring arrangements, and institutional responsibilities to ensure that subprojects remain within AEPC's accredited risk appetite. The screening result suggests that the programme's anticipated E&S impacts are limited in scale, largely reversible, site-specific, and capable of being effectively mitigated through good international industry practice and project-specific management measures. Accordingly, the programme is considered suitable for implementation under a Category B environmental and social risk classification, subject to compliance with the ESMF, exclusion list, and subsequent subproject-level E&S due diligence requirements.

Table 6: Environmental and Social Risk Screening of the Programme

S.N.	Screening Questions	Yes	May be	No	Evaluation
	ESS Policy Principle 1: Assessment and management of environmental and social risk and impacts				
1.	Is project area located in Protected Area, Buffer zone of protected area or Special area for protecting biodiversity?			✔	At programmatic level, the siting of the project at the protected area or the special area for protecting biodiversity falls under the exclusion list. Any such project will not make it to other E&S risk screening.
2.	Is there forest adjacent or nearby the project area?		✔		The disposal of the MSW nearby forest area might be a likely scenario and to reduce the incremental burden, the project facilities will be sited in a part of the existing disposal/landfill site. In order for the project to receive support from the programme, the project location shall be sufficiently away from the nearest forest. Where a forest is adjacent to the project site, the potential incremental impacts due to the project shall be evaluated. However, the programme shall not support the activities that involves felling of the trees.
3.	Is there any cultural and/or religious site nearby the project area?			✔	At programmatic level, the siting of the project in proximity to a place of cultural or religious significance falls under the exclusion list. Any such project will not make it to other E&S risk screening.
4.	Are there settlements nearby the project area?		✔		There might be a community close to the existing landfill site in form of formal/informal settlement. Such community shall be consulted upon during the preparation of the E&S assessment report for the specific municipality.
	ESS Policy Principle 2: Biodiversity conservation and sustainable management of living natural resources				

S.N.	Screening Questions	Yes	May be	No	Evaluation
5.	Is there any range of endangered or threatened animals and birds nearby the project?	✔			The landfill area might witness the animals and birds from the vicinity attracted by the food waste going to the landfill. However these will likely be the scavengers and domesticated animals rather than the endangered animals. A confirmation on the prevalence of such birds and animals in the project vicinity shall be taken during the stakeholder consultation.
6.	Are there wetlands in the subproject's vicinity?		✔		There might be the wetlands in the vicinity of the proposed project sites. In case such wetland fall under the area of special significance the, project shall fall under the exclusion. If the wetland is human made, the potential impacts to such wetlands shall be documented during the detail E&S assessment.
7.	Are there unique or aesthetically valuable land or water form?			✔	The area of aesthetic value are seldom used for the waste disposal. Since the project will be sited nearby the landfill site, the availability of land/water of unique aesthetic value is ruled out.
	ESS Policy Principle 3: Human Rights				
8.	Is the Information disseminated to the community?	✔			Information dissemination is part of the process and each individual project shall comply it.
9.	Are there Vulnerable Groups (Adibasi/Janajati/Dalit/female headed households residing within or adjacent to project site?			✔	The project will not build an entirely new facility to trigger incremental impacts to the vulnerable groups. And the project falls on exclusion criteria if any form of land-acquisition is triggered. Any other information of the population residing nearby the project area is subject to be a part of the detail E&S assessment
10.	Are there any Community Resource Properties resources that might be affected due to project intervention?			✔	Since the project will not introduce additional requirement of the land or other forms of public amenities, no community resource or properties are likely to be affected by the project intervention.
11.	Are there any natural resources that might be affected due to project intervention?			✔	Since the project will not introduce additional requirement of the land or other forms of resources, incremental stress on the existing natural resources is unlikely.
12.	Are there any water sources?		✔		Riverside disposal of MSW is a likely scenario. However, the project will not create incremental impacts due to siting of project components in a part of the existing disposal/landfill site. In order for the project to receive support from the programme, the project location shall be sufficiently away from any water body.
13.	Will the project affect livelihood of the community or people?			✔	The project doesn't involve the any activity that interferes with the existing livelihood of the community. Since the project aims to capitalize on

S.N.	Screening Questions	Yes	May be	No	Evaluation
					the existing value chain, no such impacts are envisaged.
	ESS Policy Principle 4: Labour and working conditions:				
14.	Potentiality of Waste generation?			✔	The project is likely to generate residual wastes during the processing. However, the project will not generate incremental waste in comparison to ongoing waste management process. Hence this doesn't involve incremental wastes.
15.	Are there risk related to occupational health and safety during project construction and operation?	✔			The occupational health and safety risks are pertinent at the facility level, this will include the process oriented risks such as exposure to noise, heat and ergonomics.
16.	Is there risk of social conflicts between worker and community people?		✔		The project will attract a workforce to the facility. Only in the situation where there is a community adjacent to the project area, such conflicts are likely. The likelihood of such conflicts during the project construction and operation is subject to detail E&S assessment.
	ESS Policy Principle 5: Community Health Safety and Security				
17.	Will Health and Safety be an issue in the project due to construction and operation phase to worker or community people nearby?			✔	The construction and operation of the proposed project will have very little impact on the community health, safety and security as no incremental impacts will be imparted by the project.
18.	Will there be potential environmental hazards like floods, erosions, etc. due to construction and operation activities?			✔	As the project will be sited in the existing landfill area, it will not directly trigger any potential environmental hazards such as flood, erosion etc. due to the project related construction and operation activities
	ESS Policy Principle 6: Land Acquisition and involuntary resettlement				
19.	Families or household affected?			✔	Any project involving the direct land acquisition or involuntary resettlement will be excluded from the programme.
20.	Will project require the land for project installation?			✔	The project not require additional land for the installation of the project. Any necessary land will be available for the project within the existing landfill site.
	ESS Policy Principle 7: Resource Efficiency and pollution Preventions				
21.	Will there be any source of pollution? (including transportation)	✔			Although the project will not directly act as a source of pollution, the physical leakage of the methane from the cio-CNG plants and odor pollution from the RDF plant is pertinent issue.

5.3 Environmental and Social Management Measures

Based on the preliminary environmental and social screening, the proposed programme is expected to generate predominantly site-specific and manageable risks associated with waste processing, bio-methanation, RDF production, transportation, occupational health and safety, labour management, and community interactions. While the exact nature and magnitude of impacts will vary across municipalities and individual subprojects, the programme has identified a set of generic environmental and social

management measures to guide risk mitigation throughout project design, construction, operation, and decommissioning. These measures establish the minimum environmental and social requirements to be incorporated into all subprojects financed under the programme and will be further refined through site-specific Environmental and Social Management Plans (ESMPs) prepared during subproject implementation. The implementation of the management measures, together with site-specific ESMPs, stakeholder engagement processes, labour management procedures, grievance mechanisms and regular monitoring, is expected to reduce residual environmental and social risks to acceptable levels consistent with the programme's Category B risk classification.

Table 7: Environmental and social risk management measures

Risk Category	Potential Impact/Risk	Key Management Measures
Biodiversity and Natural Habitats	Disturbance to nearby forests, wetlands, wildlife and ecological resources	Exclude protected areas and critical habitats; maintain buffer distances from sensitive ecosystems; undertake site-specific biodiversity screening; prohibit tree felling unless authorized.
Water Resources and Water Quality	Contamination of nearby surface water and groundwater from leachate, wastewater or accidental spills	Maintain setback distances from water bodies; install drainage and leachate collection systems; treat wastewater prior to discharge; monitor water quality periodically.
Air Quality and Odour	Odour nuisance, fugitive emissions, dust generation and methane leakage	Install gas capture and treatment systems; implement odour management plans; maintain equipment regularly; suppress dust during construction and waste handling.
Pollution and Waste Management	Residual waste generation and improper disposal of rejects	Develop waste management plans; maximize material recovery; ensure safe handling and disposal of residual wastes through approved facilities.
Fire and Explosion Hazards	Fire incidents associated with methane, RDF storage and combustible waste	Develop fire prevention and emergency response plans; install fire detection and suppression systems; maintain safe storage practices and emergency preparedness measures.
Occupational Health and Safety	Worker injury, exposure to pathogens, machinery accidents, noise and heat stress	Provide PPE; implement OHS plans; conduct safety training; establish incident reporting systems; maintain machine safeguards and emergency procedures.
Community Health and Safety	Exposure to odour, traffic hazards, noise and accidental releases	Control traffic movements; maintain community safety signage; implement emergency response procedures; maintain regular stakeholder communication.
Labour and Working Conditions	Unsafe working conditions, labour disputes, discrimination and unfair employment practices	Develop Labour Management Procedures; ensure compliance with labour laws; establish worker grievance mechanisms; provide equal employment opportunities.
Livelihood and Informal Waste Workers	Disruption of existing informal waste recovery activities	Assess existing waste value chains; prioritize inclusion of informal workers; provide livelihood restoration and employment opportunities where relevant.
Gender and Social Inclusion	Unequal access to project benefits and employment opportunities	Implement GESI Action Plan; ensure inclusive consultations; promote participation of women and marginalized groups in employment and training.
Sexual Exploitation, Abuse and Harassment (SEAH)	Harassment, exploitation or abuse involving workers and communities	Adopt Codes of Conduct; conduct SEAH awareness training; establish confidential reporting and survivor-centred grievance mechanisms.

Risk Category	Potential Impact/Risk	Key Management Measures
Stakeholder Relations and Social Conflict	Community opposition, disputes and grievances	Conduct meaningful stakeholder consultations; establish Grievance Redress Mechanism (GRM); disclose project information regularly.
Cultural Heritage	Chance discovery of archaeological or cultural resources during construction	Implement Chance Find Procedures; immediately halt work upon discovery and notify relevant authorities.
Resource Efficiency and Climate Performance	Inefficient use of energy, water and materials	Promote resource-efficient technologies; monitor energy recovery performance; optimize water use and material recovery rates.

The risks identified (**Table 8**) are indicative and represent the most likely environmental and social issues associated with the implementation of bio-methanation and RDF production facilities under the programme. During subproject preparation, each facility shall undergo site-specific environmental and social screening to determine the applicability and significance of these risks and to develop appropriate mitigation measures through project-specific Environmental and Social Management Plans (ESMPs). Responsibility for implementation of mitigation measures shall rest primarily with the Project Developer, while AEPC (Accredited Entity) shall provide oversight and compliance monitoring, and participating municipalities shall support stakeholder engagement, waste supply management, and local coordination activities.

Table 8: Anticipated impacts and mitigation measures

Project Activity	Potential risk	Proposed management measures	Responsible party
Activity 1.2.1: Establish proof-of-concept for W2E as viable market solutions to MSWM through peer learning and best-case analysis.			
Pilot demonstration of the production of RDF and Fertilizers in the industry and Farms	Fugitive emissions during RDF production.	Emissions from the RDF production machines is controlled while preparing the specification of the machine by putting the emissions as one of the key criteria.	Accredited entity
	Safety issues related to the operation of the production unit.	Prepare a standard operating procedure and provision the PPE (Mask, Gloves etc.) to the RDF handler to avoid any situation that compromises safety. Also, limit the unit from visitors' access.	Project Developer
	Perceived risks due to the quality of the fertilizer produced.	Undertake the quality test of fertilizer from the accredited laboratory for the assurance of the product quality and its suitability for farm applications.	Accredited Entity
Activity 3.1.1: Improve project bankability through PPP model and predictable revenue stream.			
Implementation of biogas plants	Physical methane leakage from digesters, storage tanks, piping systems and gas upgrading units resulting in GHG emissions and fire hazards	Regular inspection and maintenance of gas handling systems; installation of gas leak detection systems; implementation of preventive maintenance schedules; emergency response procedures	Project Developer
	Odour generation during feedstock reception, storage and digestate handling affecting nearby communities	Maintain enclosed feedstock handling areas; rapid processing of organic waste; good housekeeping practices; implementation of odour management plans	Project Developer
	Leachate and wastewater generation causing contamination of nearby surface water or groundwater	Install drainage systems, leachate collection facilities and wastewater treatment units; prohibit direct discharge into water bodies; periodic water quality monitoring	Project Developer
	Occupational health and safety risks associated with machinery, confined spaces, biological agents, noise and gas exposure	Develop OHS Plan; provide PPE; worker training; emergency preparedness procedures; periodic health and safety audits	Project Developer

Project Activity	Potential risk	Proposed management measures	Responsible party
	Fire and explosion risks associated with methane storage and handling	Install fire detection and suppression systems; maintain safety distances; prepare emergency response plans; conduct regular safety drills	Project Developer
	Traffic and transportation impacts associated with waste delivery and digestate distribution	Traffic management plans; designated transport routes; vehicle maintenance; scheduling to avoid peak traffic periods	Municipality/Project Developer
	Community concerns related to odour, traffic and facility operation	Stakeholder consultations; information disclosure; grievance redress mechanism; regular communication with neighbouring communities	Municipality/Project Developer
	Exclusion of informal waste workers from the waste value chain	Assess existing waste recovery practices; prioritize integration of informal workers into project-supported waste collection and sorting systems	Municipality/Project Developer
	Gender, labour and SEAH risks during construction and operation	Labour Management Procedures; Code of Conduct; SEAH awareness training; confidential grievance mechanism	Municipality/Project Developer/ AE
Implementation of RDF plants	Dust emissions during waste sorting, shredding, screening and RDF production	Install dust suppression systems; provide enclosed processing areas where feasible; regular cleaning and maintenance; use of PPE	Project Developer
	Odour nuisance arising from temporary storage of mixed municipal waste	Minimize waste storage duration; maintain covered storage areas; regular waste processing and housekeeping measures	Project Developer
	Noise and vibration from shredders, conveyors and pelletizing equipment	Install noise control measures; provide hearing protection; maintain equipment; restrict noisy activities to designated hours	Project Developer
	Fire hazards associated with storage of combustible RDF materials and plastic-rich waste streams	Fire prevention plans; designated storage areas; fire detection and suppression systems; routine inspections; emergency response procedures	Project Developer
	Air pollution from RDF handling and transportation activities	Proper storage and covering of RDF materials during transportation; vehicle maintenance; dust suppression measures	Project Developer

Project Activity	Potential risk	Proposed management measures	Responsible party
	Occupational injuries from moving machinery, conveyors and shredding equipment	Machine guarding; lock-out/tag-out procedures; worker training; PPE provision; routine safety inspections	Project Developer
	Community health and nuisance impacts from traffic, dust and operational activities	Traffic management plans; stakeholder consultations; grievance mechanism; periodic monitoring of nuisance impacts	Municipality/Project Developer
	Improper disposal of non-process able residual waste fractions	Develop waste management procedures; ensure disposal through approved facilities; maintain records of waste disposal	Project Developer
	Labour, social inclusion and SEAH risks during construction and operation	Labour Management Procedures; worker grievance mechanism; Code of Conduct; GESI measures and SEAH prevention protocols	Project Developer / AE
	Market failure resulting in stockpiling of RDF products and associated environmental risks	Establish off-take agreements prior to operation; monitor inventory levels; develop contingency storage and disposal arrangements	Project Developer / AE

6 Legal and institutional framework

6.1 Applicable Legal Framework in Nepal

This section summarizes the legal and institutional framework for the project, including the country's applicable policy framework (i.e., national laws and regulations) relating to relevant social and environmental issues, including obligations of the country directly applicable to the project under relevant international treaties and agreement.

Table 9: Legal and regulatory provision related to the programme

Regulation/ Standards	Description and Provision
Constitution of Nepal, (2015)	▪ The constitution requires the nation to give priority to the protection of environment and prevention of the further damage of the environment on the account of physical development activities. ▪ The constitution of Nepal, 2015 Guarantees people's welfare and all-round-progress through economic, social and cultural transformation, while defending and strengthening political achievements and their development. ▪ It has spelled out the matter of loss or damage caused by the emission of global GHGs and the right of citizens to get compensation as per national and international laws, negotiations and treaties. ▪ It prescribes for the State to give priority to the protection of the environment and prevention of its further damage due to physical development activities. ▪ Clause 1 of Article 35 ensures every citizen's right to free basic health services, access to information about their health, equal access to healthcare, and the right to clean water and hygiene from the state.
Environment Protection Act, 2019	▪ This act provides a legal basis for the concerned authorities for regulating a BES, IEE or/and EIA. ▪ This act stipulates that no one is to create pollution that would cause significant adverse impacts on the environment or harm to public life and health, or to generate pollution beyond the prescribed standards. ▪ It provides a basis for the protection of objects and places of national heritage and places with rare plants, wildlife and biological diversity and states that any person/party affected by pollution or adverse environmental impact caused by anybody may apply to the prescribed authority for compensation to be recovered from the polluter/pollution generator.
Labor Act, 2017	▪ The Act emphasizes on occupational health and safety of workers and stipulates provision of necessary safety gears and adopting necessary precautionary measures against potentially hazardous machine/equipment in the workplace. It also stipulates to arrange such as removal of waste accumulated during production process and prevention of dust, fume, vapor and other waste materials, which adversely affect the health of workers. ▪ This act classified people below 15 years as child and "Nabalik" for the age group of above 14 years and below 18 years. ▪ The act also stated that equal opportunity will be given to women as man. Similarly, working period of other employees must not exceed 8 hours a day and 48 hours in week.

Regulation/ Standards	Description and Provision
Child Labor Prohibition and Regulation Act, 2001	▪ This act prohibits to engage children below 16 years in works in risk-prone sectors such as construction related works. In other words, any employment of children below the age of 16 is to be excluded from becoming contracted in any of the project construction works.
Local Government Operation Act, 2017	▪ The legal framework delineates the roles and regulations of local governments in delivering services and amenities to their communities, while also defining procedures for the establishment, dissolution, and restructuring of local governments.
Solid waste management Act, 2011	▪ Article 4 provides that the management of hazardous, medical, chemical or industrial waste rest upon the generators of such wastes. Management should be as prescribed in the Act. ▪ Article 5 provides that individuals and entities have the duty to reduce the amount of solid waste generated while carrying out work or business.
National Foundation for Development of Indigenous Nationalities Act, 2058 BS (2002 AD)	▪ It defines those ethnic groups and communities who have their own mother language and traditional rites and customs, distinct cultural identity, distinct social structure and written or unwritten history. The act has recognized 59 indigenous communities in Nepal. These indigenous communities are known as Adivasi/Janjati in Nepali and Indigenous Nationalities in English as per the act. These groups as whole are generally considered to be the marginalized segment of the population who engage in economic activities ranging from hunting/gathering and shifting agriculture in or near forests to wage laborers or even small-scale market-oriented activities.

6.2 Project institutional framework for implementing ESMF

The ESMF will be implemented through a tiered institutional arrangement that aligns with the overall programme governance structure. The arrangement is designed to ensure that E&S risks are identified, assessed, managed, monitored, and reported throughout the project cycle while maintaining clear accountability among the AE, participating municipalities and private sector project developers. At the programme level, AEPC, as the Accredited Entity and Executing Entity, will have the overall responsibility for E&S oversight and compliance with GCF ESS requirements. AEPC's ESS focal point will manage the activities related to screening subprojects, reviewing E&S assessment documents, ensuring compliance with the ESMF and exclusion list, consolidating safeguards monitoring reports and reporting E&S performance to the GCF. AEPC will provide technical guidance, capacity building, and quality assurance support during project preparation and implementation.

At the subproject level, the Project Developer will be primarily responsible for preparing and implementing site-specific ESMPs and other plans (e.g., ESMP, OHS Plan, Stakeholder Engagement Plan, Labor Management Procedures, Emergency Response Plan) as required by the ESMF. The developer will ensure compliance with national regulatory requirements, obtain all necessary environmental permits and approvals, implement mitigation measures, maintain monitoring records, and submit periodic compliance reports to AEPC. The municipalities will support implementation through provision of land and waste supply arrangements, facilitation of community consultations, monitoring of local environmental performance and resolution of community grievances related to municipal service delivery. Municipalities will also participate in site inspections and safeguards monitoring as part of their oversight role. To ensure accountability and transparency, E&S monitoring will be undertaken through a combination of developer self-monitoring, municipal oversight, and periodic supervision by

AEPC. Any incidents, accidents, grievances, or non-compliance issues will be reported through a structured escalation mechanism and corrective actions will be tracked until closure.

Table 10: ESMF implementation responsibility matrix

Institution	Key Responsibilities
AEPC (AE)	ESMF implementation oversight, screening, review and approval of safeguards instruments, monitoring, capacity building, reporting to GCF, corrective action tracking.
Municipality	Support consultations, monitor local compliance, facilitate grievances, oversee waste supply arrangements, and participate in site inspections.
Project Developer	Prepare and implement ESMPs and other safeguards plans, obtain permits, implement mitigation measures, maintain OHS standards, conduct monitoring and reporting.
Contractors/Suppliers	Comply with ESMP, OHS requirements, labor standards, waste management measures, and code of conduct requirements.

7 Stakeholder engagement and information disclosure

7.1 Stakeholder Consultation

Stakeholder engagement is a fundamental component of the proposed programme and forms an integral part of the environmental and social risk management process. Given the programme's focus on municipal solid waste management, waste-to-energy infrastructure, and public-private partnership arrangements, meaningful engagement with affected communities, local governments, private sector operators, waste workers, civil society organizations, and relevant government agencies is essential to ensure transparency, social acceptance, and informed decision-making throughout the project cycle.

At the programme level, stakeholder consultations have already been done during project preparation to inform programme design, identify key environmental and social concerns, validate implementation modalities, and understand market and institutional barriers. These consultations involved representatives from federal and local governments, development partners, private sector, industry association, NGOs, CSOs and representative from IPs. The feedback received during these engagements has been incorporated into the programme design. Going forward, AE will ensure the facility level consultation during detail feasibility study, environmental and social safeguard assessments and gender assessments at facility level. Since, AE has experience in implementing the large-scale biogas projects and has Standard Operating Procedures for implementing such activities win close coordination with stakeholders, the local stakeholders have applauded the projects as it confirms the mitigation and adaptation benefits while improving health related benefits by the waste. The feedback from the stakeholder consultation is summarized in table below:

Table 11: Summary of stakeholder feedback

Stakeholder Concern Received	Recommendation	Proposed Incorporation in Project Design
Lack of standards for Bio-CNG, Fertilizer and RDF s	Support in developing standards and regulatory instrument	Include technical assistance for regulatory alignment, standards finalization, and operational guidelines
Lack of Accredited lab in Nepal to test Bio-CNG, Fertilizer and RDF. Currently developers send the samples to India for test	Support for the establishment of accredited laboratories and capacity building for testing and certification.	Include the accredited Labs and capacity building support
Weak waste segregation	Promote source segregation and incentives	Include municipal waste segregation campaigns, household incentives, and enforcement support
Lack of affordable finance	Provide concessional loans and blended finance	Develop de-risking financing instruments using GCF support, such as Viability Gap Funding (VGF)
Uncertain Bio-CNG market	Ensure off-take mechanisms	Facilitate linkages with transport sector, NOC, institutional/ industrial users.
Weak fertilizer market	Promote organic fertilizer acceptance	Link digestate/fertilizer with agriculture programmes and farmer awareness, and introduce Result-Based Financing (RBF) to incentivise the WtE project developer to explore and expand the market for Fertilizer.
Existing plants are struggling	Support rehabilitation and optimization	Include technical assistance for existing WTE facilities where feasible
Weak municipal capacity	Strengthen local government capacity	Include capacity-building and institutional support for municipalities

Stakeholder Concern Received	Recommendation	Proposed Incorporation in Project Design
Poor intergovernmental coordination	Establish coordination mechanism	Establish federal-provincial-local coordination structure under the project
Risk to vulnerable groups	Include GESI and safeguards	Integrate GESI action plan, GRM, stakeholder engagement plan, and OHS measures
In many cases, the financial assumptions and parameters used in project analyses do not adequately reflect ground realities, leading to unrealistic assessments of project viability.	Use realistic financial modelling approaches based on field-level technical, operational, and market data.	Conduct field-based technical, financial, and market assessments during detailed feasibility study and develop realistic assumptions and improve the accuracy and reliability of project financial analyses.

At the subproject level, each participating municipality and project developer will be required to undertake site-specific stakeholder consultations as part of the environmental and social assessment process. Consultations shall be conducted in a culturally appropriate, gender-responsive, and inclusive manner, ensuring participation of women, informal waste workers, marginalized groups, Indigenous Peoples, Dalits, nearby communities, local businesses, and other potentially affected stakeholders. The consultation process will seek to identify project-related concerns, gather local knowledge, assess potential impacts, and jointly discuss mitigation measures. Stakeholder engagement shall be viewed as a continuous process rather than a one-time event and will continue throughout project implementation and operation.

Particular attention shall be given to communities residing near existing landfill and waste disposal sites, as these communities may experience both positive and adverse impacts associated with project implementation. Similarly, informal waste workers and waste pickers who derive livelihoods from existing waste streams shall be consulted to ensure that project interventions do not unintentionally undermine their income opportunities and that appropriate measures for inclusion, livelihood enhancement, or formalization are considered where relevant. In addition to this, the stakeholder's engagements are embedded in different activities throughout the project implementation cycle. The stakeholder engagement plan captures key engagement activities scheduled quarterly, methods of engagement, and target stakeholders. The plan is developed to ensure a structured, inclusive, and participatory process that supports transparency, trust-building, and effective project implementation.

Table 12: Stakeholder engagement plan over the programme period

Stakeholders engagement activities	2027				2028				2029				2030				2031				2032				2033				2034			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Inter governemnt agency task force formation																																
Meeting of the task force																																
Participation in visit to the similar technology implemented in nearby countries and workshops and knowledge sharing by AE/interagency task force etc																																
Conduction of training for testing and standerdization to the labs, project dvelopers etc and refreshers training in consecutive years																																
Consultation meeting with sectoral ministries and agencies																																
Conduction of validation workshop with different stakeholders for finalizing RBF policy																																
Conduction of task force meeting for the review of policies																																
Updating the policy based on the context																																
Awareness of stakeholders regarding the use of the CNG																																
Participation in visit to the similar technology implemented in nearby countries and workshops and knowledge sharing and learning																																
Regular information dissemination through different media																																
Conduction of awareness at ward level and municipality level on climate change, waste management and behavioural change activity																																
Awareness raising on climate change, waste management and circular economy for private sectors developer, waste collector potential users and local government representatives and schools/college																																
Conduction of training program for potential developers for O&M																																
Conduction of refresher trainings for the project developers																																
Conduction from the training and refreshers on repair/maintenance for local service centers																																
Stakeholder consultation for ESS and preparation of facility level (ESMP/ESIA/ESMS) in selelcted 12 municipalities																																
Stakeholder consultation for gender assessment and preparation of facility level gender action plan in selelcted 12 municipalities																																

7.2 Consultation with Indigenous People

Indigenous Peoples, officially recognized in Nepal as Adivasi Janajati, constitute approximately 35 percent of the national population and are present across the mountains, hills and Terai regions. Many municipalities that may participate in the programme are likely to host Indigenous communities such as Tharu, Tamang, Magar, Newar, Rai, Gurung and others. While the proposed programme will be implemented within existing municipal waste management facilities and does not envisage land acquisition or physical displacement, the presence of Indigenous Peoples within the zone of influence of subprojects cannot be ruled out. Accordingly, the programme recognizes the need to ensure that Indigenous communities are adequately informed, consulted and provided opportunities to participate in decisions related to subproject planning and implementation.

As part of the environmental and social screening process, each subproject will assess the presence of Indigenous Peoples within and around the project area and evaluate any potential impacts, concerns or opportunities associated with the proposed intervention. Where Indigenous communities are identified, consultations will be undertaken in a culturally appropriate manner, using local languages and community institutions where necessary. The safeguards assessment will document community concerns, expectations and recommendations and incorporate appropriate measures into the ESMP. The consultation process will seek to ensure meaningful participation of Indigenous women, vulnerable households and traditional community representatives. Where the screening identifies potential adverse impacts on Indigenous Peoples, a more detailed assessment and targeted management measures will be developed as part of the subproject safeguards documentation before implementation proceeds.

7.3 Information Disclosure

To ensure transparency and accountability, all relevant environmental and social information shall be disclosed in a timely and accessible manner pursuant to the AE's ESS policy. Disclosure materials may include project summaries, ESMPs and monitoring reports. Information shall be disclosed through appropriate channels such as AE's website, municipal notice boards, project websites, and other locally appropriate communication mechanisms. Disclosure materials shall be prepared in an English and a Nepali language with adequate time provided to the stakeholders to review disclosed information and provide feedback. Records of consultations, comments received and actions taken in response to stakeholder concerns shall be maintained by the project developer and made available to information seeker upon request.

7.4 Grievance Redress Mechanism

As part of the stakeholder engagement process, each supported subproject shall establish a Grievance Redress Mechanism (GRM) consistent to the central level grievance mechanism of AE to receive, document, assess, and resolve concerns raised by affected stakeholders. The mechanism shall be accessible, transparent, culturally appropriate, and free of retaliation. Multiple channels for grievance submission, including verbal, written, telephone, and electronic means, shall be made available where feasible. Special provisions shall be established for handling sensitive complaints, including labor-related grievances and Sexual Exploitation, Abuse and Harassment (SEAH)-related complaints.

Mode of posting grievance could be through an attendant, a telephone number, a fax, a post box, an email address, web space or any combination of these. In any case, the AE will maintain process to sort, classify and investigate the grievances by the GRC. The generic grievance redress mechanism of AE is presented in figure below:

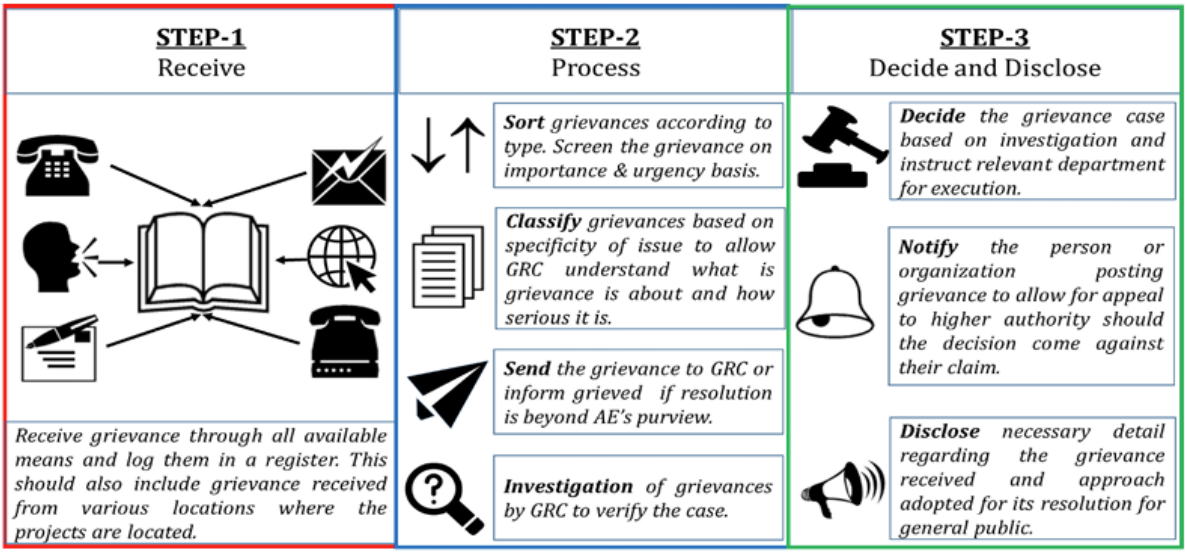


Figure 8: AE's central level grievance mechanism

8 Monitoring and evaluation arrangements

The monitoring and evaluation system established under this ESMF is intended to ensure that environmental and social risks associated with waste collection, transfer, RDF production, bio-methanation, composting, digestate utilization, transport, storage, and associated infrastructure are effectively identified, managed, and monitored throughout the programme lifecycle. Monitoring shall be commensurate with the nature and significance of the environmental and social risks identified during screening and subsequent assessments and shall verify that mitigation measures outlined in site-specific Environmental and Social Management Plans (ESMPs) or any other equivalent plan are implemented effectively. The monitoring system shall also ensure that subprojects remain consistent with the environmental and social risk profile envisaged under the programme-level ESMF and continue to fall within the acceptable risk threshold established by AEPC.

Monitoring activities shall focus on the key environmental and social risks identified under the programme, including occupational health and safety, community health and safety, odour and air emissions, leachate and wastewater management, fire and explosion risks, transport-related impacts, management of residual waste streams, stakeholder acceptance, labour and working conditions, inclusion of vulnerable groups, informal waste worker integration, and gender and social inclusion outcomes. Environmental and social monitoring shall be undertaken at three levels:

- **Subproject Level Monitoring –** Project developers and facility operators shall be responsible for routine monitoring of compliance with approved ESMPs and other applicable environmental and social instruments. Monitoring shall include regular inspections of waste handling practices, pollution prevention measures, occupational health and safety performance, implementation of grievance mechanisms, stakeholder engagement activities, labour conditions, and compliance with applicable environmental permits and standards.
- **Programme Level Monitoring –** AEPC shall periodically review environmental and social performance across all supported subprojects to verify compliance with the ESMF, screening requirements, exclusion criteria, mitigation measures, and reporting obligations. Particular attention shall be given to recurring risks associated with waste processing operations, worker safety, community concerns, and implementation of inclusion measures for women, informal waste workers, Dalits, and other vulnerable groups.
- **Independent Verification and Audits –** Where necessary, AEPC may commission independent environmental and social audits, compliance reviews, or field verification missions to assess the adequacy of risk management measures and identify corrective actions. Independent reviews may be prioritized for subprojects presenting relatively higher environmental or social risks or where significant grievances, incidents, or non-compliance issues have been reported.

Monitoring shall include both quantitative and qualitative indicators and, where relevant, data shall be disaggregated by sex, caste, ethnicity, and other relevant social categories to assess equitable access to programme benefits and opportunities. Monitoring processes shall also incorporate stakeholder feedback obtained through consultations, community engagement activities, and grievance redress mechanisms to ensure that concerns raised by affected communities and workers are appropriately addressed.

The programme shall maintain procedures for reporting environmental and social incidents, accidents, near misses, grievances, and cases of non-compliance. Any significant incident involving worker injury, community health and safety impacts, environmental contamination, fire, explosion, serious labour

violations, or allegations of sexual exploitation, abuse, or harassment shall be reported promptly to AEPC and investigated to determine root causes and corrective actions. Appropriate remedial measures shall be implemented to prevent recurrence and improve environmental and social performance.

Environmental and social monitoring findings shall be documented through periodic monitoring reports prepared by subproject proponents and consolidated at programme level by AEPC. Monitoring results shall be used to identify implementation gaps, support adaptive management, strengthen risk mitigation measures, and improve overall environmental and social performance throughout programme implementation. The monitoring system shall therefore function not only as a compliance mechanism but also as a continuous learning process to enhance the sustainability, safety, and social acceptability of waste-to-energy investments supported under the programme.

9 Budget for ESMF Implementation

The implementation of this ESMF requires dedicated resources to ensure that environmental and social risks are appropriately identified, assessed, monitored, and managed throughout the project lifecycle. The budget allocation covers the preparation of project-specific environmental and social safeguard instruments, implementation of mitigation and monitoring measures, occupational health and safety provisions, and capacity strengthening of implementing entities and stakeholders. These resources will support compliance with applicable national regulations, the requirements of the accredited entity, and relevant environmental and social standards. While the indicative budget presented below provides an estimate of the core costs associated with ESMF implementation, additional safeguard-related expenditures may arise during project preparation and implementation depending on the nature, scale, and location-specific risks of individual sub-projects. Such costs, including those associated with mitigation, compensation, resettlement, biodiversity management, or other specialized safeguard measures identified through subsequent assessments, will be incorporated into sub-project budgets and financed through the project to ensure that all environmental and social impacts are effectively addressed.

The costs associated with mitigation and compensation measures arising from project-specific safeguard instruments to be prepared following the screening process outlined in Chapter 5 cannot be accurately estimated at this stage, as these will depend on the characteristics and risk profile of individual sub-projects. Nevertheless, the project commits to allocating the necessary financial resources to ensure that all adverse environmental and social impacts are identified, avoided, minimized, mitigated, and, where required, compensated in accordance with the requirements of this ESMF and the applicable environmental and social standards. Table below presents the ESMF implementation cost.

Table 13: ESMF implementation cost

Item	Budget Cost (USD)
Preparing Project level Environmental Assessments and ESMP	72,150
Environment Safeguard Implementation cost	360,000
Training and Capacity Building	24,000
Occupational Health and Safety measures	36,000
Total:	**492,150**