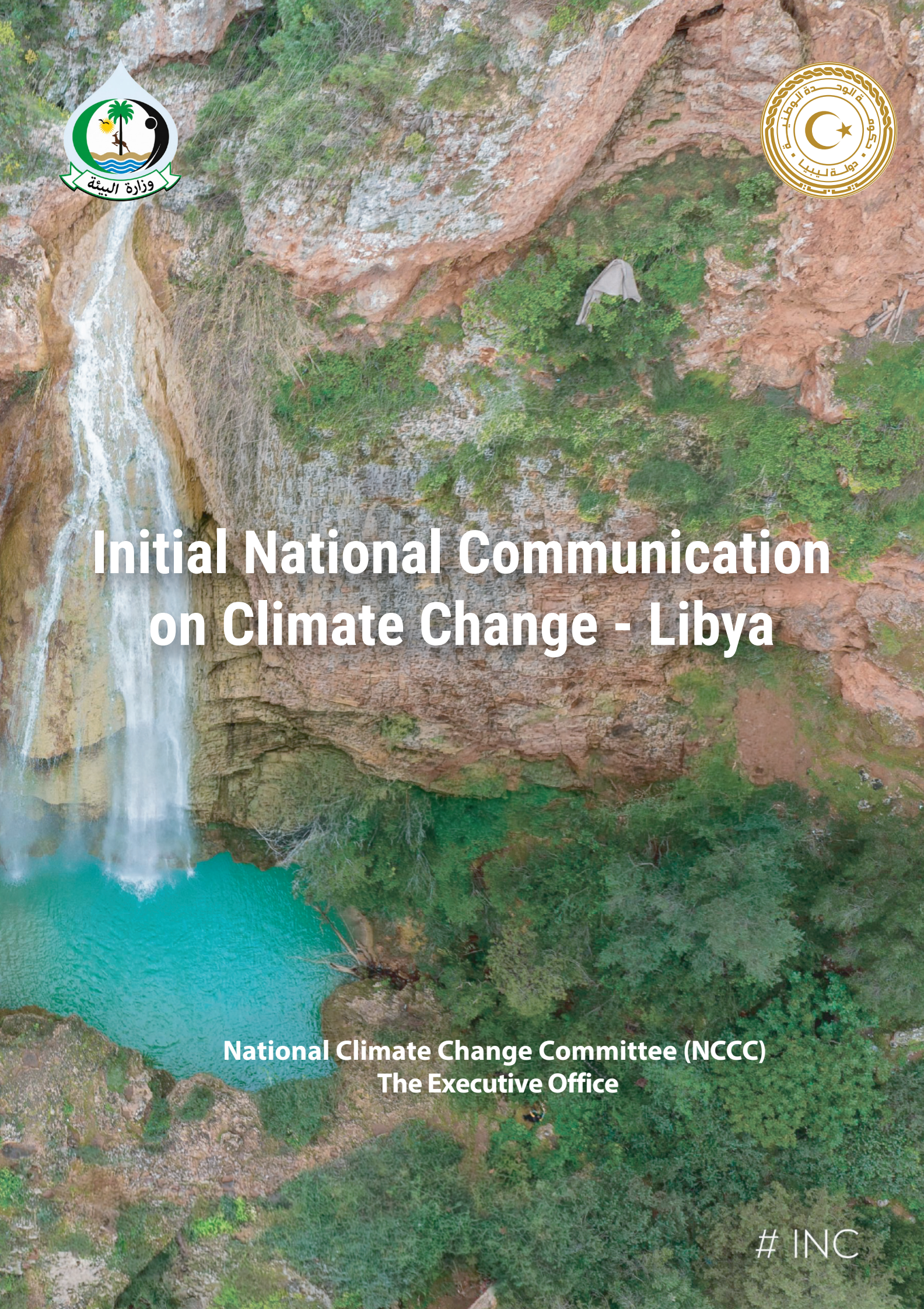


Initial National Communication on Climate Change - Libya

National Climate Change Committee (NCCC)
The Executive Office

INC

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National Climate Change Committee (NCCC)
The Executive Office

November 2025

Government of National Unity

Endorsement of the National Climate Documents in the State of Libya

The Government of the State of Libya hereby endorses the Initial National Communication (INC) as official national document. This document reflect Libya's commitment to climate action and sustainable development, while advancing the country's national priorities.

This document was prepared with the support of the Government of National Unity through the Ministry of Environment, in collaboration with relevant national institutions and stakeholders, through an inclusive and consultative process. They provide a national framework to guide the implementation of climate change actions and contribute to fulfilling Libya's national and international commitments.

By virtue of this endorsement, this document are approved for official use and shall serve as the national reference for the implementation of climate-related policies and measures in the State of Libya.



Mr. Abdul Hamid Dbeibah
Prime Minister of the
Government of National Unity

Signature:

Date: __/__/__

Official Stamp:

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This First National Communication is the product of a collective effort, shared commitment, and joint expertise among all partners dedicated to supporting Libya's climate agenda and strengthening its effective engagement with the international community.

November \ 2025

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Abbreviations and Acronyms:

Abbreviation	Arabic Term	English Translation
AAL	متوسط الخسارة السنوية	Average Annual Loss
AF	صندوق التكيف	Adaptation Fund
AIP	خطة الاستثمار في التكيف	Adaptation Investment Plan
BTR	تقرير الشفافية السنوي	Biennial Transparency Report
CBD	اتفاقية التنوع البيولوجي	Convention on Biological Diversity
CBIT	مبادرة بناء القدرات من أجل الشفافية	Capacity Building Initiative for Transparency

CBT	وسم ميزانية المناخ	Climate Budget Tagging
CCAM	تدابير التكيف مع تغير المناخ	Climate Change Adaptation Measures
CCS	احتجاز الكربون وتخزينه	Carbon Capture and Storage
CIDSS	نظام الاستخبارات المناخية ودعم القرار	Climate Information and Decision Support System
CIFs	صناديق الاستثمار المناخي	Climate Investment Funds
C-RRR	منطقة المخاطر المرتبطة بالمناخ	Climate-Related Risk Region
CRA	تقييم مخاطر المناخ	Climate Risk Assessment
CRA-FiSS	التمويل الزراعي المستجيب للمناخ لأصحاب الحيازات الصغيرة	Climate-Responsive Agricultural Finance for Small-holders
CSO	منظمة المجتمع المدني	Civil Society Organization
CTCN	مركز وشبكة تكنولوجيا المناخ	Climate Technology Centre and Network
DRR	الحد من مخاطر الكوارث	Disaster Risk Reduction
EO-NCCC	المكتب التنفيذي للجنة الوطنية لتغير المناخ	Executive Office – National Climate Change Committee
EPF	صندوق حماية البيئة	Environmental Protection Fund
ESS	الضمانات البيئية والاجتماعية	Environmental and Social Safeguards
ETF	إطار الشفافية المعزز	Enhanced Transparency Framework
EWS	نظام(ات) الإنذار المبكر	Early Warning System(s)
FAO	منظمة الأغذية والزراعة	Food and Agriculture Organization
FPIC	الموافقة الحرة والمسبقة والمستنيرة	Free, Prior, and Informed Consent
GCF	صندوق المناخ الأخضر	Green Climate Fund

GDP	الناتج المحلي الإجمالي	Gross Domestic Product
GEF	مرفق البيئة العالمية	Global Environment Facility
GGA	الهدف العالمي للتكيف	Global Goal on Adaptation
GBF	الإطار العالمي للتنوع البيولوجي	Global Biodiversity Framework (Kunming–Montreal)
GHG	غازات الاحتباس الحراري	Greenhouse Gases
GMMR	النهر الصناعي العظيم	Great Man-Made River
IDP	النازحون داخليًا	Internally Displaced Persons
IMF	صندوق النقد الدولي	International Monetary Fund
IPCC	الهيئة الحكومية الدولية المعنية بتغير المناخ	Intergovernmental Panel on Climate Change
IWRM	الإدارة المتكاملة للموارد المائية	Integrated Water Resource Management
JT	انتقال عادل	Just Transition
L&D	الخسارة والضرر	Loss and Damage
LDCF	صندوق أقل البلدان نمواً	Least Developed Countries Fund
LNMC	المركز الوطني الليبي للأرصاد الجوية	Libyan National Meteorological Center
MCDA	تحليل القرار متعدد المعايير	Multi-Criteria Decision Analysis
MDBs	بنوك التنمية المتعددة الأطراف	Multilateral Development Banks
MEL	الرصد والتقييم والتعلم	Monitoring, Evaluation, and Learning
MoA	وزارة الزراعة	Ministry of Agriculture
MoE	وزارة البيئة	Ministry of Environment

MoF	وزارة المالية	Ministry of Finance
MoH	وزارة الصحة	Ministry of Health
MoLG	وزارة الحكم المحلي	Ministry of Local Government
MoP	وزارة التخطيط	Ministry of Planning
MoT	وزارة المواصلات	Ministry of Transport
MoWR	وزارة الموارد المائية	Ministry of Water Resources
MRV	القياس والإبلاغ والتحقق	Measurement, Reporting, and Verification
MTEF	إطار الإنفاق المتوسط الأجل	Medium-Term Expenditure Framework
NAICP	منصة المعلومات والتنسيق الوطنية للتكيف	National Adaptation Information and Coordination Platform
NAP	خطة التكيف الوطنية	National Adaptation Plan
NCCC	اللجنة الوطنية لتغير المناخ	National Climate Change Committee
NDA	السلطة الوطنية المعينة	Nationally Designated Authority
NDC	المساهمة المحددة وطنيا	Nationally Determined Contribution
NIE	الكيان الوطني المنفذ	National Implementing Entity
NIWG-CR	الحوكمة الوطنية المتكاملة للمياه من أجل التكيف مع تغير المناخ	National Integrated Water Governance for Climate Resilience
ODA	المساعدات الإنمائية الرسمية	Official Development Assistance
PA	منطقة محمية	Protected Area
PAR	الضغط والإطلاق	Pressure and release
PCCB	لجنة باريس لبناء القدرات	Paris Committee on Capacity Building

PMO	مكتب رئيس الوزراء	Prime Minister's Office
PPP	الشراكة بين القطاعين العام والخاص	Public–Private Partnership
RSFSC	ممرات إمدادات الغذاء المرنة	Resilient Food Supply and Security Corridors
SAP	خطة التكيف القطاعية	Sectoral Adaptation Plan
SDGs	أهداف التنمية المستدامة	Sustainable Development Goals
SDS	العواصف الرملية والترابية	Sand and Dust Storms
SLR	ارتفاع مستوى سطح البحر	Sea-Level Rise
SME	الشركات الصغيرة والمتوسطة	Small and Medium Enterprises
SREX	تقرير خاص عن الظواهر المناخية المتطرفة	Special Report on Extreme Weather and Disasters (IPCC)
TAAP	خطة عمل التكيف الإقليمي	Technical Adaptation Action Plan
UNCCD	اتفاقية الأمم المتحدة لمكافحة التصحر	United Nations Convention to Combat Desertification
UNDP	برنامج الأمم المتحدة الإنمائي	United Nations Development Programme
UNFCCC	اتفاقية الأمم المتحدة الإطارية بشأن تغير المناخ	United Nations Framework Convention on Climate Change
WEFE	العلاقة بين المياه والطاقة والغذاء والنظم البيئية	Water–Energy–Food–Ecosystems (Nexus)
WHO	منظمة الصحة العالمية	World Health Organization
WMO	المنظمة العالمية للأرصاد الجوية	World Meteorological Organization

Executive Summary

The Initial National Communication on Climate Change for Libya provides an evidence-based, comprehensive overview of Libya's climate context, greenhouse gas emissions data, mitigation actions, adaptation priorities, support needs, and transparency arrangements. It aims to enrich national decision-making and fulfill reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC), while ensuring consistency with Libya's National Adaptation Plan and the adaptation chapter in its Nationally Determined Contributions (NDCs).

National Circumstances and Climate Risks. Libya covers approximately 1.77 million square kilometers and has a coastline of approximately 2,000 kilometers. Its climate is predominantly hot desert, with a narrow Mediterranean zone along the north. Observed warming has averaged approximately +0.25°C per decade since 1971, and projections indicate an additional temperature increase of 2 to 3 degrees Celsius by mid-century under high-emissions scenarios, with more volatile rainfall, worsening droughts, water scarcity, and land degradation. These dynamics increase exposure in the water, agriculture, coastal areas, health, infrastructure, and ecosystem sectors. The national climate risk assessment identifies critical hazards, including droughts, heat waves, flash floods, dust and sandstorms, coastal erosion, and sea-level rise, which collectively constitute Libya's adaptation imperative.

Greenhouse Gas Inventory and Key Messages. The national inventory for the period 2017-2023 follows the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines and the 2019 Refinement. In 2023, total greenhouse gas emissions are estimated at 97,324 kilotons of carbon dioxide equivalent, with the energy sector as the primary source of emissions and significant data gaps for Agriculture, Forestry, and Other Land Use (AFOLU) and waste. The level of uncertainty is lowest in energy and highest in AFOLU and waste, reflecting the scarcity of land and waste statistics. The inventory provides the quantitative basis for tracking NDCs, prioritizing data system improvements, national emission factors, and quality assurance/quality control (QA/QC).

Mitigation Actions and Their Impacts. The Initial National Communication (INC) consolidates policies and measures related to energy, land use, AFOLU, and waste, consistent with the national inventory and the Enhanced Transparency Framework (ETF). It explains methodological options, coverage, and the linkages of "information necessary to track progress" toward Libya's NDC. The chapter identifies institutional arrangements, quantification methodologies, uncertainty management, and documentation protocols to support future Biennial Transparency Report (BTR) reporting.

Adaptation: Priorities and Systems. The adaptation chapter applies a structured methodology to assess sectoral and geographic vulnerabilities, identify a portfolio of priority measures, and establish monitoring, evaluation, and learning (MEL) arrangements. It details targets and theory of change, multi-criteria prioritization of measures, institutional and policy linkages, financial linkages, and MEL structure that integrates loss and damage and aligns with the ETF. Cross-cutting integration covers Male / Female aspects and vulnerable categories, nature-based and ecosystem approaches, and regional consistency. The chapter explicitly ensures consistency with the National Adaptation Plan (NAP) and NDCs, considering adaptation as a national priority for development and risk management.

Support Required and Received. The report provides structured evidence on financial, technological, and capacity-building support received and identifies priority needs for implementing mitigation and adaptation measures. It proposes an integrated capacity development roadmap and clarifies how support information will feed into ETF-compliant reporting.

Constraints, Gaps, and Recommendations. The INC documents the institutional, technical, financial, and data constraints that hinder climate action, along with practical recommendations to strengthen governance, data systems, financial readiness, and inclusion. The focus is on strengthening national data infrastructure and institutional roles to ensure continuous iterative improvement of inventories, tracking of mitigation actions, and MEL for adaptation.

Transparency and Readiness for BTR Reporting. The report describes QA/QC, documentation, version control, audit trails, and how INC data and procedures prepare Libya for BTR reporting. It highlights the role of national platforms, such as the National Coordination and Information Platform on Adaptation and the Climate Risk Information and Decision Support System, in enhancing data management, indicator workflows, and reporting to the ETF.

Strategic Messages

Climate risks are a development and security priority. Libya's warming and climate variability threaten water resources, food, health, infrastructure, and ecosystems, requiring systematic adaptation integrated with regional and sectoral planning.

Energy drives mitigation, and data systems enhance credibility. The energy sector accounts for the majority of emissions; therefore, strengthening national data systems, emission factors, and QA/QC will improve accuracy, enable better model design, and support NDC tracking.

Adaptation is implementable and measurable. With a prioritized investment portfolio, institutional arrangements, financial linkages, and MEL framework aligned with the ETF, Libya is enabled to scale adaptation with equity, nature-based solutions, and regional coherence.

Transparency is integral to this project. The INC establishes the foundation for performance reporting by clarifying roles, documentation, and digital systems to ensure consistent, auditable progress reporting.

Chapter 1. National Circumstances

The preparation of Chapter 1 — National Circumstances — of Libya's Initial National Communication (INC) is guided by the following normative instruments:

I. Article 12 of the United Nations Framework Convention on Climate Change (UNFCCC). This article establishes the obligation of all Parties to communicate to the Conference of the Parties (COP) information related to the implementation of the Convention, including a description of national circumstances relevant to climate change.
II. Decision 17/CP.8: Guidelines for the preparation of national communications from Parties not included in Annex I. This decision provides the detailed structure and recommended content for communications from non-Annex I Parties, and explicitly calls for a description of development priorities, objectives, and national and regional circumstances to contextualize climate actions and reporting.
III. UNFCCC Guidelines on National Communications for Parties not included in Annex I. These guidelines serve as a practical tool to assist countries such as Libya in preparing comprehensive, consistent, and transparent national communications. They stipulate that national circumstances should include information relevant to geography, climate, population, economy, policies, and institutional arrangements, as well as vulnerabilities and sustainable development needs.

1.1 Geographic Context and Climate Characteristics

Libya occupies a strategic location in North Africa, extending over an area of approximately 1,665,000 km², bordered by the Mediterranean Sea to the north and six neighboring countries: Egypt and Sudan to the east, Chad and Niger to the south, and Algeria and Tunisia to the west. Its coastline stretches approximately 1,900 km, providing socio-economic opportunities while simultaneously exposing it to coastal hazards. The national expanse ranges from the Mediterranean coastal plain to southern desert margins, with vast interior desert landscapes.

Topographically, the Sahara Desert dominates the country, with extensive dune systems, interior depressions, and isolated oases such as Al-Kufrah and Murzuq that enable settlement in hyper-arid zones. Distinctive highlands include Jabal Nafusa (Western Mountains) in the northwest and the Green Mountains (Jabal al-Akhdar) in the northeast, both of environmental and cultural significance. Fertile plains such as Jefara and Benghazi remain pivotal for agricultural and livestock production.

Climatically, Libya is predominantly classified as hot desert climate, with a Mediterranean zone confined to the northern coastal strip. Rainfall is scarce and irregular, ranging from less than 50 mm/year in the south to 200–500 mm/year along the coast, concentrated in winter months (December–February). Interior regions experience extreme summer heat with temperatures frequently exceeding 40°C, while coastal winters are milder. Observed warming has averaged approximately +0.25°C per decade since 1971, with projections indicating an additional temperature increase of 2–3°C by mid-century under high emissions scenarios. Precipitation is expected to decrease and become more volatile, exacerbating drought, water scarcity, and land degradation.

Libya's ecosystems include coastal and marine habitats in the Mediterranean, mountain forests in the Green Mountains, temporary wetlands, and vast fossil groundwater reserves such as the Nubian Sandstone Aquifer System. The Man-Made River (MMR) distributes groundwater resources to coastal cities and agricultural areas; however, over-extraction and salinization pose increasing risks. These natural assets are fundamental to livelihood sustainability, biodiversity, and climate resilience, yet remain under escalating environmental and anthropogenic pressures.

In summary, Libya's geographic and climatic characteristics establish its vulnerability: a densely populated coastal belt exposed to sea-level rise and flooding, vast arid interior spaces constrained by water scarcity, and fragile ecosystems threatened by desertification and over-exploitation. These features define the country's urgent need for integrated, risk-informed adaptation and sustainable resource governance.

1.2 Demographic Profile

Libya's population in 2025 is estimated at approximately 7.2 million people, with an average density of approximately 4 persons per km², reflecting the dominance of desert landscapes and the concentration of settlement in limited coastal zones and oases. Population distribution is highly unbalanced; Most Libyans reside in the northern coastal belt, while southern and interior regions remain sparsely populated.

Urbanization levels exceed 80%, making Libya one of the most urbanized countries in Africa. This pattern has been shaped by long-term migration toward coastal cities where infrastructure, services, and employment opportunities are concentrated. However, rapid urban growth has outpaced planning capacity, exacerbating pressure on water supplies, energy, housing, and waste management systems.

Demographically, Libya is characterized by a youth-dominated structure (population pyramid); approximately 60% of the population is under the age of thirty. This represents a potential demographic dividend, but also a pressing challenge given limited job creation and persistent education gaps in post-conflict contexts. Population projections indicate annual growth of approximately 1.3–1.5%, with the possibility of reaching 9 million by 2040.

Migration and displacement patterns are influenced by intersecting factors. Libya serves as a transit country and destination for international migrants from the Sahel and sub-Saharan Africa, while internally, periods of armed conflict and governance instability, and disasters such as the Ghat, Ubari, and Derna floods of 2023, have caused repeated displacement. Although climate-induced migration is not systematically tracked, increasing drought, flooding, and environmental degradation are recognized as emerging factors driving mobility and displacement.

Overall, Libya's demographic characteristics—coastal urban concentration, rapid youth population growth, and elevated displacement risks—exert severe pressure on adaptive capacity and require targeted strategies to improve service delivery, expand employment opportunities, and strengthen population stability.

1.3 Economic Structure

Libya's economy depends heavily on hydrocarbons, with the oil and gas sector representing approximately 60% of gross domestic product (GDP) and more than 90% of government revenues and exports. This dependence makes the economy highly vulnerable to global oil price fluctuations, as well as production disruptions linked to conflict and climate risks affecting water and infrastructure.

The agriculture sector, although representing only approximately 1–2% of GDP, remains fundamental to rural livelihoods, providing employment for an estimated 15–17% of the workforce. Production is constrained by water scarcity, salinization, land degradation, and desertification, making it highly sensitive to climate variability. Small-scale farmers and oasis communities are among the most exposed to risks.

The fisheries sector contributes less than 1% of GDP but provides important coastal employment and food security. However, overfishing, pollution, and coastal erosion threaten the sustainability of marine resources.

Tourism, which once made a modest contribution to the economy, has largely collapsed due to political instability and insecurity, despite Libya's rich cultural heritage and diverse landscapes. Its recovery depends on national stability, infrastructure investment, and conservation of fragile ecosystems.

Water management is a critical economic and security priority. Libya relies almost entirely on non-renewable fossil aquifers, which are exploited via the Man-Made River (MMR). While the system meets most urban and agricultural demand, it faces infrastructure deterioration, groundwater depletion, and saltwater intrusion, increasing costs and vulnerability to shocks.

In the energy sector, Libya possesses Africa's largest proven crude oil reserves and significant natural gas resources. Domestic energy consumption relies primarily on fossil fuels, with electricity generation representing more than 60% of total demand. Energy subsidies contribute to inefficiency, while the share of renewable energy does not exceed 1% of the national energy mix. Despite plans to expand solar and wind energy, these remain in the conceptual phase.

Economic diversification efforts, including renewable energy, agricultural modernization, green infrastructure, and the blue economy, have been expressed in strategic documents. However, structural barriers such as governance fragmentation, weak private sector development, and dependence on public sector employment constrain progress.

In summary, Libya's economic structure is defined by hydrocarbon dependence, climate-sensitive productive sectors, and systemic fragility, highlighting the urgency of diversification toward resilient, low-carbon, and resource-efficient pathways.

1.4 Environmental Conditions and Natural Resources

Libya's environmental conditions are defined by arid to hyper-arid climate, vast desert regions, and high environmental vulnerability. The desert exceeds 95% of the national territory, while productive lands are confined to a narrow Mediterranean coastal strip and isolated interior oases. This natural resource base—land, soil, water, and biodiversity—is under increasing pressure from climate variability, rapid population growth, and unsustainable land-use practices, exacerbating structural fragility.

Land and Soil Resources

Arable land represents less than 2% of total area, concentrated in the Jefara Plain in the northwest and mountainous areas such as the Green Mountains. Soil degradation is widespread, driven by desertification, overgrazing, salinization, deforestation, and unplanned urban expansion. Oasis systems, historically based on traditional water-harvesting practices, face increasing threats from groundwater depletion, mechanized agriculture, and climate stress. Land reclamation and anti-desertification initiatives have been launched but face persistent institutional, financial, and technical constraints.

Water Resources

Libya is one of the most water-scarce countries, , with renewable water availability far below the scarcity threshold of 1,000 m^3/year per capita and continuing to decline with population growth. The country relies almost entirely on non-renewable fossil groundwater, exploited primarily via the Man-Made River (MMR). Surface water resources are extremely limited, seasonal, and unreliable. Water security is undermined by over-extraction, aquifer reservoirs depletion, saltwater intrusion, and aging infrastructure. While the Water Security Strategy 2025–2050 outlines measures such as desalination, water reuse, and Integrated Water Resources Management, implementation remains in the planning phase, constrained by limited institutional capacity and financing.

Biodiversity and Protected Areas

Despite its arid character, Libya hosts diverse ecosystems: Mediterranean coastal and marine areas, mountain forests in the Green Mountains, transient wetlands, and oases and desert rangelands. These habitats support endemic species and migratory wildlife along the Africa–Eurasia flyway. However, biodiversity is declining due to habitat fragmentation, over-exploitation, urban encroachment, and weak enforcement of protection regulations. The national network of protected areas includes sites such as Ain Al-Ghazalah, Wadi El-Kuf, and Farwa Lagoon, but management effectiveness is limited by lack of funding and institutional gaps. The updated National Biodiversity Strategy and Action Plan (2023–2030) indicates recognition of the need to protect ecosystems, but its provisions remain largely unimplemented.

Key Environmental Challenges

Libya's environment faces multiple and intersecting pressures:

i. Desertification, affecting extensive agro-pastoral areas and transitional zones, driven by drought, soil erosion, and unsustainable land management.
ii. Water scarcity, the most severe constraint on agriculture, health, and urban development, exacerbated by dependence on fossil aquifers and lack of alternatives.
iii. Pollution, including untreated wastewater, poor solid waste management, and oil-related industrial pollutants, concentrated in urban and coastal areas, exacerbating ecosystem degradation and public health risks.

Libya's environmental baseline is characterized by resource scarcity, ecological fragility, and escalating pressures from climate hazards and unsustainable practices. These dynamics reinforce the country's vulnerability and highlight the urgent need for coordinated strategies in land restoration, water governance, and biodiversity protection, to be integrated into future adaptation and sustainable development planning.

Table No. (1) Summary of environmental constraints and climate vulnerabilities in Libya

Governance Gaps and Capacity Constraints	Social and Economic Impacts	Climate-Related Vulnerabilities	Primary Barriers
Land and Soil Resources	Weak implementation of land-use planning; limited desertification control programs	Declining agricultural productivity; soil erosion and degradation; food insecurity	**Desertification, salinization, overgrazing, unplanned urban expansion; less than 2% arable land**
Water Resources	Deteriorating groundwater infrastructure; insufficient Integrated Water Resources Management (IWRM); weak financing	Water scarcity in urban areas; conflicts over scarce resources; rising infrastructure costs	**Escalating drought risks; declining water security for households, agriculture, ecosystems (environmental flows), and energy**
Biodiversity and Ecosystems	Inadequate biodiversity monitoring; insufficient funding for protected area networks	Loss of biodiversity-based livelihoods (fisheries, agroforestry)	**Loss of ecosystem services; reduced resilience of coastal, mountain, and oasis systems**
Pollution and Environmental Quality	Limited environmental regulation and enforcement; fragmented institutional responsibilities	Public health burdens; rising water treatment and coastal rehabilitation costs	**Marine and urban environmental degradation; health risks; declining fisheries productivity**

This heatmap illustrates environmental constraints and vulnerabilities in Libya, showing relative intensity across different sectors (land, water, biodiversity, pollution) and categories (constraints, vulnerabilities, social and economic impacts, governance gaps). It demonstrates that water resources represent the most acute and pervasive vulnerability, while land degradation, biodiversity loss, and pollution add cumulative pressures.

Figure 1: Heatmap of environmental constraints and fragilities in Libya



1.5 Institutional and Governance Framework

Climate governance is emerging and strengthening, shaped by evolving national priorities, decentralization reforms, and commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The current structure combines a central inter-ministerial coordinating body, technical entities, and local-level actors, though their capacity varies and coordination across them is limited. These characteristics directly affect the country's exposure to climate hazards, sensitivity, and adaptive capacity.

National Coordination and Sectoral Mandates:

National Committee on Climate Change (NCCC). Re-established by Prime Minister Decision No. 336 of 2021 as the highest inter-ministerial coordinating body for climate policy, overseeing national communications, and ensuring consistency with UNFCCC mechanisms.

Executive Office of the National Committee on Climate Change (EO-NCCC). Established by decision of the Minister of Environment., comprising representatives from relevant sectors including water resources, agriculture, local governance, the National Oil Corporation, the General Electricity Company, industry, health, transport, and others. Its responsibilities include technical supervision, collecting the required data, and submitting it to the National Climate Change Committee for the preparation of key national documents (such as National Communications, the National Adaptation Plan, and Nationally Determined Contributions for the service sectors).

Table (2): Institutional structure of climate governance in Libya

Level of Responsibility	Role in Adaptation/Mitigation	Ministry/Entity
National (Policy, Coordination)	Chairs the National Committee on Climate Change; leads environmental regulation, biodiversity, monitoring, and environmental inspection	**Ministry of Environment**
National (Coordination)	National authority overseeing climate change; authority to establish systems for implementing UNFCCC and Paris Agreement in alignment with existing legislation and national plans	**National Committee on Climate Change**
National (Technical Coordination)	Technical office for coordination, data collection, and reporting; operates under the direction and guidance of the National Committee on Climate Change	**Executive Office (EO-NCCC)**
Sectoral (Water)	Leads Integrated Water Resources Management (IWRM); implements water strategies	**Ministry of Water Resources**
Sectoral (Agriculture, Rural Areas)	Climate-resilient agriculture; desertification control; food security	**Ministry of Agriculture and Livestock**
Local (Municipalities)	Oversees municipal councils and strategic action plans; decentralizes adaptation planning and service delivery	**Ministry of Local Government**
Sectoral (Health, National)	Monitors climate-sensitive diseases; impacts of air pollution and heat stress; strengthens health system resilience	**Ministry of Health**
Sectoral (Coordinating, National)	Grid stability; station rehabilitation; fuel transition; emission reduction; carbon neutrality; promote renewable energy in national energy mix; adapts energy infrastructure	**General Electricity Company**
Sectoral (National)	Reduces gas flaring and decarbonization; monitors methane and greenhouse gas emissions; develops alternative energy infrastructure	**Ministry of Oil and Gas / National Oil Corporation**
Sectoral (Industry, National)	Energy efficiency; adoption of low-carbon technologies in industrial processes; clean technology implementation to reduce fossil fuel dependence	**Ministry of Industry**
Sectoral (Transport, National)	Infrastructure resilience (roads, ports, airports); transition to low-carbon mobility	**Ministry of Transport**
Sectoral (Coastal, Marine)	Fisheries management and coastal ecosystem management; marine biodiversity protection; integration of climate considerations in national development plans; climate mainstreaming in public investment management	**Ministry of Marine Wealth**
National (Planning, Coordination)	Development of national development plans and programs; integration of climate considerations into national and sectoral strategic plans; water resource mobilization; continuous monitoring of sustainable development indicators including climate action	**Ministry of Planning**
National (Finance, Budget)	Climate budget allocation within the state budget; credit readiness for Green Climate Fund/Global Environment Facility/Adaptation Fund; climate finance strategy	**Ministry of Finance**
National (Executive)	Adoption of national adaptation and mitigation strategies and plans	**Office of the Prime Minister**
Technical Entity (National)	Continuous determination of climate change indicators; provision of data and information to the National Committee on Climate Change	**National Libyan Centre for Meteorology**

National (Disaster Risk Reduction, Emergency)	Authority to manage all emergency situations, crises, and disasters facing Libya	**National Centre for Emergency, Crisis, and Disaster Management**
National (Finance, Investment)	Financing adaptation and mitigation investment projects at national and local levels	**Environmental Protection Fund**
Technical/Academic (National and Regional)	Contribution to preparation of prospective studies on adaptation and mitigation	**Ministry of Higher Education and Scientific Research**
Local (Municipality, Community)	Community awareness raises on climate issues	**Civil Society Organizations**
Municipal/Local	Participation in implementing adaptation and mitigation strategies at municipal level	**Municipal Councils**

Fragility Link. Weak inter-ministerial coordination, lack of budgets for early warning system development, risk-based planning, and asset protection (water, energy, coastal infrastructure), combined with data gaps and weak feedback mechanisms, have increased fragility in urban and interior areas facing extreme climate phenomena.

Decentralization and Local Roles (Local Level)

Under Local Government Ministry Decision No. 1500 of 2022, municipalities and local councils bear defined responsibilities in environmental management, water services, and disaster preparedness. In practice, capacities are unequal; human resources, budgets, and technical tools vary significantly across municipalities, limiting implementation of land-use controls, drainage network maintenance, and local preparedness.

Fragility Link. Where municipal capacity is weak, exposure to hazards and damages increases (such as flood-prone urban basins and informal Residential Areas), while recovery is delayed due to limited local service delivery and enforcement of planning.

Stakeholder Engagement: Civil Society and Academia

Data Systems and Integration: Monitoring networks and data repositories (meteorology, hydrology, land use) remain fragmented, with incomplete time series and limited public data access. This increases uncertainty in risk assessment and slows response.

Institutional Continuity: High staff turnover and inconsistent mandate allocation weaken policy consistency and follow-up, affecting everything from coastal zoning to groundwater protection.

Legal and Policy Alignment: Core environmental laws predate the Paris Agreement; ongoing work to harmonize laws on climate-resilient infrastructure, environmental impact assessment standards, and data sharing has not yet been completed.

Planning Tools Under Development: The National Adaptation Plan (NAP) and Nationally Determined Contributions (NDCs) provide structured approaches to coordination (sectoral committees), data governance, monitoring and evaluation reporting, and financing frameworks, but their content has not yet been implemented. Proposals such as the National Coordination and Information Platform on Adaptation and the Climate Information and Decision Support System (CIDSS) remain in the conceptual phase and have not been operationalized.

Fragility Link: Until data governance standardization and mandate assignment across levels are completed, exposure will remain high, particularly in coastal and urban systems, sensitivity linked to water–energy–food nexus will persist, and adaptive capacity—institutional, financial, and informational—will remain constrained.

Climate action governance in Libya is organized around the National Committee on Climate Change (NCCC) and its Executive Office (EO), with sectoral mandates within a decentralization reform framework. However, unequal capacities, data fragmentation, and partial legal alignment limit decision-makers' ability to conduct risk-based planning. These gaps translate directly into increased climate fragility, particularly in coastal cities and water-dependent systems, and municipalities with limited-service capacity. Strengthening coordination, data interoperability, and capacity-building at sub-national levels are essential foundations for reducing risks and enabling implementation of planned adaptation and reporting frameworks.

1.6 Policy and Legal Context

The policy and legal landscape related to climate is foundational but incomplete. Over the past decade, the country has expressed strategic intent to integrate climate and environmental issues into national development through high-level visions, sectoral strategies, and institutional decisions, yet implementation remains uneven and in early stages. This structure directly affects climate vulnerability; the broadening of legal mandates is matched by weakness in operational mechanisms, keeping risk exposure high, sensitivity persistent, and adaptive capacity constrained.

National Development Strategies and Alignment with Sustainable Development Goals

Libya's Vision 2030 frames environmental sustainability and climate resilience as enabling factors for economic recovery, human development, and institutional modernization. The vision emphasizes water security, renewable energy, sustainable agriculture, and human capital development. Libya has committed to the 2030 Agenda for Sustainable Development, and recent government documents reflect linkages between Sustainable Development Goal 13 (Climate Action), Goal 6 (Clean Water and Sanitation), and Goal 2 (Zero Hunger and Sustainable Agriculture), though statistical and monitoring capacities to track progress toward SDG targets remain limited.

Fragility Link. Without strong monitoring and alignment with development visions and SDG targets, risk-based priority-setting in water-scarce municipalities and coastal cities remains insufficiently defined, slowing adaptation in the most exposed systems under Goal 6.

Sectoral Policies and Plans (Planning Phase)

- Water Security Strategy 2025–2050 outlines a long-term pathway for Integrated Water Resources Management, groundwater protection, non-conventional supplies (desalination, reuse), and infrastructure resilience.
- National Biodiversity Strategy and Action Plan (2023–2030) define priorities for ecosystem protection, protected area management, and biodiversity mainstreaming.
- Government planning references identify climate-smart practices, irrigation efficiency, and land rehabilitation in vulnerable areas.
- Energy Efficiency Rationalization Strategy and sectoral strategy documents for electricity and renewable energy (2023–2035) define expansion pathways for solar and wind energy.
- **National Adaptation Plan (NAP) and Nationally Determined Contributions (NDCs)** provide the conceptual framework for coordination, data governance, and reporting; their substance has not yet entered implementation.

Fragility Link. Strategies without operational budgets, data protocols, and enforcement tools mean that drought management, coastal risk reduction, and groundwater protection remain driven by short-term responses rather than systematic prevention.

Environmental Laws and Climate-Related Regulations

- Law No. 15 of 2003 forms the baseline for environmental protection and improvement (pollution control, land and resource conservation). It predates current climate commitments and does not explicitly address adaptation and mitigation.
- Decisions have established and clarified national coordination (National Committee on Climate Change and its Executive Office within the Ministry of Environment) and local roles, such as the Local Government Ministry decision specifying municipal responsibilities in environment, water services, and disaster preparedness.
- Planning drafts discuss legal alignment (clearer mandates, environmental impact assessment standards for climate risks, data-sharing rules, finance governance). These reforms have not yet been enacted.

Fragility Link.

Outdated or ill-defined climate provisions reduce the effectiveness of risk-based environmental assessment processes, weaken enforcement of coastal setback restrictions, and limit oversight of groundwater over-extraction. This exacerbates damage from flooding, soil and water salinization, and desertification, particularly in areas where municipalities lack sufficient institutional and technical capacity.

Participation in Multilateral Environmental Agreements

Libya is a party to the United Nations Framework Convention on Climate Change, the Kyoto Protocol, the Paris Agreement, and to agreements including the Convention on Biological Diversity, the Convention to Combat Desertification, the Barcelona Convention (Mediterranean), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). These frameworks provide entry points for cooperation and financing (Green Climate Fund, Global Environment Facility, Adaptation Fund).

Fragility Link. Limited local legal enforcement, data readiness, and financial creditworthiness complicate access to expanded financing and delay actions that would reduce exposure (early warning, rainfall drainage, coastal protection).

Finally, it is important to note that Libya has defined what should be done (visions and sectoral strategies) and who should coordinate (National Committee on Climate Change, its Executive Office, and sectoral ministries), but how implementation will occur—through enforceable rules, interoperable data systems, budgeted programs, and local implementation—remains only partially defined. Closing the policy–implementation gap is central to reducing exposure (coastal and urban systems), decreasing sensitivity (water-dependent livelihoods), and strengthening adaptive capacity (institutions, data, finance).

1.7 Social Development and Context-Specific Vulnerability

Social development in Libya is marked by clear regional disparities, service delivery gaps, and prolonged institutional fragility. These characteristics interact with climate hazards (heat, drought, flooding, coastal risks) to increase exposure and sensitivity while constraining adaptive capacity, particularly in rural regions and oases, coastal urban belts, and conflict-affected municipalities.

Poverty, Livelihoods, and Spatial Disparities

Since 2011, multiple assessments describe increasing livelihood insecurity and unequal access to opportunities. Rural and marginal areas, particularly in the south and interior oases, depend on rainfed agriculture (Coastal Areas), pastoralism, and informal trade, all highly sensitive to water scarcity, salinization, and desertification. Limited social protection and weak financial inclusion reduce household capacity to adapt to and recover from climate shocks.

Fragility Link. Repeated droughts and land degradation reduce farm incomes, driving migration to coastal cities, increasing demand for already-strained services. Where local institutions are weak, delayed responses to drought or flooding translate into prolonged livelihood losses and higher recovery costs.

Access to Basic Services (Education, Health, Water, Energy)

Service provision is unequal and subject to frequent disruption due to conflict, infrastructure damage, and resource constraints:

- School infrastructure and continuity are weaker in rural and displacement-affected areas; flooding events have disrupted education in several municipalities.
- Facilities and coverage are unequal, particularly in the south and at the oases, limiting response to climate-sensitive health hazards (heat stress, water-borne diseases).
- Dependence on non-renewable fossil groundwater transported via the Great Man-Made River makes many cities vulnerable to infrastructure failures, saltwater intrusion, and over-extraction.
- Electricity supply is unreliable in several regions (electricity coverage spans 98% of Libyan territory) but armed conflicts in near and distant urban areas have affected energy transmission lines, and peak demand during heat waves and outages undermines household resilience and emergency response capacity.

Fragility Link. Where water and energy systems fail, household coping capacity declines sharply: cooling becomes unavailable during heat waves; pumping and storage capacity shrinks; schools and clinics close, amplifying climate impacts on health, learning, and livelihoods.

Intersection of Conflict and Fragility with Climate Risks

Prolonged political fragmentation, local violence, and institutional duplication erode coordinated risk management. Disasters such as the 2023 Derna floods exposed weaknesses in early warning, land-use controls, and asset maintenance, with cascading impacts on displacement and recovery.

- Displacement and return movements increase pressure on host communities and fragile natural resources.
- Competition for resources, such as groundwater and rangelands, particularly in southern border areas, can fuel local tensions.
- Degraded migration routes and pastures reduce herder options, driving mobility and income volatility.

Fragility Link. Fragility increases exposure (Residential Areas in hazard-prone locations), sensitivity (degraded protective systems and ecosystems), and reduces adaptive capacity (coordination, finance, data).

In summary, social fragility in Libya frames climate-related vulnerability, and there remains an urgent need to support various segments of society, particularly in the provision of basic services, to enhance social justice and resilience against climate risks. These factors are closely tied to climate hazards in water-scarce interior regions and densely populated coastal cities. Strengthening basic services (water–energy–health–education), ensuring access to resources for women and youth in a manner responsive to their needs, and building local institutional capacities, alongside reliable data and risk-based planning, are foundational steps for reducing exposure and sensitivity, and building adaptive capacity across the national territory.

1.8 Knowledge, Research, and Technology Landscape

Libya's climate knowledge and technology base is fragmented and under-resourced, with limited integration across national institutions. These constraints directly increase the climate vulnerability outlined in previous

sections: weak monitoring networks and data sharing reduce hazard detection accuracy (exposure); scarce research analysis and translation limit targeted responses (sensitivity); and gaps in skills, infrastructure, and governance constrain adaptive capacity, particularly for water-stressed interior regions and densely populated coastal cities.

Institutional Capacity in Meteorology and Academia

National Libyan Centre for Meteorology (LNMC). The primary provider of weather and climate services. Available documents describe basic monitoring coverage and operational constraints: outdated equipment, incomplete digitalization, gaps in modeling and forecasting skills, and limited data sharing between institutions. These shortcomings restrict early warning, seasonal forecasting, and risk-based planning for floods, droughts, and heat waves.

Universities and Research Centers. Multiple academic and research institutions engage meteorology, agriculture, water, and environmental studies. Activity is scattered, project-based, with underfunded laboratories and weak links to decision-makers. As a result, useful analyses (desertification, irrigation efficiency, or salinity dynamics) often remain local and do not scale to national policy or operational guidance.

Information Systems and Data Availability

Data remains confined to institutional silos across agencies, with heterogeneous standards, incomplete time series (meteorology, hydrology, land use), and limited public access. No integrated climate information system exists. Many workflows are paper-based or non-interoperable, hindering planning, monitoring, evaluation, and reporting (MEL/ETF) readiness, and financing preparedness.

Given critical documentation gaps, documented needs include: (1) longer and continuous climate and hydrological records; (2) integration of remote sensing and geospatial data for monitoring land, water, and coasts; (3) standardized protocols for data collection, storage, and dissemination; (4) open data infrastructure with clear stewardship.

Strategic documents (NAP and NDCs) reference a National Adaptation Information and Coordination Platform (NAICP) and a Climate Information and Decision Support System (CIDSS) to unify data streams and analytics; however, both platforms remain in the conceptual phase and have not yet become operational.

Impact on Fragility. Without interoperable data and routine analytics, coastal setback implementation, groundwater extraction controls, urban drainage design, and heat and health planning rely on incomplete evidence, prolonging losses during extreme events and hindering corrective investment.

Research, Innovation, and Existing Climate-Related and Traditional Knowledge

Available studies and pilot projects focus on desertification, water stress, and irrigation efficiency (such as drip systems), as well as oasis livelihoods. Outputs are unevenly documented and rarely integrated into national guidance or agricultural extension services.

No formal platform connects academics, practitioners, municipalities, and ministries to co-develop and disseminate climate technologies (drought-resistant agriculture, salt-tolerant practices, urban stormwater solutions).

Local technologies, such as khettaras (traditional underground irrigation channels) and reservoir-based irrigation in oases, are documented intermittently and not systematically organized for learning or replication, despite their relevance to low-cost adaptation under water scarcity.

Impact on Fragility. The absence of mechanisms to capture and scale practical knowledge (scientific or traditional) limits locally appropriate adaptation, increasing the sensitivity of agriculture, water supplies, and residential areas to drought, salinization, and flooding.

Overall, Libya possesses scattered institutional mandates and expertise, but the knowledge and technology landscape is not yet positioned to support routine risk-based decisions. Priority needs that logically follow from the vulnerabilities described in Sections 1.1–1.7 include:

(1) upgrading and digitalization of hydroclimatic monitoring networks and archives.
(2) establishing interoperable data systems based on stewardship with clear standards and open access where appropriate.
(3) analytical pipelines and services that transform data into operational products (alerts, guidance, inputs for setbacks and classification) for water, agriculture, health, and urban planning.
(4) linking mechanisms (platforms and advisory functions) connecting universities, the National Libyan Centre for Meteorology, sectoral ministries, municipalities with practitioners and communities, including systematic integration of traditional adaptation practices.
These steps are foundational for reducing exposure (better warning and planning), decreasing sensitivity (targeted services for water, food, and health sectors), and building adaptive capacity (skills, institutions, evidence) across Libya's most climate-vulnerable regions.

1.9 Summary of Key Constraints and Opportunities

The enabling environment for climate action in Libya is shaped at the intersection of structural vulnerabilities, data and institutional gaps, and emerging entry points for sectoral and spatial transformation. Despite growing political awareness of climate risks, the country remains in the early stages of operationalizing comprehensive climate governance. While persistent constraints undermine adaptive capacity, opportunities exist to leverage environmental resources, local knowledge, and evolving policy frameworks to build resilience.

Key Constraints

1. **Climate and Environmental Data Deficits**

- National monitoring systems suffer from a lack of resources and outdated technologies. The National Meteorological Centre operates with limited spatial coverage, particularly in southern regions and oases exposed to climate change.
- Long-term data on hydrology and land use are scarce, undermining risk assessments, water governance, and food security planning.
- No centralized, interoperable climate information platform exists, limiting coordination between the National Centre for Meteorology, ministries, and research institutions, and constraining Libya's ability to fulfill Enhanced Transparency Framework (ETF) reporting commitments.

2. **Institutional and Governance Capacity Gaps**

- Ministries lack dedicated climate units and mandates to mainstream adaptation into sectoral policies. Coordination across national, municipal, and research entities remains limited, leading to inefficiencies and duplication (though work is underway).
- Local authorities, formally empowered within the decentralization framework (Decision 1500/2022), face acute shortages in human and technical capacity, limiting their ability to design and implement spatial targeted adaptation action plans (TAAPs).
- Weak law enforcement and fragmented institutional mandates delay operationalization of climate-related strategies, including the Water Security Strategy (2025–2050) and National Biodiversity Strategy (2023–2030).

3. **Financial and Technical Resource Constraints**

- Libya lacks a national climate finance strategy and has limited access to international climate funds (GCF, GEF, AF), partly due to low institutional capacity to prepare bankable proposals.

- General budgets do not incorporate climate considerations; climate activities remain largely donor-driven and externally financed, with limited domestic contribution.
- Deteriorating infrastructure (Great Man-Made River system, electricity transmission network, dam systems) increases pressure on adaptation investments, as underscored by the catastrophic 2023 Derna floods.

Opportunities for Integrated and Resilient Development

Despite these challenges, Libya's geography, ecological resources, and emerging governance reforms offer strategic opportunities:

i. **Transition to Renewable Energy**: Libya's potential in solar and wind energy ranks among the highest in North Africa, providing a promising pathway to diversify energy sources, reduce fossil fuel dependence, and achieve climate-compatible and sustainable economic growth.

ii. **Local and Traditional Knowledge**: Traditional water management practices (khettaras, reservoir-based irrigation) and oasis-based livelihood strategies form the foundation for community-led, context-appropriate adaptation.

iii. **Sectoral Policy Reforms:** Updated strategies in water, biodiversity, and agriculture signal political will for sectoral transformation; once institutional and financial mechanisms are strengthened, they can anchor long-term resilience.

iv. **Emerging Climate Institutions**: The National Committee on Climate Change (NCCC) and its Executive Office (EO-NCCC) serve as coordination platforms that, through enhanced integration, can improve cross-sectoral planning and catalyze international partnerships.

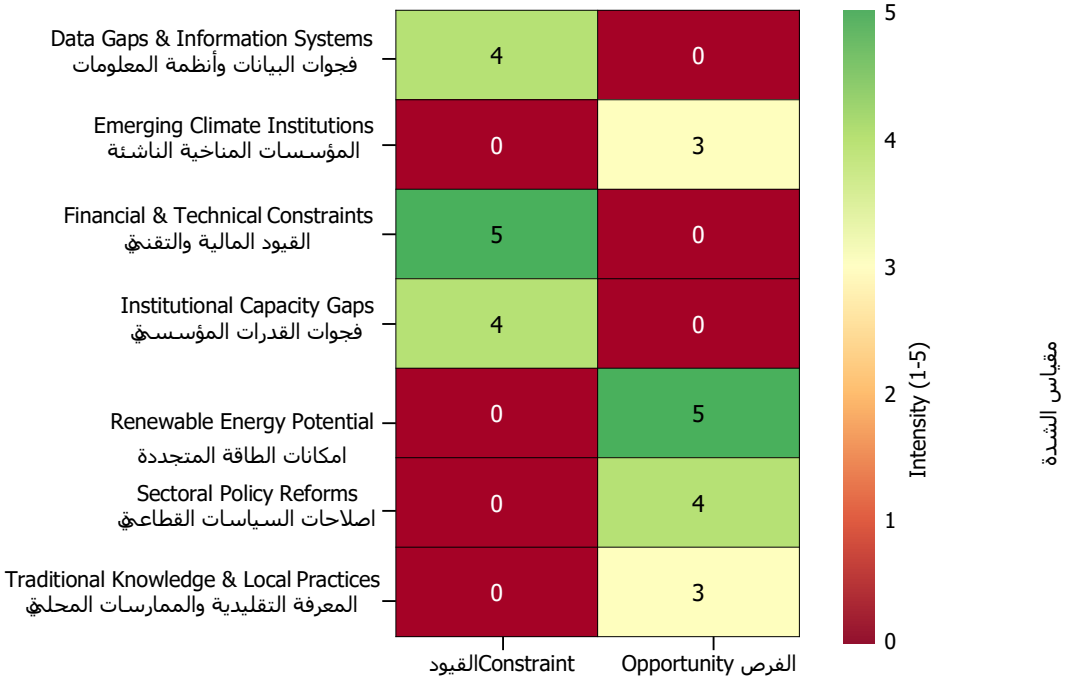
Entry Points for Climate Action in National Planning

Although the National Adaptation Plan (NAP) and Nationally Determined Contributions (NDCs) remain under development, several immediate opportunities exist to integrate climate action into Libya's development trajectory:

1. Mainstreaming resilience and risk management into water governance, based on the Water Security Strategy 2025–2050.
2. Strengthening municipal adaptation planning through decentralization frameworks and TAAPs, aligned with local risk maps and community consultation.
3. Expanding climate education and public awareness, particularly among youth and women, as part of national social protection and empowerment strategies.
4. Establishing a national system of climate and environmental statistics, serving as the foundation for both Enhanced Transparency Framework reporting and evidence-based planning.

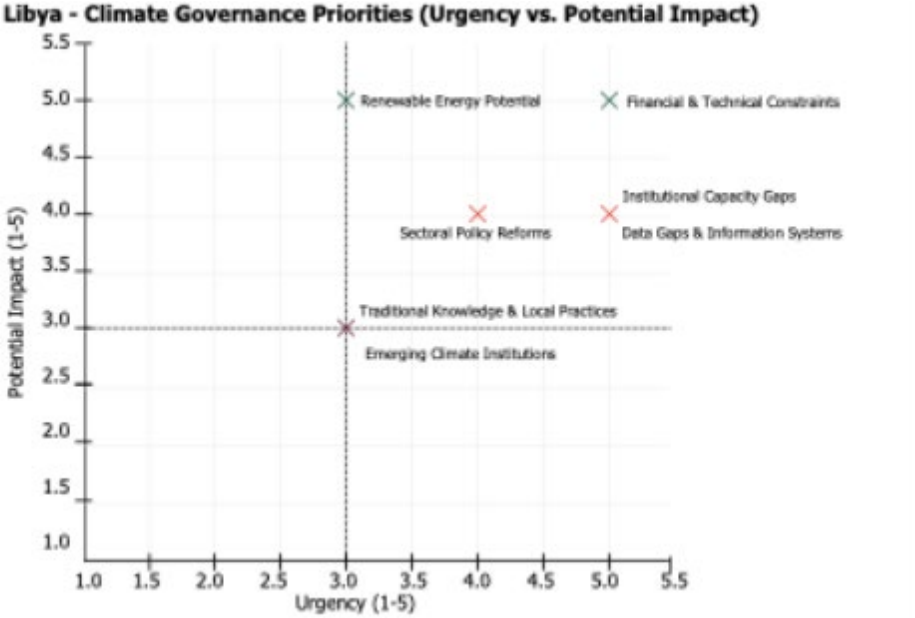
Integrated Perspective. Libya stands at a foundational stage of climate governance. Addressing data gaps, institutional fragmentation, and financing barriers is critical to unlocking the country's adaptation potential. By leveraging renewable energy resources, traditional adaptive practices, and emerging institutional frameworks, Libya has an opportunity to transition from reactive approaches to a systematic development pathway with climate resilience. The following matrix summarizes this graphically: "Constraints versus Opportunities Matrix."

Figure (2): Libya – Climate Governance Constraints versus Opportunities (Heatmap)



- Red–orange shades highlight severe constraints (data, institutional, and financing gaps).
- Green shades indicate strong opportunities (renewable energy, policy reforms).
- Yellow shades reflect mid-range but underutilized areas (traditional knowledge, emerging institutions).

Figure (3): Climate Governance Priorities



Upper Right Quadrant (High Urgency, High Impact):

1. Data gaps and information systems
2. Institutional capacity gaps
3. Financial and technical constraints represent immediate action priorities.

Mid-Right (Medium Urgency, High Impact):

1. Renewable energy potential
2. Sectoral policy reforms → Strategic opportunities requiring investment after addressing urgent gaps.

Mid and Lower Quadrants:

1. Traditional knowledge and local practices
2. Emerging climate institutions → Important for long-term resilience but currently underutilized.

Analysis. The four-quadrant analysis highlights that Libya's most urgent and impactful climate action priorities lie in addressing systemic gaps in data, institutional capacity, and financial resources. These deficits constrain the country's ability to implement adaptation strategies, access climate finance, and fulfill international reporting commitments under the Paris Agreement. Simultaneously, renewable energy potential and sectoral policy reforms represent strategic opportunities with transformative impact, contingent on strengthening enabling conditions.

Finally, while traditional adaptive knowledge and emerging institutions currently play a limited role, they remain essential elements of a long-term resilience strategy, supporting community-led adaptation and gradual institutional embedding. This prioritization distribution underscores the need for a phased approach: urgent investment in foundational capacities, coupled with medium-term expansion of renewable energy and sectoral reforms, and long-term integration of local practices and decentralized governance.

Chapter 2. National Greenhouse Gas Inventory

Libya's national greenhouse gas inventory provides the first unified baseline of emissions and removals in the country, fulfilling a core commitment under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. The inventory highlights that the energy sector is Libya's primary emissions driver, while identifying critical data and institutional needs. This inventory not only supports future mitigation actions and tracks Nationally Determined Contributions (NDCs) but also signals priority areas for international support to strengthen transparency and climate governance in Libya.

2.1 Purpose and Scope

Libya's national greenhouse gas inventory aims to provide a transparent, consistent, comparable, complete, and accurate account of anthropogenic greenhouse gas emissions and removals across the country. This inventory is a cornerstone of Libya's reporting obligations under the UNFCCC and the Paris Agreement. It enables evidence-based policymaking, supports the design of mitigation and adaptation measures, and facilitates compliance with international transparency requirements.

The inventory is prepared in accordance with the following normative instruments:

- **Article 4.1(a) and Article 12.1 of the UNFCCC**, requiring all Parties to report national inventories of anthropogenic emissions by source and removals by sink.
- **The Enhanced Transparency Framework (ETF)** of the Paris Agreement (Decision 18/CMA.1), which establishes methods, procedures, and guidelines for reporting.
- The Revised 1996 and 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and the 2019 Refinement, which provide methodological guidance to ensure consistency and comparability.

Inventory Scope

- Geographic coverage encompasses all Libyan territory, including land, marine, and coastal areas within national borders.
- Gases covered include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3), where data are available.
- Sectors covered (following IPCC classification):
  1. Energy (fuel combustion activities and fugitive emissions from oil and gas).
  2. Industrial Processes and Product Use (IPPU).
  3. Agriculture, Forestry, and Other Land Use (AFOLU).
  4. Waste (solid waste disposal, wastewater treatment, waste incineration).

Geographic coverage encompasses all Libyan territory, including land, marine, and coastal areas within national borders.

Temporal coverage: The current inventory covers the period 2017–2023, with emissions estimated using IPCC Tier 1 methodologies, supplemented by international datasets (International Energy Agency, Food and Agriculture Organization) to address national data gaps.

2.2 Institutional Arrangements

The National Committee on Climate Change tasks its Executive Office with coordinating the preparation and maintenance of Libya's greenhouse gas inventory, as the Committee itself is the national entity responsible for preparing climate change reports, ensuring compliance with the commitments of the UNFCCC and the Paris Agreement, and coordinating among active service sectors.

Responsible Entities

- **EO-NCCC:** Overall coordination, inventory verification, and submission to the UNFCCC.
- **Relevant Ministries:**
  - **Ministry of Oil and Gas / General Electricity Company**: Energy sector data, including fuel combustion and fugitive emissions.
  - **Ministry of Industry**: Industrial processes and product use.
  - **Ministry of Agriculture**: Agriculture, livestock, and land-use data.
  - **Ministry of Environment**: Forestry, ecosystems, and environmental protection.
  - **Municipal Councils, Public Works and Waste Management**: Solid waste and wastewater data.

Data Providers

- Statistics and Census Department, national utility companies (electricity, water, waste management), oil and gas companies, cement factories, and fertilizer industries.
- National Entities on a local scale provide waste, land use, and local energy consumption data.

Processes

- **Data Collection**: Relevant ministries and companies gather sectoral activity data and submit to the NCCC-EO.
- **Aggregation and Estimation**: The NCCC-EO applies IPCC methodologies to calculate emissions and removals.
- **Verification**: Data are verified through comparison with international datasets (International Energy Agency statistics, Food and Agriculture Organization, United Nations) and historical national data to ensure consistency.
- **Reporting**: Summary tables, national inventory reports, and submissions are prepared according to UNFCCC templates and the Enhanced Transparency Framework format.

Constraints and Challenges

- **Data fragmentation**: Limited integration between ministries and companies.
- **Data gaps**: Incomplete time series, particularly in AFOLU and waste sectors.
- **Weak QA/QC capacity**: Limited expertise and technical resources for systematic quality assurance and quality control.
- **Coordination gaps**: Absence of a permanent inter-ministerial working group dedicated to inventory preparation, resulting in irregular information exchange.

2.3 Methodological Framework

Libya's national greenhouse gas inventory is based on the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The 1996 Revised IPCC Guidelines were applied, where appropriate, to some older time series. The 2019 Refinement to the 2006 Guidelines was applied selectively to improve accuracy, particularly regarding fugitive emissions and agricultural soils.

Application of Tiers:

- Tier 1 for most categories, given data constraints.
- Tier 2 for cement and enteric fermentation, where national data were available.
- Tier 3 methods have not been systematically applied but remain a priority for future cycles.

Emission Factors:

- IPCC default values were applied in most cases.
- Country-specific factors were used in limited cases (fuel combustion in power plants, cement production).
- Gaps remain in AFOLU and waste sectors.

The inventory applied Global Warming Potential values from the IPCC Fifth Assessment Report (AR5), consistent with Enhanced Transparency Framework requirements.

2.4 Sector and Gas Coverage

The inventory covers the following gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorinated compounds, sulfur hexafluoride, and nitrogen trifluoride (where applicable). Sectors (IPCC categories):

1. **Energy**. Fuel combustion (power generation, transport, manufacturing, residential/commercial) and fugitive emissions from oil and gas.
2. **Industrial Processes and Product Use (IPPU).** Use of cement, lime, steel, ammonia, methanol, and hydrofluorocarbons in refrigeration.
3. Agriculture, Forestry, and Other Land Use (AFOLU). Enteric fermentation, manure management, soil, biomass burning, land-use change; removals from limited forest areas.
4. **Waste**. Landfills, wastewater treatment, and open burning.

Data completeness has been documented transparently using IPCC notation keys: "NO" (Not Occurring) when there is evidence that a specific emission source does not exist; "NE" (Not Estimated) for categories that could not be estimated due to insufficient data. "IE" (Included Elsewhere) denotes cases where emissions are classified in another category.

Major emission sources have been fully recorded.

2.5 Emissions by Gas and Sector

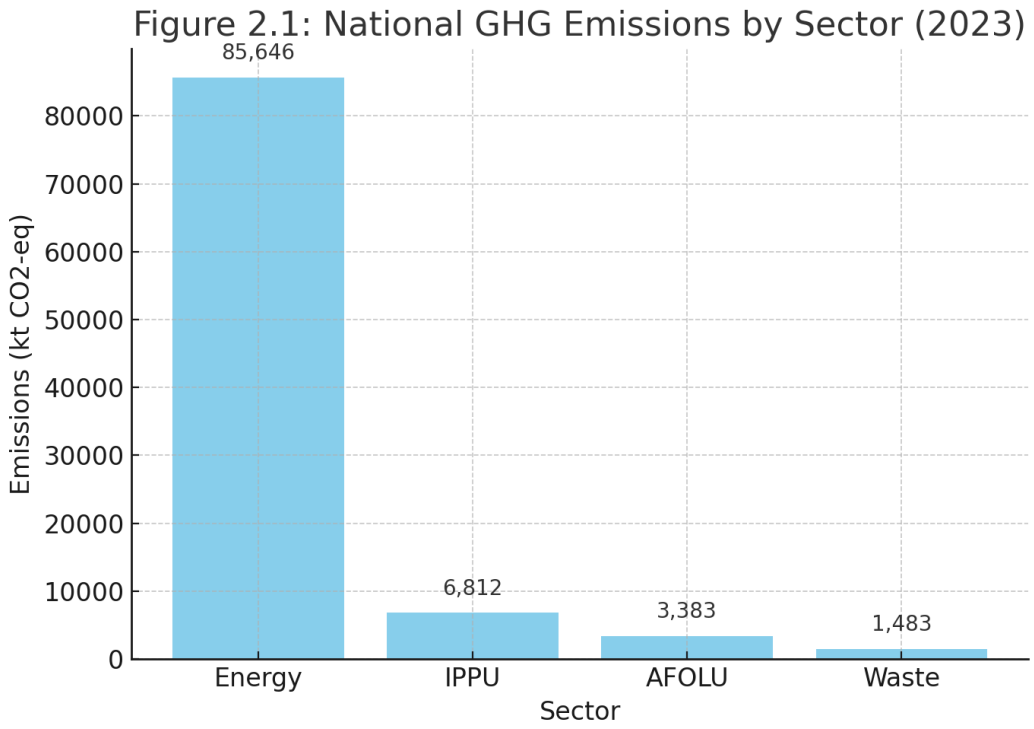
Table (3): National Greenhouse Gas Emissions by Gas (2023, kilotons CO_2 equivalent)

Gas	Emissions (KtCo2-eq)	Share (%)
Carbon dioxide (CO_2)	85,476	87.8
Methane (CH_4)	7,921	8.1
Nitrous oxide (N_2O)	3,314	3.4
Hydrofluorocarbons and others (HFCs, etc.)	613	0.6
Total	97,324	100

Table (4): National Greenhouse Gas Emissions by Sector (2023, kilotons CO_2 equivalent)

Sector	Emissions	Share (%)
Energy	85,646	88.0
Industrial Processes and Product Use (IPPU)	6,812	7.0
Agriculture, Forestry, and Other Land Use (AFOLU)	3,383	3.5
Waste	1,483	1.5
Total	**97,324**	**100**

Figure (3): Sectoral Share of Emissions, 2023 (Energy ~88%)

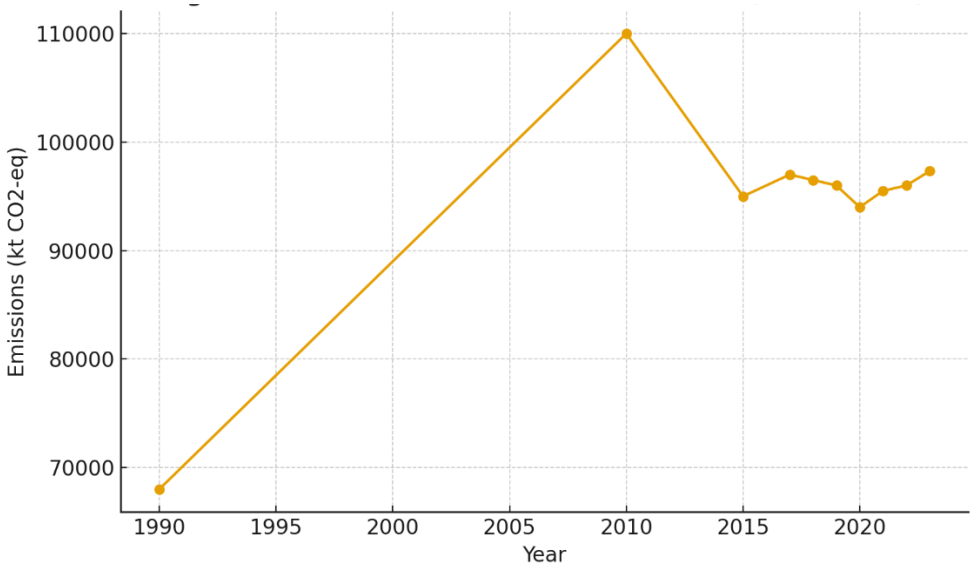


Key Categories: Energy dominates, followed by cement and ammonia in the Industrial Processes and Product Use sector, livestock and soils in the AFOLU sector, and methane from landfills in the waste sector.

2.6 Time Series Data (1990–2023)

- 1990: ~68,000 kilotons CO_2 equivalent.
- 2010: ~110,000 kilotons CO_2 equivalent (growth in energy demand and industrial activity).
- 2011–2015: Decline due to conflict and reduced oil production.
- 2017–2023: Stabilization at approximately 95,000–100,000 kilotons CO_2 equivalent.

Figure (4): Total National Emissions 1990–2023 (Line Chart)



Drivers: Hydrocarbon dependence, population growth (from 5 million to 7 million), limited renewable energy sources, land degradation, and increased waste.

2.7 Uncertainty Analysis

Table (5): Uncertainty Levels by Sector

Sector	Assessment Level	Primary Data Sources	Data Quality Issues
Energy	Medium	Fuel and fugitive emissions data	Average fuel data and fugitive emissions gaps
Industrial Processes and Product Use	Medium-High	Industry data gaps, fluorinated gases	Sectoral data deficiencies; fluorinated gas emissions
Agriculture, Forestry and Other Land Use (AFOLU)	High	Limited statistics; no land-use monitoring	Scarce statistical data; absence of land monitoring systems
Waste	High	No waste studies; incomplete wastewater data	Absence of waste studies; incomplete wastewater treatment data

Category	Description	Illustrative Examples
Infrastructure	Aging or damaged infrastructure; limited local manufacturing capacity; weak measurement and monitoring systems	Aging power grid; shortage of methane detection sensors; limited laboratory equipment
Data, Verification, and Reporting	Fragmented data systems; absence of standardized reporting formats; absence of quality assurance and quality control protocols in line ministries	Irregular reporting to EO-NCCC; non-digital records at sub-national level
Financial	Scarcity of local financing; limited access to concessional climate funds; lack of guarantees for public-private partnerships	Stalled independent power producer and landfill-to-power projects due to credit risk
Regulatory	Outdated energy and environmental laws; absence of climate change law operationalizing mitigation commitments	Weak penalties for gas flaring; absence of renewable energy feed-in regulations
Institutional	Overlapping mandates; inadequate inter-ministerial coordination; shortage of technical staff	Duplication of roles between national and municipal levels; staff turnover
Social	Low public awareness; inadequate incentives for behavior change; weak local community participation	Limited uptake of waste segregation and public transport measures

Uncertainty Estimation:

- Energy: ±10–15%
- Industrial Processes and Product Use: ±20-30%
- Agriculture, Forestry and Other Land Use (AFOLU): ±30–50%

- Waste: ±40-60%

Total Uncertainty: >30%, driven primarily by AFOLU and waste sectors

2.8 Quality Assurance and Quality Control Procedures

Implementation Actions:

1. **Cross-verification** with international datasets (International Energy Agency, Food and Agriculture Organization)
2. **Time-series consistency verification**
3. **Data validation** with national experts
4. **Application of notation keys**

Current Gaps:

No formal quality assurance/quality control plan; weak calibration procedures; absence of archiving systems; no external peer review.

Recommendations:

1. Establish a national QA/QC plan within the Executive Office of the National Committee on Climate Change (EO-NCCC)
2. Provide training for sectoral contact points
3. Implement a centralized data management system
4. Conduct independent expert peer review

2.9 Data Gaps and Capacity Constraints

- **Missing datasets identified:** Oil and gas fugitive emissions; agricultural and forestry land-use change; waste composition; fluorinated gas imports
- Estimates are largely based on standard assumptions and indirect indicators, rather than precise, specific, or directly observed data.
- **Institutional requirements:** Permanent inventory team; national emission factors; centralized system; QA/QC capacity; integration with National Adaptation Implementation and Coordination Plan (NAICP) and Climate Information and Decision Support System (CIDSS). These align directly with Chapter 7 (Support Needs).

2.10 Key Messages and Synthesis

→ **Total emissions (2023):** 97,324 kilotons CO_2 equivalent

By greenhouse gas: CO_2 87.8%; CH_4 8.1%; N_2O 3.4%; other substances 0.6%

By sector: Energy 88%; industrial processes and product use 7%; AFOLU 3.5%; waste 1.5%

Trends:

1. Rising energy and transport emissions; declining removals from land-use change
2. Continued hydrocarbon dependence; negligible renewable energy contribution
3. AFOLU and waste sectors are small but characterized by high uncertainty and mitigation potential

Implications:

1. Energy sector represents the primary mitigation challenge
2. Inventory establishes baseline for tracking Nationally Determined Contribution performance
3. Improved AFOLU and waste data required for co-benefits reporting

Next Steps:

1. Enhance data systems (NAICP, CIDSS)
2. Developing national emission factors
3. Expand AFOLU and waste data coverage
4. Institutionalize QA/QC procedures

Chapter 3 – Mitigation Actions and Impacts

3.1 Purpose, Scope, and Normative Framework

This chapter describes policies and measures adopted or under development by the State of Libya to reduce greenhouse gas emissions and assesses their qualitative and quantitative impacts—both ex-ante and ex-post. It fulfills reporting requirements under Article 4.1(b) of the United Nations Framework Convention on Climate Change (UNFCCC), which calls upon all parties to implement national and, where appropriate, regional programs containing measures to mitigate climate change and to report on them. The chapter also follows Decision 18/CMA.1 from the Paris Agreement on the Enhanced Transparency Framework (ETF), ensuring that information provided contributes to "tracking progress" toward achievement of Libya's Nationally Determined Contribution (NDC).

This section covers the entire Libyan territory and all major emissions-generating sectors in accordance with the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines and 2019 Refinement:

(1) Energy (fuel combustion and fugitive emissions),

(2) Industrial Processes and Product Use (IPPU),

(3) Agriculture, Forestry and Other Land Use (AFOLU), and

(4) Waste (solid waste and wastewater). Greenhouse gases included are carbon dioxide, methane, nitrous oxide, and fluorinated gases (hydrofluorocarbons, perfluorocarbons, and SF_6) according to national circumstances and data availability.

Reported mitigation measures align with the national greenhouse gas inventory for 2017–2023, which serves as the basis for estimating mitigation impacts and tracking progress toward the first nationally determined contributions (2025–2035). They are rooted in Libyan strategies (2023–2035) and policy frameworks, particularly the National Strategy for Renewable Energy and Energy Efficiency (2023–2035) (General Electricity Company, Renewable Energy Authority, and Ministry of Planning), and the "2030 Initiative" to reduce methane emissions and flaring in oil and gas operations (National Oil Corporation). These policies collectively aim to progressively decouple economic growth from emissions through energy efficiency, sustainable energy transition, and improved resource management across various sectors.

Linkages with other chapters are evident: Chapter 2 provides the emissions baseline and methodological foundation for measuring mitigation impacts; Cha**pter 5 (Support Received and Needed)** addresses technical and financial means for implementing mitigation actions; Chapter 7 establishes the monitoring, reporting, and verification (MRV) framework under the Enhanced Transparency Framework (ETF). The mitigation measures presented here also form foundational pillars for Libya's long-term low-emission development pathway, consistent with Paris Agreement objectives and national commitments to sustainable development and post-conflict recovery.

3.2 Institutional Arrangements for Mitigation Policy

Libya's institutional structure for mitigation policy has been progressively defined since 2021 through a series of government decrees establishing the National Committee on Climate Change and its Executive Office. The National Committee on Climate Change, established under Cabinet Decision No. 2021/336, functions as an interministerial coordination body for climate policies, ensuring alignment between national development plans and international climate

commitments. As for the Executive Office, it was established under a 2023 decision by His Excellency the Minister of Environment, Chairman of the National Committee on Climate Change. The National Committee on Climate Change is the supervisor and entity responsible for preparing and submitting national communications, coordinating the mechanisms of nationally determined contributions and the national adaptation plan across sectors, and facilitating access to international climate finance.

At the sectoral level, implementation roles and data provision are distributed among key ministries and entities. The Ministry of Oil and Gas and the National Oil Corporation lead mitigation efforts in the energy and oil-gas sectors, focusing on flared gas recovery, efficiency improvements, and renewable energy deployment. The General Electricity Company of Libya (GECOL) manages power generation and grid efficiency. The Ministry of Transport oversees improving fuel efficiency, developing land transportation, and expanding public transport measures. The Ministry of Industry and Ministry of Economy promote low-carbon industrial production and technology upgrading; the Ministry of Agriculture and Livestock contribute through sustainable land management and emission-reducing agricultural practices. The Ministry of Local Governance oversees municipal solid waste management, with increasing municipal participation under Decree 1500/2022, which formalized their environmental mandates and service provision.

The EO-NCCC coordinates mitigation data and ensures its quality across these entities through the National Adaptation Implementation and Coordination Platform (NAICP) and the Climate Information and Decision Support System (CIDSS). These digital systems channel data flows from sectoral ministries, state-owned enterprises, and municipalities into national repositories for monitoring, reporting, and verification (MRV), ensuring conformity with greenhouse gas inventories and alignment with the Enhanced Transparency Framework (ETF). Quarterly dashboards produced by the EO-NCCC synthesize progress on both mitigation and adaptation measures, while sectoral coordinating agencies (SACCCs) validate technical inputs before integration into Biennial Transparency Reports (BTRs).

The legal basis for mitigation governance rests on the decisions and complementary environmental and legislative instruments, particularly Law 7/1982 on Environmental Protection, Law 15/2003 on Environmental Protection and Improvement, and Law 59/2012 on Local Governance. However, the framework remains incomplete in the absence of a comprehensive climate change law. This gap constrains cross-sectoral enforcement of mitigation commitments and impedes integration of climate objectives into national planning instruments. Ongoing reform efforts led by the NCCC and Ministry of Justice aim to codify climate risk integration, update sectoral laws, and institutionalize coherence mechanisms for mitigation and adaptation governance.

Capacity constraints persist in technical, data, and budgetary domains. Key challenges include limited national emission factors, weak interministerial coordination among relevant ministries, and insufficient regulatory instruments to operationalize measurement, reporting, and verification protocols. Strengthening financial systems, data management capacities, and cross-ministerial standard operating procedures are near-term priorities under Libya's Capacity Building Roadmap (2025–2027). These efforts are supported by readiness programs with the Green Climate Fund, Global Environment Facility, and African Development Bank, focusing on financial accreditation, climate budget tagging, and integration of measurement, reporting, and verification data into public investment management systems.

3.3 Baseline and Reference Assumptions and Interface with Inventory

The mitigation analysis baseline for Libya is derived from the national greenhouse gas inventory for 2017–2023, which constitutes the reference dataset for assessing mitigation impacts and establishing sector-level business-as-usual pathways. The baseline year is 2023, consistent with the latest documented inventory data available.

3.3.1 Baseline and Reference Assumptions

Baseline emissions are determined by extrapolating historical trends in activity data using the 2017–2023 period as the calibration interval. The energy sector, representing approximately 88% of national emissions, is projected using final energy demand by fuel type and sector (electricity generation, transport, industry, residential), assuming a moderate economic recovery path and population growth of approximately 1.5% annually. The Industrial Processes and Product Use (IPPU) baseline follows production indicators for cement, iron, and steel industries. Agriculture, Forestry and Other Land Use (AFOLU) emissions are projected using historical agricultural production data and land-use trends, while waste sector baselines derive from urbanization rates and per-capita waste generation.

Key reference parameters include the fuel mix, dominated by natural gas and heavy fuel oil, together accounting for over 90% of total primary energy demand; average electricity demand growth of 4% annually; and fixed first-order emission factors per the 2006 IPCC Guidelines, as country-specific factors are unavailable. International data from the International Energy Agency supplement national statistics from the General Electricity Company of Libya and the National Oil Corporation, bridging activity data gaps after cross-verification to ensure consistency and reliability.

3.3.2 Consistency with Greenhouse Gas Inventory

The mitigation baselines and inventory data share identical methodological foundations, ensuring full consistency with the 2006 IPCC Guidelines and 2019 Refinement. Both apply 100-year global warming potentials from the IPCC Fifth Assessment Report, first-order methodologies with sectoral disaggregation by IPCC categories (1A–4). Recalculations performed on historical data during the inventory process, particularly for energy emissions and fugitive emissions—have been incorporated into baseline modeling to prevent time-series discontinuities.

3.3.3 Uncertainty and Data Limitations

Uncertainty remains substantial across numerous subcategories, primarily due to:

- **Oil and gas fugitive emissions**, where activity data and flaring volumes exhibit high volatility
- **Default emission factors**, applied in the absence of country-specific values, introducing potential uncertainty ranges of ±20–30%
- **Industrial process emissions**, particularly from cement and ammonia, where plant-level data are incomplete
- **Waste sector activity data,** limited to major municipalities (Tripoli, Benghazi, Misrata)

Future updates under Libya's Capacity Building Roadmap (2025–2027) aim to address these gaps through development of national emission factors, expansion of direct data collection, and enhancement of quality assurance and quality control protocols via NAICP and CIDSS platforms.

3.4 Mitigation Strategies by Sector

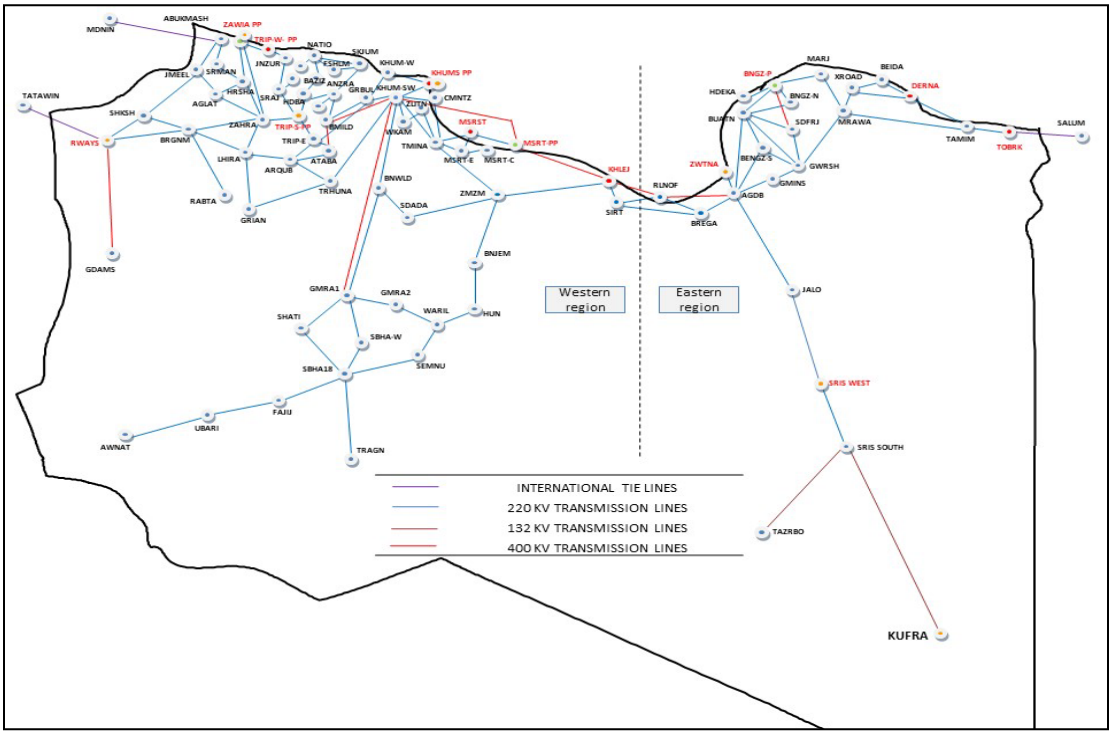
The following is a consolidated summary of strategies, policies, and measures for each sector in accordance with the ETF. Inputs reflect current policy indicators and plans for Libya in shared drafts; quantitative impacts will be integrated in Section 3.10 and the principal measures table (3.5).

3.4.1 Energy Supply and Transformation

Strategic Objective: Reduce methane and carbon dioxide emission intensity in oil and gas sectors; modernize power generation and networks; expand renewable energy sources and enhance

efficiency. Libya prioritizes reducing methane emissions from oil and gas and improving energy sector efficiency, as these represent the largest emissions sources by inventory share and mitigation potential.

Figure 5: National Libyan Transmission Network Diagram



As of 2024, Libya's installed electricity generation capacity stood at approximately 11.3 gigawatts, supported by over 20,000 kilometers of high-voltage transmission networks. The high-voltage transmission system extends across Libyan territory from west to east and from north to the country's southern frontier. This system was designed to deliver electricity to all regions and municipalities.

Key Measures:

- **2030 Initiative Program for Gas Flare Reduction and Minimization**: Multi-action package for flaring and venting reduction; alignment with Global Methane Pledge; progressive adoption of Oil and Gas Methane Partnership (OGMP) international partnership practices through UNEP (UN Environment Programme) and IMEO (International Methane Emissions Observatory) and MARS (Methane Alert and Response System) for targeted monitoring. Type: Regulatory/Operational; Implementing Entity: National Oil Corporation and subsidiaries. Status: Under Implementation. Greenhouse Gases: CH_4 (Methane).

- **Network loss reduction and distribution improvement (GECOL):** SCADA system upgrades, loss reduction, combined-cycle gas turbine conversion, fuel-switching to gas. Type: Regulatory/technological; Implementing entity: General Electricity Company of Libya; Status: Under implementation/planned; Greenhouse gas emissions: CO_2

Energy efficiency constitutes a complementary pillar guided by the National Electricity Efficiency Strategy 2023–2035, which targets savings of 16,926 gigawatt-hours by 2035, equivalent to

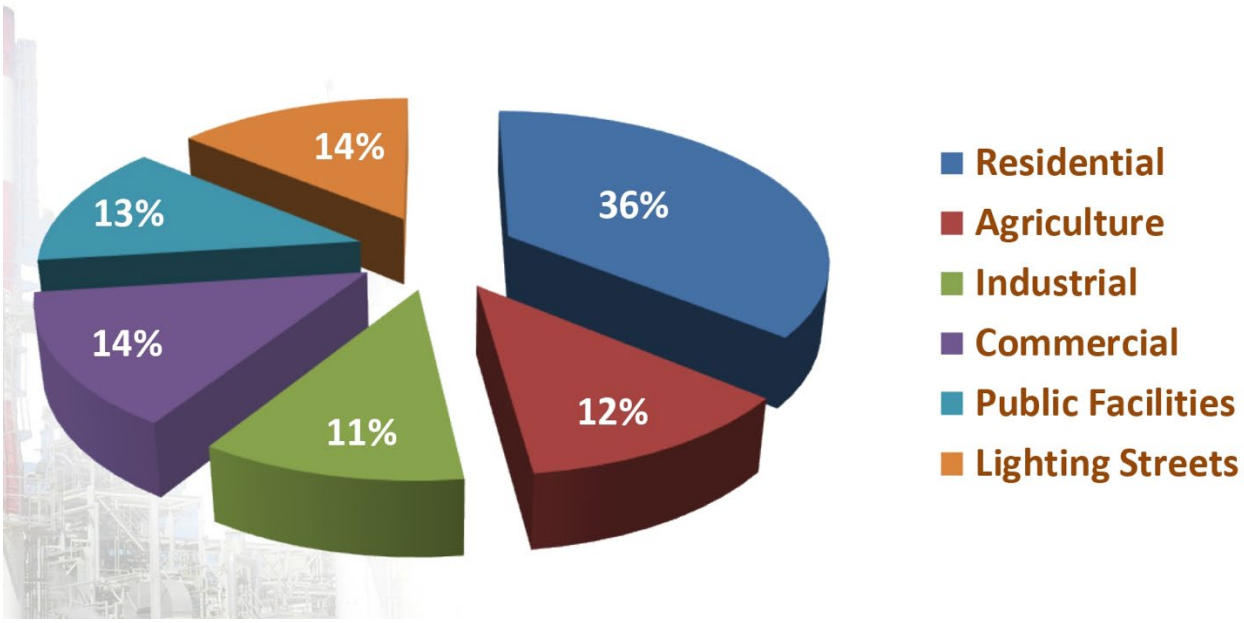
17.5% of projected electricity consumption. These savings are expected to be achieved through demand management, loss reduction, and application of broader energy conservation measures.

Figure 6: Energy Efficiency Poster



- **Renewable energy additions per NSREEE/NSED**: Utility-scale solar photovoltaic and wind energy toward 4–5.25 gigawatts by 2035 with phased implementation. Type: Policy/technological; Implementing entities: Renewable Energy Authority of Libya (REAOL), GECOL, private independent power producers (IPPs); Status: Approved/ongoing implementation; Greenhouse gas emissions: CO_2

Figure 7: Electricity Consumption Patterns, 2021



Note: Electricity consumption patterns in 2021 highlight the dominance of the residential sector, which accounted for 36% of total demand. Public utilities represented 13%, commercial uses 14%, agriculture 12%, industry 11%, and streetlights 14%. This structure reflects the importance of electricity in meeting household needs and the relatively modest share of industrial demand, highlighting the broader social and economic context within which this sector operates.
Coverage and Scope: National grid; major oil and gas assets; priority power generation nodes and transmission corridors
Estimated Impacts: To be reported ex-ante by measurement once plant-level data are consolidated; energy sector is the largest contributor to baseline emissions and mitigation potential. Methodologies conform to inventory levels and AR5 global warming potentials.
Methodology and Data: IPCC 2006/2019 Guidelines, currently Tier 1; gradual transition to higher tiers for methane; activity data from the National Oil Corporation and GECOL, supplemented by International Energy Agency data where gaps exist, validated. Overlap between flaring, leak detection, and gas production controlled through allocation rules.
Co-Benefits: Air quality, reliability, fuel savings, employment opportunities in grid modernization. Costs and Financing: Capital expenditure for combined-cycle gas turbines, renewable energy, and Leak Detection and Repair (LDAR) stations; general budget plus independent power producer (IPP) models and international climate finance Risks/Barriers: Operations and maintenance, supply chains, implementation; mitigated through monitoring, reporting, and verification (MRV) systems and phased procurement
Tracking Indicators: Annual recorded/avoided flaring volumes; technical transmission losses; installed renewable capacity; quarterly frequency via NAICP/CIDSS; owners: National Oil Corporation and GECOL

3.4.2 Transport

Strategic Objective: Improve fuel consumption efficiency and maintenance; transition toward public and cleaner transport modes; enhance logistics service efficiency
Examples of procedures for inspecting and maintaining major vehicles.

- Vehicle inspection and maintenance expansion: Periodic testing to maintain fleet efficiency. Type: Regulatory; Implementing entity: Ministry of Transport; Status: Planned
- Urban public transport pilot projects and rapid bus transit corridors: Modal shift in major cities. Type: Investment/regulatory; Implementing entities: Municipalities, Ministry of Transport; Status: Planned
- Clean vehicle fleet pilot projects (electric vehicles/compressed natural gas for municipal services): Phased procurement and charging stations. Type: Investment/voluntary; Implementing entities: Municipalities, GECOL interface; Status: Pilot

Coverage and Scope: Major urban centers and national corridors; public and semi-public fleets

Estimated Impacts: Ex-ante reductions from fuel savings; primary gas CO_2. Data from fuel sales and vehicle records; Tier 1; overlaps with electricity sector calculated when electric vehicles replace petrol/diesel

Methodology and Data: Fuel sales records and fleet registry; Tier 1; crossovers with electricity sector accounted for when electric vehicles displace conventional fuels

Co-Benefits: Air quality, health, travel time savings. Costs and Financing: Capital expenditure for fleets and depots; concessional lines and public-private partnership projects. Risks: Grid readiness, operations and maintenance; mitigation measures: phased pilot projects, maintenance contracts

Tracking Indicators: Liters per 100 kilometers by fleet type; public transport passengers per kilometer; share of electric vehicles; quarterly via NAICP/CIDSS; owners: Ministry of Transport and Municipalities

3.4.3 Industrial Processes and Product Use (IPPU)

Strategic Objective: Reduce process emissions and energy consumption in cement and key industries; manage hydrofluorocarbon compounds. Cement constitutes a major source by 2023 share.

Key Measures:

- **Clinker substitution and kiln efficiency in cement (2A1):** Addition of pozzolanas and waste heat recovery. Type: Regulatory/technological; Implementing entities: Cement plants; Status: Planned/under implementation
- **Ammonia/chemical process improvement**: Catalysts and process control. Type: Technical; Implementing entities: Industrial sector; Status: Planned
- **Refrigerant management**: Service standards, recovery, and gradual transition to hydrofluorocarbon alternatives. Type: Regulatory; Implementing entity: Ministry of Environment; Status: Planned

Coverage and Scope: Major cement and chemical plants; refrigeration service networks

Estimated Impacts: Process CO_2 reductions and indirect energy savings; hydrofluorocarbon reductions ex-ante with management expansion

Methodology and Data: 2006 IPCC Guidelines applies default data in absence of plant-level data; transition to plant-level data in next cycle

Co-Benefits: Competitiveness, employment opportunities, air quality

Costs and Financing: Plant capital expenditure; green credit lines. Risks: Availability of raw materials and additives; mitigation through supply contracts

Tracking Indicators: Clinker-to-cement ratio; specific heat consumption; hydrofluorocarbon recovery volumes; semi-annual reporting to the EO-NCCC.

3.4.4 Agriculture, Forestry and Other Land Use (AFOLU)

Strategic Objective: Promote carbon sequestration and reduce non-CO_2 emissions through increased tree cover and improved land and input management

Key Measures:

- Tree-planting initiatives—Office of the Prime Minister: 100 million trees; Ministry of Agriculture: 10 million drought-resistant trees to enhance carbon sinks and local climate services. Type: Programmatic/investment; Implementing entities: Office of the Prime Minister, Ministry of Agriculture; Status: Planned/early stages; Greenhouse gases: CO_2 removals
- Improved livestock management and fertilizer practices: Feeding practices, herd management, and application techniques to reduce methane and nitrous oxide emissions. Type: Advisory/regulatory; Implementing entity: Ministry of Agriculture; Status: Planned

Coverage and Scope: Priority areas and buffers around urban zones; rangelands and irrigated zones

Estimated Impacts: Ex-ante carbon sequestration per hectare planted and survival rates; methane/nitrous oxide emission reductions through input efficiency

Methodology and Data: IPCC initially lagged in developing standards; national standards developed through field trials

Co-Benefits: Windbreaks, erosion control, shade provision, livelihoods. Costs and Financing: Capital expenditure for nurseries and irrigation; general budgets supplemented by desertification fund/Green Climate Fund resources. Risks: Seedling survival, water stress; mitigation measures: species selection, drip irrigation

Tracking Indicators: Area planted and survival rate; fertilizer application intensity; annually per National Agricultural Planning Program (NAICP)/Climate Information and Decision Support System (CIDSS)

3.4.5 Waste (Solid Waste and Wastewater)

Strategic Objective: Reduce methane emissions from landfills and wastewater through sanitary infrastructure, gas capture, and conversion. Priority measures identified in the draft nationally determined contributions

Key Measures:

- **Rehabilitation and upgrading of 3 major uncontrolled waste disposal sites with biogas networks and flaring:**
  Type: Infrastructure/regulatory; Implementing entities: Local Government and Municipalities; Status: Planned; Greenhouse gases: CH_4
- **Establishment of 3 new sanitary landfills with CH_4 capture and energy recovery:**

  Type: Infrastructure; Implementing entities: Local Government, independent power producers; Status: Planned; Greenhouse gases: CH_4

- **Three major composting facilities and three organic material processing plants for organic matter conversion:**
  Type: Infrastructure/economic; Implementing entities: Municipalities; Status: Planned; Greenhouse gases: CH_4

- **Wastewater treatment plant rehabilitation and rollout of aerobic treatment:**

Type: Infrastructure/standard; Implementing entities: Water utilities and Municipalities; Status: Planned; Greenhouse gases: CH_4

Coverage and Scope: Initial focus on Tripoli, Benghazi, and Misrata, with subsequent expansion to additional municipalities

Estimated Impacts: Ex-ante CO_2-equivalent reductions per facility based on capture rates and conversion volumes; potential energy generation from biogas where feasible

5.3 Master Table of Planning Procedures and Projects, the Enhanced Transparency Framework, and Portfolios of Actions aMeasure

Table 5: Master Table of Planning Procedures and Projects, the Enhanced Transparency Framework, and Portfolios of Actions and Measures

Measure ID	Title	Sector / IPCC Category	Type	Status	Start Year / End Year	Coverage (Entities/Assets/Regions)	Targeted GHG	Ex-Ante Impact ($MtCO_2e$/yr; year/period; method)	Ex-Post Impact (if available; method)	Co-Benefits (brief text + SDG tags)	Costs / Financing (scope; instrument)	Implementing Agency	Tracking Indicator(s) and Frequency	Data Sources / QA/QC
EN-OG-01	2030 Methane Initiative: Reduction of Flaring and Venting (Oil and Gas)	Energy: 1B2 Fugitive Emissions (Oil and Gas)	Regulatory/ operational	Under implementation	2023 / 2030	Major oil and gas fields and processing assets countrywide	CH_4, CO_2	To be determined ex-ante; 2025–2035; top-down factors for flared gas capture and bottom-up emission measurement; IPCC 2006/2019	To be determined ex-post; facility-level MRV (meters, OGI/LDAR records)	Air quality; safety; energy recovery; employment (SDG 3, 7, 8, 13)	CAPEX: flared gas capture, compressors, associated gas detection equipment (LDAR); OPEX: operations and maintenance; public-private partnership + concessional climate finance	National Oil Corporation (lead), subsidiary companies	Avoided flaring volume; repaired leaks; methane intensity (kg/bbl CO_2e); quarterly	2017–2023 inventory; NDC v9; draft NC mitigation chapter; QA/QC: cross-verification with UNEP IMEO-MARS alerts
EN-POW-02	Network Loss Reduction and Distribution Improvement	Energy: 1A1a Public Electricity and Heat	Technology/ regulatory	Planned/under implementation	2024 / 2035	National transmission and distribution network; priority nodes	CO_2	To be determined ex-ante; 2026–2035; top-down savings through loss reduction and combined-cycle gas turbine efficiency	To be determined ex-post; SCADA records and fuel intensity	Reliability; fuel savings; employment (SDG 7, 9, 8, 13)	CAPEX: SCADA system, power lines, transformers, combined-cycle gas turbines; OPEX: network operations and maintenance; independent power producers/government + climate funds	GECOL (lead)	Network technical losses (%); specific emissions (gCO_2/kWh); quarterly	2017–2023 inventory; draft NC mitigation chapter; QA/QC: measured losses vs. modeled
EN-RE-03	Utility-Scale Solar PV and Wind Additions (NSREE/NSED milestones)	Energy: 1A1a (indirect electricity displacement)	Policy/ technology	Approved/ongoing implementation	2024 / 2035	National grid; utility-scale sites; private independent power producers	CO_2	To be determined ex-ante; 2026–2035; displaced grid emission factor method	To be determined ex-post; measured generation (GWh) × grid efficiency	Air quality; biodiversity; employment (SDG 7, 9, 8, 13)	CAPEX: solar PV/wind power stations; OPEX: operations and maintenance; independent power producer agreements/PPAs + climate finance	REAOL, GECOL, private IPPs	Installed megawatts; annual gigawatt-hours; quarterly	NDC v9; draft NC mitigation chapter; QA/QC: PPA measurement vs. SCADA
TR-IM-04	Vehicle Inspection and Maintenance Expansion	Energy: 1A3 Transport	Regulatory	Planned	2026 / 2035	Major urban centers and national fleet	CO_2	To be determined ex-ante; 2026–2035; baseline fleet degradation vs. maintained fleet model	To be determined ex-post; fuel efficiency test records	Air quality; health (SDG 3, 11, 13)	CAPEX: testing stations; OPEX: operations; municipal budgets + international financial institutions	Ministry of Transport; Municipalities	Average liters/100 km by vehicle class; vehicles passing I/M; semi-annual	2017–2023 inventory; NDC v9; QA/QC: sample audit processes

TR-BRT-05	Urban Public Transport Pilots and Rapid Bus Transit Corridors	Energy: 1A3 Transport	Investment/regulatory	Planned	2026 / 2035	Tripoli, Benghazi, and Misrata corridors	CO_2	To be determined ex-ante; passenger-km rates × emission factor differential	To be determined ex-post; passenger records and fuel consumption	Air quality; travel time savings; inclusion (SDG 3, 10, 11)	CAPEX: buses and depots; OPEX: services; public-private partnership + sovereipn funds + climate funds	Ministry of Transport; Municipalities	Passenger-km; load factor; quarterly	NDC v9; QA/QC: tickets vs. sensors
TR-EV-06	Clean Vehicle Fleet Pilots (EV/CNG) for Municipal Services	Energy: 1A3 Transport	Investment/voluntary	Pilot	2025 / 2030	Municipal fleets (solid waste, utilities)	CO_2	To be determined ex-ante; km displacement × emission factor; add electricity demand to power EF	To be determined ex-post; telematics and IoT data	Air quality; noise reduction; O&M cost savings (SDG 3, 11)	CAPEX: vehicles, charging infrastructure; OPEX: electricity/fuel; public-private partnership + grants	Municipalities; GECOL interface	Share of electric vehicles in fleet; electric vehicle-kilometers; quarterly	NDC v9; QA/QC: odometer vs. energy meters
IP-CEM-07	Clinker Substitution and Kiln Efficiency (Cement)	IPPU: 2A1 Cement	Regulatory/technological	Planned/under implementation	2026 / 2035	Major cement plants	CO_2	To be determined ex-ante; clinker ratio reduction × production; waste heat recovery savings	To be determined ex-post; plant reports and audits	Competitiveness; employment (SDG 8, 9, 12)	CAPEX: waste recycling, grinding; OPEX: additives; credit lines + guarantees	Ministry of Industry; cement plants	Clinker-to-cement ratio; specific heat consumption; semi-annual	Inventory; draft NC mitigation chapter; QA/QC: plant audit processes
IP-HFC-08	Refrigerant Management and Transition to Hydrofluorcarbon Alternatives	IPPU: 2F HFCs	Regulatory/standard	Planned	2026 / 2035	Refrigeration and air conditioning service networks countrywide	HFCs	To be determined ex-ante; recovery rate × bank volume × total GWP	To be determined ex-post; recovered/destroyed by kilogram by type	Air quality; safety; skills development (SDG 3, 8, 12)	CAPEX: recovery equipment; OPEX: maintenance; extended producer responsibility + grants	Ministry of Environment	HFCs recovered (kg); leak rate reduction; annual	Inventory; QA/QC: licensed technician registry
AF-TRE-09	National Tree-Planting: PM 100 million + MA 10 million	AFOLU: Land Use (Removals)	Programmatic/investment	Planned/early implementation	2025 / 2035	150,000 hectares + 33,000 hectares; priority ecological zones and urban buffers	CO_2 (removals)	To be determined ex-ante; tCO_2/hectare × survival rate; cohort method	To be determined ex-post; sample plots; remote sensing	Erosion control; local climate; livelihoods (SDG 13, 15, 8)	CAPEX: nurseries and planting; OPEX: maintenance; African Development Bank/Green Climate Fund + general budgets	Office of the Prime Minister; Ministry of Agriculture	Hectares planted; survival rate; annual	NDC v9; QA/QC: RS verification

AF-AGR-10	Livestock and Fertilizer Management	AFOLU: 3A/3C	Regulatory/advisory	Planned	2026 / 2035	Rangelands and irrigated agriculture	CH_4, N_2O	To be determined ex-ante; emission intensity factors per head/hectare	To be determined ex-post; farm surveys and input records	Productivity; soil health (SDG 2, 12, 13)	CAPEX: extension kits; OPEX: consultancy; grants/credit	Ministry of Agriculture	Emission intensity per product; annual	Inventory; QA/QC: audit samples
WS-LFG-11	Rehabilitation of 3 Major Landfills with Biogas Flaring	Waste: 4A Solid Waste Disposal	Infrastructure/regulatory	Planned	2026 / 2032	Tripoli, Benghazi, and Misrata landfills	CH_4	To be determined ex-ante; Tier 1 decay with capture rates	To be determined ex-post; biogas flow meters and flare records	Health; odor control; employment (SDG 3, 11)	CAPEX: wells, wellheads, flares; OPEX: operations and maintenance; public-private partnership + climate funds	Ministry of Local Governance; Municipalities	Nm^3 LFG captured; tCH_4 flared; quarterly	NDC v9; QA/QC: meter calibration
WS-LFG-12	3 New Sanitary Landfills with LFG-to-Power Technology	Waste: 4A Solid Waste Disposal	Infrastructure/investment	Planned	2026 / 2035	New Tripoli, Benghazi, and Misrata facilities	CH_4, CO_2 (displaced energy)	To be determined ex-ante; capture × utilization × grid EF	To be determined ex-post; power generation meters and gas flow	Energy recovery; employment (SDG 7, 8, 11)	CAPEX: units and engines; OPEX: operations and maintenance; independent power producer agreements/PPAs	Ministry of Local Governance; independent power projects	MWh generated; tCH_4 utilized; quarterly	NDC v9; QA/QC: SCADA vs. plant meters
WS-DIV-13	Organic Waste Diversion (3 composting + 3 MBT)	Waste: 4A/4B	Infrastructure/economic	Planned	2026 / 2032	Tripoli, Benghazi, and Misrata facilities	CH_4	To be determined ex-ante; diverted load × default reduction factors	To be determined ex-post; weighbridge data	Employment; soil improvement (SDG 8, 12, 11)	CAPEX: plants; OPEX: processes; tipping fees + PPPs	Municipalities	Tons diverted; % organic diversion; quarterly	NDC v9; QA/QC: weighbridge audit processes
WW-TRT-14	Wastewater Treatment Plant Rehabilitation and Aerobic Treatment Rollout	Waste: 4D Wastewater	Infrastructure/standard	Planned	2026 / 2032	Municipal wastewater treatment plants countrywide	CH_4	To be determined ex-ante; methane emission factors by treatment type	To be determined ex-post; plant meters and laboratory testing	Health; water quality (SDG 3, 6)	CAPEX: plant rehabilitation; OPEX: energy/chemicals; municipal budgets + international financial institutions	Water utilities; Municipalities	WWTPs with aerobic systems; BOD removal; quarterly	NDC v9; QA/QC: laboratory QA/QC protocols

Methodology and Data: IPCC applies default methane emission standards for landfill waste; plant-level data will be integrated as facilities commence operations; overlaps managed through exclusive allocation between capture and diversion measures.
Co-Benefits: Public health, employment, odor control, energy recovery
Costs and Financing: Capital expenditure for landfills/extraction systems; municipal budgets, public-private partnerships, climate funds
Risks: Operations and maintenance, tariffs and implementation; mitigation measures: service contracts, phased tariff reform pilots
Tracking Indicators: Tons diverted waste; CO_2 capture and utilization; wastewater treatment plants with aerobic treatment; quarterly via NAICP/CIDSS

3.5 Master Table for Enhanced Transparency Framework (ETF, consolidated)

3.6 Methods for Estimating Impacts (Transparency under Decision 18/CMA.1)

3.6.1 Approaches

Libya will measure mitigation impacts using a mix of sector-appropriate methodologies aligned with IPCC good practice and the national inventory system.
Bottom-Up Engineering Approaches: Applied when activity-level measurement data are available (e.g., recovered flaring gas, reduced network losses, captured landfill gas, clinker ratio changes). Device or facility data are integrated with emission factors to estimate avoided emissions. This aligns with inventory practices under 2006 Guidelines and 2019 Refinement, as appropriate.
Top-Down Intensity Approaches: Applied when only aggregate energy or production data are available, with impact measured as a change in emission intensity (e.g., gCO_2/kWh at system level; fuel economy). International datasets are used to bridge gaps, consistent with inventory verification practices.
Hybrid Approach: Employed when mitigation measures affect both activity and intensity (e.g., renewable energy sources displacing marginal generation with concurrent grid efficiency improvements). The tiered inventory framework supports model selection.
Additionality Treatment: For ex-post reporting, only measured or attributable changes imputed to the implemented mitigation measure are counted. For ex-ante estimates, business-as-usual assumptions align with inventory time-series and national assumptions in the nationally determined contribution; where attribution uncertainty exists, conservative adjustments are applied.

3.6.2 Emission Factors and Tiers

The default basis is the 2006 IPCC Guidelines with selective use of 2019 Refinement enhancements; 100-year global warming potentials (AR5) are applied for aggregation, consistent with inventory methodologies and nationally determined contribution assumptions.

Tier selection by sector:

- **Energy and transport**: Tier 1 factors for fuel combustion and system intensities; gradual upgrade to higher tiers where plant-level data permit
- **2030 Initiative for Gas Flare Reduction and Minimization from Oil and Gas Operations**: Transition from Tier 1 to Tier 2/3 methodologies where operationally feasible, with expansion of facility-level measurements, emission detection equipment, well location identification, and flare stack monitoring systems.
- **Industrial Processes and Product Use (IPPU):** Tier 2 for cement where plant data exist; Tier 1 otherwise
- **Agriculture, Forestry and Other Land Use (AFOLU) and Waste:** Tier 1 initially, with national factor development as data systems mature

Country-specific vs. IPCC default factors: Country-specific factors are applied where available (e.g., selected power plants, cement); otherwise, IPCC defaults are applied, documented by inventory practice.

3.6.3 Attribution and Overlap Control

To prevent double counting across measures that interact within the same category, Libya will apply a transparent attribution hierarchy:

1. **Control boundary definition**: Asset-, corridor-, or facility-level boundaries (e.g., power station, landfill, rapid bus transit corridor) such that each mitigation measure's impact is calculated on a distinct activity set.
2. **Temporal sequencing**: Apply network efficiency and loss reductions before renewable energy displacement when both affect CO_2/kWh; then use the updated grid factor for renewable mitigation measures.
3. **Exclusive mass/energy accounting**: In waste, diverted material to composting/biomedical waste is removed from the landfill gas generation base; captured biogas used for power generation is not separately flared.
4. **Conservative adjustments**: Where data cannot fully resolve overlaps, a documented discount is applied and noted on the mitigation measure card and master table, consistent with inventory QA/QC culture.

3.6.4 Uncertainty and Sensitivity Analysis

Quantitative measurement: Primary activity data models will display uncertainty ranges or confidence intervals reflecting activity data and factor uncertainty by sector (e.g., higher for fugitive methane, lower for metered electricity). Sectoral uncertainty patterns follow inventory uncertainty analysis.

Sensitivity tests: Ex-ante results will demonstrate the impact of key factors: greenhouse gas capture efficiency, tree survival rates, network loss trajectories, clinker ratios. Assumptions align with inventory time-series and methodological notes for the nationally determined contribution.

3.6.5 Consistency with Projections

Where national projections exist, mitigation measure impacts will be reconciled with the projection baseline used in the nationally determined contribution pathway and inventory time-series. Mitigation measures that alter structural parameters in the energy system or industrial output will update underlying intensity or activity assumptions in the next inventory cycle to maintain internal consistency. Reporting will follow Enhanced Transparency Framework (ETF) methodologies through performance reports, with data flows anchored to the National Libyan Climate Intelligence Platform and Adaptation Coordination (NAICP) and Climate Information and Decision Support System (CIDSS).

3.6.6 Data Systems, Documentation, QA/QC

Data systems: Mitigation measure indicators, activity data, and meter records are reported by responsible entities and consolidated via NAICP/CIDSS for transparency and traceability.

Documentation: Each mitigation measure card records methodologies, equations, factors, sources, allocation rules, and update history, reflecting inventory documentation practice and notation keys.

Quality Assurance and Quality Control: QA/QC encompasses internal verification processes, cross-checks between measurement and models, comparisons with international datasets where appropriate, and inter-ministerial technical review before Biennial Transparency Report submission.

3.7 Implementation Status and Barriers

3.7.1 Progress Narrative

The implementation of Libya's mitigation policy advances amid challenging institutional and infrastructure conditions, yet numerous milestones demonstrate tangible progress since 2021.

Institutional progress: Establishment of the National Committee on Climate Change (NCCC) and its Executive Office (EO-NCCC) has created a permanent coordination mechanism for mitigation policy, measurement, reporting, verification, and international reporting. Relevant ministries have appointed sectoral climate coordinating agencies, and data flow to NAICP and CIDSS has begun in pilot mode.

Energy, Oil, and Gas. The "2030 Initiative" for Methane Gas Emissions Reduction, led by the National Oil Corporation, has entered its initial operational phase through the implementation of several projects for utilizing flared gas both in the near and medium term, as well as other strategic projects planned before 2030. The General Electricity Company has begun updating the distribution control system and is currently preparing tenders for the first batch of combined cycle gas turbines as part of the National Sustainable Energy Strategy 2023–2035. While renewable energy addictions are still in their early stages, the General Electricity Company has completed feasibility studies for more than 700 megawatts of photovoltaic solar power and three wind power sites.

Transport: The Ministry of Transport has completed draft vehicle inspection and maintenance regulations and pilot electric vehicle fleets. Feasibility studies for rapid bus transit corridors in

Tripoli and Benghazi have been completed, and financing proposals are currently being prepared through the African Development Bank (AfDB).

Industrial Processes and Product Use (IPPU): The Ministry of Industry has initiated preliminary feasibility studies for clinker substitution and waste heat recovery at two cement plants (Al-Futtayah and Souq al-Khamis).

Agriculture, Forestry and Other Land Use: The 100 million tree initiative, launched by the Ministry of Planning and overseen by the Prime Minister's Office.

Waste and Wastewater: The Ministry of Local Governance and municipal authorities have completed design and assessment of three sanitary waste landfills (Tripoli, Misrata, Benghazi) and three composting facilities. Feasibility studies for methane-to-power conversion systems are underway with support from the United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP).

Overall, mitigation measures have transitioned from planning phases to early operational stages, with tangible progress in institutional readiness, pilot projects, and pipeline development.

3.7.2 Key Barriers

Despite this progress, numerous cross-sectoral and sector-specific barriers impede full implementation:

Table 7: Key Barriers

Category	Description	Illustrative Examples
Infrastructure	Aging or damaged infrastructure; limited local manufacturing capacity; weak measurement and monitoring systems	Aging power grid; shortage of methane detection sensors; limited laboratory equipment
Data, Verification, and Reporting	Fragmented data systems; absence of standardized reporting formats; absence of quality assurance and quality control protocols in line ministries	Irregular reporting to EO-NCCC; non-digital records at sub-national level
Financial	Scarcity of local financing; limited access to concessional climate funds; lack of guarantees for public-private partnerships	Stalled independent power producer and landfill-to-power projects due to credit risk
Regulatory	Outdated energy and environmental laws; absence of climate change law operationalizing mitigation commitments	Weak penalties for gas flaring; absence of renewable energy feed-in regulations
Institutional	Overlapping mandates; inadequate inter-ministerial coordination; shortage of technical staff	Duplication of roles between national and municipal levels; staff turnover
Social	Low public awareness; inadequate incentives for behavior change; weak local community participation	Limited uptake of waste segregation and public transport measures

3.7.3 Corrective Actions and Support Needs

To overcome these barriers, Libya will implement the following corrective measures and mobilize targeted international support, as detailed in Chapter 5 (Support Received and Needed):

1. **Capacity Building and Institutional Strengthening:** Expand sectoral training on emission estimation and verification at NAICP/CIDSS; establish dedicated monitoring and verification units within the National Oil Corporation, GECOL, and key ministries; introduce technician accreditation programs (LDAR, refrigerant recovery, measurement).
2. **Legal and Regulatory Reform:** Develop and adopt a national climate change law establishing legal mandates for mitigation actions, monitoring and reporting; update electricity and renewable energy laws to enable independent power producer participation and tariff reform; complete vehicle inspection and maintenance regulations.
3. **Technology Transfer and Innovation:** Secure partnerships for methane capture technology, grid integration, and renewable energy storage systems; introduce clean production technologies in cement, waste management, and agriculture through bilateral cooperation and technology mechanism channels.
4. **Finance Mobilization:** Operationalize a national climate finance facility; apply climate budget tagging across all ministries. Enhance readiness to access the Green Climate Fund, Adaptation Fund, and climate investment funds; encourage public-private partnerships for renewable energy infrastructure and waste management through the Ministry of Economy and Finance.
5. **Data Improvement, Monitoring, Reporting and Verification:** Expand NAICP/CIDSS integration for automated data collection; link with the national statistics system; institute annual MRV review cycles for transparency reports.

3.8 Co-Benefits for Sustainable Development and Just Transition

3.8.1 Overview

Libya's mitigation actions aim not only to reduce greenhouse gas emissions but also to achieve tangible social, economic, and environmental co-benefits aligned with the country's broader development objectives, including energy security, public health, job creation, and improved service delivery. These synergies are explicitly recognized in national strategies such as the National Sustainable Energy Strategy (2023–2035), National Strategy for Renewable Energy and Energy Efficiency, the National Adaptation Plan, and the Nationally Determined Contributions (2025–2035).

The co-benefits framework also reflects Libya's commitment to the 2030 Sustainable Development Agenda, particularly Sustainable Development Goals 3 (Health), 7 (Affordable and Clean Energy), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation and Infrastructure), 11 (Sustainable Cities), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 (Life on Land).

3.8.2 Environmental and Health Co-Benefits

1. **Air quality improvement:** Reductions in gas flaring and venting and fossil fuel combustion in energy and transport sectors are expected to significantly reduce fine particulate matter, nitrogen oxide, and sulfur dioxide emissions. Estimates in the draft NC mitigation chapter indicate that full implementation of the 2030 Methane Initiative and power grid modernization measures could reduce local air pollutant concentrations by 8–12% in major urban centers such as Tripoli and Benghazi by 2035.
2. **Health benefits:** Declining ambient air pollution translates to avoided premature deaths and increased disability-adjusted life years, to be monitored in collaboration with the Ministry of Health using national epidemiological data and World Health Organization health impact assessment coefficients.
3. **Avoided loss and damage:** Methane capture from waste and oil operations not only mitigate greenhouse gas emissions but also reduces risks of fires, explosions, and groundwater contamination, enhancing infrastructure and community resilience.
4. **Water and soil quality:** Improvements in wastewater treatment and organic waste diversion reduce leachate contamination, enhance groundwater, and improve soil nutrient balance, particularly in peri-urban zones.

3.8.3 Economic and Technological Co-Benefits

1. **Job creation and skills development:** Renewable energy programs, waste management, and afforestation initiatives are projected to generate over 20,000 direct and indirect employment opportunities by 2035, particularly in installation, maintenance, and local manufacturing. The 100 million tree initiative alone supports over 2,000 seasonal jobs and new income-generating opportunities in nursery management and irrigation services.
2. **Industrial competitiveness:** Process improvements in cement, ammonia, and chemical industries reduce energy intensity and production costs, enhancing the competitiveness of Libyan products regionally.
3. **Technology transfer:** Partnerships under the Climate Technology Centre and Network and bilateral cooperation (e.g., Italy, Germany, European Union) promote introduction of laser-based emission detection systems, advanced measurement infrastructure, and low-carbon cement additives.
4. **Energy reliability and diversification:** Deployment of renewable energy and flaring reduction provide cleaner and more stable power supplies, reducing dependence on imported fuel and increasing national grid resilience.

3.8.4 Social and Equity Dimensions

In Libya, the transition toward a low-emission economy is guided by principles of equity, inclusion, and just transition, ensuring no group bears disproportionate social or economic burdens.

1. **Distributional safeguards:** Planned tariff reforms in energy and waste sectors will incorporate social protection measures to shield low-income households from price shocks. The Ministry of Finance and the EO-NCCC are developing a climate budget tagging

framework to ensure mitigation-related subsidies and incentives are transparently and progressively targeted.

2. **Skills retraining and workforce transition:** The Green Skills Program, scheduled for launch in 2025 under the Ministry of Labor, will retrain workers from fossil fuel-intensive sectors for roles in renewable energy, waste management, and green building. Partnerships with vocational institutes and universities will focus on digitalization, solar energy systems maintenance, and environmental monitoring.
3. **Small and medium enterprise access to finance:** A green credit facility for SMEs, supported by African Development Bank and Green Climate Fund projects, will enable small and medium enterprises to invest in clean technologies and circular economy activities.
4. **Male / Female and youth inclusion:** The Women's Inclusion Policy (2024) emphasizes female participation in renewable energy, waste, and forestry programs, ensuring Male / Female-responsive employment quotas and training opportunities. Youth are prioritized under the National Entrepreneurship Initiative (2025), which links innovation hubs to startups focused on mitigation action.

Accordingly, mitigation co-benefits and transition measures contribute not only to emission reductions but also to sustainable development and community resilience. These synergies will be systematically monitored through NAICP/CIDSS indicators and reported in subsequent Biennial Transparency Reports, ensuring transparency and alignment with the Enhanced Transparency Framework and the Global Goal on Adaptation.

3.9 Tracking, Measurement, Reporting and Verification (MRV), and Alignment with the Enhanced Transparency Framework (ETF)

The monitoring, reporting, and verification (MRV) system for mitigation actions in Libya is designed to ensure transparency, consistency, and comparability with the Enhanced Transparency Framework established under Article 13 of the Paris Agreement and Decision 18/CMA.1. The MRV system operates through two integrated digital platforms: the National Adaptation Implementation and Coordination Platform (NAICP) and the Climate Information and Decision Support System (CIDSS). Together, these systems provide an integrated data architecture for activity, output, outcome, and impact indicators across all mitigation policies and measures.

The MRV framework aligns with national inventory practices and institutional roles defined in Sections 3.2 and 3.6. Each implementing entity bears responsibility for collecting and validating activity-level data, while the National Committee on Climate Change serves as the central data custodian, responsible for consolidating, validating, and submitting data to the UNFCCC through Biennial Transparency Reports.

3.9.1 Indicator Classification and Structure

Tracking operates at four indicator levels:

Table 8: Indicator Classification and Structure

Indicator Type	Definition	Example (Measure ID Reference)	Data Owner	Frequency / System
Activity Indicators	Measure implementation progress (e.g., infrastructure built, training sessions held)	EN-OG-01 LDAR: number of inspections conducted annually	National Oil Corporation	Quarterly / NAICP
Output Indicators	Products or services directly delivered	EN-RE-03: gigawatts of renewable energy capacity installed	REAOL, GECOL	Quarterly / CIDSS
Outcome Indicators	Short and medium-term impacts on emissions or energy efficiency	EN-POW-02: network loss reduction (%) annually	GECOL	Semi-annual / CIDSS
Impact Indicators	Long-term impacts on GHG emissions or removals, aggregated as million tons CO_2 equivalent	AF-TRE-09: net CO_2 sequestered by planted trees (tCO_2/hectare)	Ministry of Agriculture	Annual / NAICP

All indicators are stored in the National Libyan Climate Intelligence Platform (NAICP) and automatically synchronized with the Climate Information and Decision Support System (CIDSS), which hosts metadata (methodology, units, responsible entities, baseline and target values) and provides dashboards for tracking progress across sectors.

3.9.2 Data Ownership, Frequency, and Flow

Data Owners: Each sectoral ministry and implementing entity retains ownership of raw activity data. This includes:

- **Energy and Oil and Gas:** National Oil Corporation, GECOL
- **Transport:** Ministry of Transport, Municipalities
- **Industry:** Ministry of Industry, cement plants
- **Agriculture, Forestry and Other Land Use:** Ministry of Agriculture, Office of the Prime Minister
- **Waste and Wastewater:** Ministry of Local Governance, public utilities

Reporting Frequency:

- **Activity and output data:** Quarterly, uploaded via NAICP web forms
- **Outcome data:** Semi-annual, validated by sectoral MRV contact points
- **Impact data (GHG reductions):** Annual, following inventory alignment

Data Flow:

- Implementing agency enters validated data in NAICP templates
- NAICP performs automated checks (completeness, consistency)
- CIDSS aggregates data into sectoral dashboards and generates metadata tables conforming to ETF template "Information for tracking progress"
- EO-NCCC reviews, certifies, and archives data in version-controlled repositories

3.9.3 Quality Assurance/Quality Control and Documentation

Effective quality assurance and quality control (QA/QC) procedures are essential to ensure Enhanced Transparency Framework credibility. Libya's MRV system implements the following:

- **Standard Operating Procedures (SOPs):** Each sector has SOPs specifying data collection steps, reporting formats, and validation procedures. For example, the National Oil Corporation follows a standard protocol for measuring and reporting methane gas under the 2030 Methane Initiative, while GECOL applies a unified reporting model for network loss measurements.
- **Audit trails:** All data entries in NAICP/CIDSS are timestamped and linked to the submitting entity's user credentials. This ensures traceability for any future recalculation, correction, or review.
- **Version control:** Each dataset is archived under a unique version code corresponding to the reporting cycle (e.g., "NAICP_2025_Q1_v2"), allowing transparent documentation of updates and methodological changes over time.
- **Internal verification:** The EO-NCCC conducts quarterly audit processes cross-checking NAICP/CIDSS data with sectoral reports. Discrepancies are resolved through inter-ministerial review meetings, with corrective notes recorded in a QA/QC log.
- **External verification:** Independent technical audit processes, supported by the United Nations Development Programme and the Global Environment Facility Technology Assessment project, will annually verify measurement, reporting, and verification processes to ensure conformity with IPCC standards and Enhanced Transparency Framework requirements.

3.9.4 Biennial Transparency Report Generation

The MRV framework directly supports Libya's Article 13 compliance by producing the required "Information for tracking progress" tables in Biennial Transparency Reports:

1. **Automatic ETF table generation:** The NAICP/CIDSS system aggregates indicator data by mitigation measure and sector to populate ETF report tables (Mitigation section, table formats 4 and 5 under Decision 18/CMA.1).
2. **Consistency verification with GHG inventory:** NAICP compares annual emission factors and activity data used in mitigation reports with those in the national inventory, ensuring identical baselines.
3. **Integration with supporting chapter (Chapter 5):** Each mitigation measure record in CIDSS includes financial and other capacity- and technology-related indicators constituting the Support Received and Needed section of the BTR.
4. **Data archiving for transparency:** All datasets and reports are stored in a digital repository managed by the EO-NCCC, accessible to authorized reviewers during technical expert review (TER) processes.

3.10 Summary of Mitigation Impacts

Libya's mitigation program outlined in this chapter combines measures currently implemented, adopted, or planned during 2023–2035.

Upon full implementation of these policies and measures, an aggregate mitigation potential of 22–28 million tons CO_2 equivalent annually is anticipated by 2035, equivalent to a reduction of approximately 17–20% compared to the baseline established in the 2023 emissions inventory.

This estimate encompasses both ex-ante projections and early ex-post results following implementation, acknowledging inherent uncertainty in activity data and emission coefficients.

This range reflects conservative adjustments to avoid double-counting impacts, particularly between:

- Energy efficiency improvements and renewable energy expansion within the energy sector, and
- Landfill gas collection (capturing methane and other gases resulting from waste decomposition), reducing gas flaring from landfills, and diverting waste away from landfilling in the waste sector.

Approximate cumulative impacts by 2035 will be distributed as follows (subject to revision during Biennial Transparency Report preparation):

Table 9: Approximate Cumulative Impacts by 2035

Sector	Estimated Mitigation Potential ($MtCO_2e$/yr by 2035)	Percentage of Total (%)	Primary Greenhouse Gases	Primary Drivers
Energy (Supply and Transformation)	12–14	55–60	CO_2, CH_4	Methane emission reductions, grid efficiency improvements, renewable energy deployment
Transport	2.0–2.5	9	CO_2	Fuel efficiency improvements, transport mode shift, electric vehicle introduction
Industrial Processes and Product Use (IPPU)	1.5–2.0	8	CO_2, HFCs	Clinker substitution, refrigerant recovery
Agriculture, Forestry and Other Land Use (AFOLU)	3.0–4.0	14	CO_2 (removals), CH_4, N_2O	Afforestation, livestock and fertilizer management
Waste and Wastewater	2.5–3.5	13	CH_4	Landfill gas capture, composting, aerobic treatment in wastewater processing
Total (Range)	**21–26 $MtCO_2e$/yr**	**100**	—	—

The upper bound represents full-scale implementation with enhanced financing and effective adoption of advanced technologies, while the lower bound assumes continuation of current institutional and financial constraints through 2030

3.10.1 Uncertainty

This initial version of Libya's national mitigation assessment is characterized by uncertainty due to limited facility-level monitoring and reliance on Tier 1 emission factors. Principal sources of uncertainty include:

1. **Oil and gas fugitive emissions**, where flaring and leaking data remain incomplete.
2. **Carbon sequestration from land use**, where seedling survival rates and carbon density factors vary by region.
3. **Waste sector baselines**, where waste generation and organic content data are extrapolated from partial surveys.

To address potential overlaps, conservative adjustments have been applied based on the attribution hierarchy defined in Section 3.6. Notably, renewable energy impacts are calculated using net grid emission factors that already account for efficiency gains and flaring reductions, while organic waste diversion is excluded from landfill gas calculations to avoid double-counting methane reductions.

3.10.2 Strategic Implications

1. **High-impact sectors:**
   - **Emission reductions** (the 2030 Initiative to reduce methane emissions and flaring by the National Oil Corporation) in oil and gas operations remain the single largest and most cost-effective mitigation opportunity.
   - **Grid modernization and renewable energy expansion** collectively represent a structural decarbonization pathway yielding emissions and economic benefits.
2. **Quick wins:**
   - **Vehicle inspection and maintenance** can deliver immediate and tangible fuel consumption and local air pollution reductions.
   - **Landfill rehabilitation and composting** offer short-term methane mitigation with strong co-health benefits.
3. **Structural transitions required:**
   - Libya's long-term mitigation pathway depends on energy sector diversification, legal modernization, and finance mobilization.
   - Rapid adoption of a climate change law, operationalization of a national climate finance facility, and expansion of digital systems linking to monitoring, reporting, and verification (NAICP/CIDSS) are critical to sustaining progress.
   - The transition must be just and inclusive, incorporating skills retraining and youth engagement measures outlined in Section 3.8.

Next steps:

1. Develop sectoral emission factors for oil and gas, cement, and waste
2. Implement real-time data collection under NAICP/CIDSS integration
3. Prepare Biennial Transparency Report tables (BTR-1) with ex-post verified reductions by 2027, per Decision 18/CMA.1

Chapter 4: Vulnerability and Adaptation

The purpose of this chapter is to assess current and projected vulnerabilities to climate change in Libya and identify priority adaptation responses that build resilience across critical sectors, livelihoods, and ecosystems. This assessment reflects Libya's extremely arid and semi-arid geography, high dependence on fossil aquifers, fragile agricultural base, and ongoing socio-political vulnerability—all of which amplify exposure and sensitivity to climate hazards.

The analysis is framed within Libya's commitments under the United Nations Framework Convention on Climate Change (Article 4.1(e)) and the Paris Agreement (Article 7), as well as reporting guidance under Decision 18/CMA.1 of the Enhanced Transparency Framework. Through alignment with these commitments, the chapter contributes to the Global Goal on Adaptation by enhancing national understanding of climate risks and informing evidence-based adaptation planning and implementation.

Objectives:

1. Assess sectoral and geographic vulnerabilities to climate change in Libya, considering exposure, sensitivity, and adaptive capacity in domains such as water, agriculture, health, ecosystems, infrastructure, and coastal systems.
2. Identify and describe priority adaptation actions, emphasizing low-regrets options and transformative choices that respond to systemic risks threatening human and natural systems, by strengthening adaptive capacity, reducing hazard exposure, and supporting transitions toward climate-resilient sustainable development.
3. Present institutional frameworks, policies, and coordination mechanisms supporting adaptation action in Libya, acknowledging current implementation gaps.
4. Establish the foundation for monitoring, evaluation, and learning (MEL) to track adaptation progress, ensure transparency and accountability, and enable iterative adjustments in response to evolving climate risks.

Scope and timeframes: The vulnerability and adaptation assessment employs multiple timeframes reflecting both immediate and long-term priorities:

- → Near-term (through 2030): Immediate risks from extreme events, recurring drought, coastal flooding, and service disruptions requiring urgent interventions to protect communities and critical infrastructure.
- → Medium-term (2040–2050): Anticipated intensification of warming, declining and volatile precipitation, and increased water stress in mid-century scenarios, with impacts on agricultural productivity, food security, and sustainable urbanization.
- → Long-term (2080–2100): Transformative risks under high emissions scenarios, including systemic threats to water availability, desertification expansion, and intergenerational challenges for sustainable development and equity.

Normative reference framework: This assessment is guided by:

i. Article 4.1(e) of the United Nations Framework Convention on Climate Change, which calls upon parties to assess climate change impacts and formulate adaptation measures.
ii. Article 7 of the Paris Agreement, which establishes the Global Goal on Adaptation, enhancing adaptive capacity, resilience, and reducing vulnerability.
iii. Decision 18/CMA.1, which provides guidance on reporting adaptation actions and outcomes under the Enhanced Transparency Framework.
iv. Good practices from National Adaptation Plan processes and monitoring, evaluation, and learning frameworks ensuring inclusivity and responsiveness to women and youth needs and iterative learning.

4.1 Methodologies and Evidence Base

This assessment employs a risk-based framework consistent with United Nations Framework Convention on Climate Change guidance and Intergovernmental Panel on Climate Change (IPCC) usage:

Risk = Climate hazard × Exposure × Vulnerability (sensitivity/adaptive capacity)

The approach triangulates observed climate evidence (ERA5, CRU), multi-model climate projections (CMIP6), and national datasets and institutional mapping (Climate Risk Assessment 2025, National Data Inventory 2025, Climate Risk Profile for Libya—World Bank, 2025). This connects Libya's physical geography (arid to hyper-arid zones, fragile coastal belt, oasis systems), socioeconomic drivers (urban concentration, youth demographics, basic service fragility), and institutional capacity (NCCC and EO-NCCC, decentralization, data systems) to explain where climate impacts manifest and which adaptation measures can most effectively reduce risks.

4.1.1 Analytical Framework

Hazards: Libya has warmed by approximately 0.25°C per decade since 1971 (ERA5, CRU). Precipitation remains highly variable, with less than 50 mm annually in the south and 200–500 mm along the coast. Projections indicate warming of (+2 to 3) °C by 2050 and (+4 to 5) °C by 2100 under SSP5-8.5 (Climate Risk Assessment central scenario), with greater extremes in heat, drought, and hot nights. SSP3-7.0 (World Bank) is used as a complementary "stress-test" scenario, particularly relevant for 2020–2050 horizons. Other critical hazards include desertification, dust storms, salinization, sea-level rise, and flash flooding.

Exposure: The dominant driver is concentration of over 90% of the population in coastal cities. Other exposure layers include interior oases, the Great Man-Made River, major transport and energy corridors, productive lands (Jefara, Green Mountains), and fragile ecosystems.

Vulnerability: Sensitivity factors include dependence on non-renewable aquifers, fragile oasis agriculture, degraded ecosystems, and fragile services (electricity, health, education). Adaptive capacity is constrained by limited operationalization of national institutions, uneven municipal capacities, fragmented data systems, and challenges to women and youth participation.

4.1.2 Evidence Base and Quality

1. **Observed climate**: ERA5 (1971–2020) and CRU TS4.07 provide temporal depth and consistency, though with uncertainty in desert/coastal areas.

2. **Climate projections**: CMIP6 ensemble with SSP5-8.5 (central) and SSP3-7.0 (complementary); baseline 1995–2014; near-term 2020–2039; mid-century 2040–2059; long-term 2080–2100.

3. **Hydrology**: CRA and National Data Inventory highlight dependence on fossil aquifers and Great Man-Made River fragility, with explicit data gaps.

4. **Land and ecosystems**: Less than 2% of land is arable; pressures from desertification, salinization, and biodiversity degradation.

5. **Sociodemographics**: Coastal concentration, youth over 60%, fragile services.

6. **Institutions**: Analysis of the NCCC and EO-NCCC structure within decentralization contexts reveals emerging institutional mandates and expanding competencies in climate management at national and local levels. However, significant gaps persist in training, institutional capacity building, inter-agency data sharing, and monitoring, evaluation, and learning (MEL) systems, weakening coordination efficiency and limiting effectiveness of integrated climate response.

4.1.3 Climate Scenarios and Uncertainty

The central scenario (SSP5-8.5) displays upper-bound risks aligned with Libya's hydrocarbon dependence. SSP3-7.0 is retained to reflect a fragmented global pathway. Uncertainty is addressed through multi-model ensembles, percentile ranges (10th to 90th), and triangulation with observed records. Special attention is given to precipitation signals given model divergence.

4.1.4 Stakeholder Engagement

National consultations with ministries, municipalities, academia, civil society organizations, women and youth groups highlight vulnerability narratives, illuminate disproportionate burdens (e.g., conflict, displacement), and identify local-level adaptations (e.g., fossil aquifers, cistern irrigation, oasis crops).

4.1.5 Consistency with the National Adaptation Plan (NAP), Nationally Determined Contributions (NDC), and Global Goal on Adaptation (GGA)

While National Adaptation Plan and nationally determined contribution frameworks are not yet operational, this assessment provides:

→ A risk baseline for adaptation prioritization

→ Entry points for sectoral integration in water, agriculture, health, coastal, and urban domains

→ A methodological foundation for MEL consistent with Decision 18/CMA.1

This positions Libya's Initial National Communication as a contribution to the Global Goal on Adaptation, supporting iterative learning and global inventory.

4.1.6 Limitations and Quality Assurance

Continuing data gaps exist in hydrology, socioeconomic disaggregation, and operationalizable spatial geographic layers. Observation biases affect desert regions, and precipitation signals remain uncertain. Disaster loss datasets are absent, and available information provides limited attribution. References to the National Adaptation Plan and nationally determined contributions are structural only, not claims of implementation. These constraints are acknowledged to ensure transparency and support future improvements.

Table [10]: Comparison of Climate Projections for Libya under SSP3-7.0 and SSP5-8.5 Scenarios

Variable	SSP5-8.5 (CRA)	SSP3-7.0	Notes/Uncertainty
Temperature (ΔT, °C)	+2.0–3.0°C (2040–2059); +4.0–5.0°C (2080–2100)	+2.0–2.5°C (2040–2059)	Strong model agreement on warming; greater divergence in late century. Consistent across ensembles; high confidence in heat-related extremes.
Extreme Heat Events	↑ Significant increase; tropical nights (>26°C) may rise 5-fold by 2050, further escalating to 2100	↑ Increased frequency of heat >45°C in interior zones by mid-century	Consistent signal; high confidence in heat extreme phenomena.
Precipitation (ΔP, %)	-5% to -10% decline by 2050; wider range by late century (-15% to 0%)	↑ Slight decline or neutral (~-5% to 0%) by 2050	Significant uncertainty; Saharan/arid North Africa shows large model spread.
Extreme Precipitation	↑ Increased probability and intensity of extremes (events like Daniel-type hurricanes expected to intensify)	↑ Intensity of heavy rainfall, especially in coastal valleys (uncertain spatial signal)	Large model divergence; qualitative agreement with observed events.
Sea-Level Rise	+0.3–0.6 m by 2100	+0.2–0.4 m by 2050	Strong trend; local variation from subsidence and storm surge. Rate 3.6 mm/yr (1995–2014).
Drought Intensity	Notable intensification by late century; risks to groundwater recharge and oasis viability	↑ Increased frequency of prolonged drought periods	Agreement on drought signal; higher intensity under SSP5-8.5.

4.2 Sectoral and Geographic Vulnerability Assessments—Common Framework

Primary climate hazards: Libya faces high exposure to a spectrum of climate hazards, many of which interact with structural vulnerabilities—water scarcity, hydrocarbon dependence, weak infrastructure, and regional inequalities—producing cascading risks across ecosystems, livelihoods, and critical assets. Observed climate trends already show a warming rate of +0.25°C per decade since 1970, accompanied by greater precipitation variability and recurring extreme events.

Projections under CMIP6 ensemble SSP5-8.5 as the central scenario (CRA 2025) and SSP3-7.0 as a complementary pathway (World Bank Climate Risk Profile 2025)—indicate further escalation of these hazards through mid- and late century. Under SSP5-8.5, warming of (+2 to 3) °C by 2050 and (+4 to 5) °C

by 2100 is projected, accompanied by more frequent and intense severe heat, drought, and hydrological shocks with profound implications for adaptation planning.

Extreme heat and heat waves

- **Observed/projected:** Libya warms faster than global average; inland summer peaks often exceed 45°C. Projections indicate +2–3°C by mid-century, with coastal "tropical nights" (>26°C) rising five-fold by 2050, continuing to escalate toward 2100 under SSP5-8.5.
- **Impacts:** Increased heat stress occurrences, elevated mortality from heatstroke and cardiovascular disease, energy demand spikes, agricultural crop losses, and declining labor productivity in agriculture, construction, and services.
- **Hotspots:** Coastal urban belt (Tripoli, Benghazi, Misrata), southern oases where cooling and medical infrastructure are weaker.

Drought and water scarcity

- **Observed/projected:** Declining and variable precipitation, with prolonged dry periods increasingly frequent. Renewable freshwater is below 100 m^3 per capita per year—considered below the global minimum. SSP5-8.5 scenario shows escalation in drought severity and duration, with significant risks to groundwater sustainability by 2080–2100.
- **Impacts:** Pasture loss, declining groundwater levels, salinization, unsustainable pumping of the Great Man-Made River (GMMR), threatening agriculture and Residential Areas.
- **Hotspots:** Interior agricultural plains (Jefara, Kufra, Murzuq), oasis communities, pastoral zones in the south.

Sand and dust storms (SDS)

- **Observed/projected:** Escalating in frequency and intensity due to desertification and soil erosion and regional circulation changes. CRA analysis indicates potential extension of sandstorm seasons under SSP5-8.5.
- **Impacts:** Increased respiratory disease, reduced solar panel efficiency, transport disruptions, crop damage.
- **Hotspots:** Southern and central desert corridors, transport axes, border regions.

Sea-level rise, coastal flooding, and salinization

- **Observed/projected:** Average sea-level rise rate approximately 3.6 mm/yr. Projections indicate 0.3–0.6 m rise by 2100 under SSP5-8.5, with impacts magnified by storm surge and coastal erosion. SSP3-7.0 projects lower but still significant mid-century rise.
- **Impacts:** Inundation of ports, desalination stations, oil terminals, and low-lying dwellings; groundwater salinization and coastal agricultural zones (e.g., Jefara plain).
- **Hotspots:** Tripoli, Benghazi, Misrata, Zuwara, Gulf of Sirte, agricultural belts surrounding urban centers.

Intense precipitation and flash flooding

- **Observed/projected:** Despite declining annual rainfall rates, extreme events are intensifying. The 2023 Derna storm demonstrated catastrophic potential. CMIP6 projections indicate rising probability of intense rainfall, though high uncertainty persists due to climate model divergence.

- **Impacts:** Flash floods in valleys and urban drainage failures, leading to loss of life, residential collapse, and infrastructure damage.
- **Hotspots:** Coastal valleys (Green Mountains, Derna, Ghat, interior Benghazi basins), urban catchments, mountain valleys.

Land degradation and desertification

- **Observed/projected:** Over 90% of Libya is desert, with accelerating land degradation from overgrazing, salinization, and recurring drought. CRA scenarios under SSP5-8.5 indicate further agricultural land loss by 2100.
- **Impacts:** Declining arable land (<2%), declining agricultural productivity, increased food insecurity, and rural-to-urban migration pressures.
- **Hotspots:** Southern rangelands, marginal agricultural zones in Fezzan and Kufra, irrigated lands under stress.

Cascading impact chains

- Drought → pasture loss → herder displacement → social tensions in oasis/agricultural areas.
- Sea-level rise + storm surge → coastal port and desalination damage → urban water crises + trade disruption
- Intense rainfall → dam overflow or failure → catastrophic downstream flooding (e.g., Derna 2023)
- Heat waves → electricity demand peaks + grid failures → water pump disruptions → cascading health and food supply risks

Geographic hotspots of aggregated climate risk

- **Coastal urban corridor (Tripoli–Misrata–Sirte–Benghazi):** High population density, economic assets, exposure to sea-level rise, salinization, and flooding.
- **Agricultural plains and valleys (Jefara, Benghazi plain, Green Mountains):** Food production centers threatened by drought, salinity, and erosion.
- **Oases (Kufra, Murzuq, Sabha):** Dependent on fragile aquifers; vulnerable to drought, desertification, and migration pressures.
- **Mountain systems and valleys (Green Mountains, Nafusa, Derna basin):** Exposed to flash flooding, erosion, and infrastructure collapse.

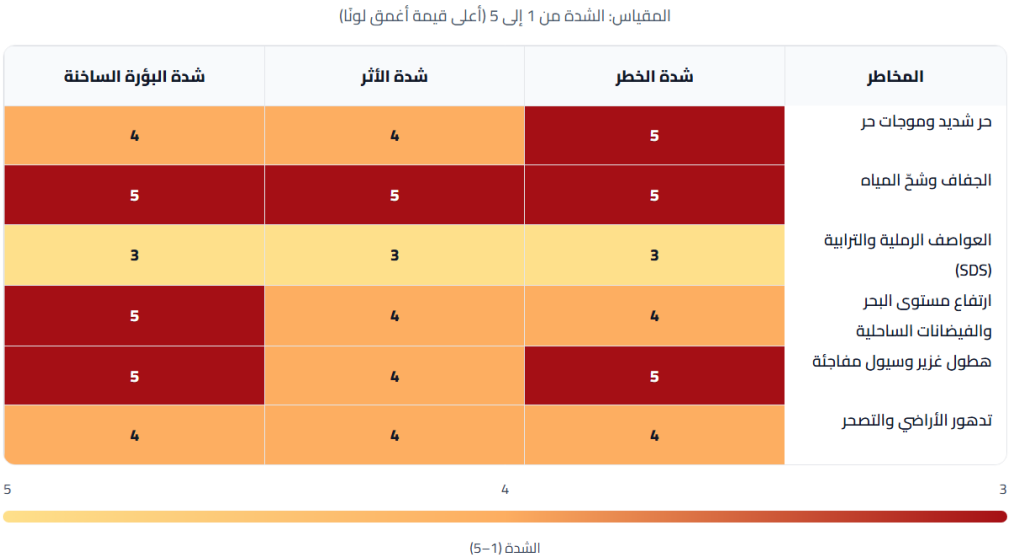
- **Energy and logistics corridors (oil ports, pipelines, highways):** Exposed to sea-level rise, storm surge, and sand/dust storm disruptions.

A hazard-intensity–impact–hotspot heat map and risk–impact–hotspot matrix provides an integrated view of Libya's climate hazard profile.

Results demonstrate that drought and water scarcity, intense rainfall and flash flooding, and sea-level rise with associated coastal flooding represent the most severe threats, followed by extreme heat waves and sand/dust storms.

The heat map illustrates relative severity of each hazard, while the matrix shows cascading impact chains and geographic hotspots, demonstrating how hazards converge in the coastal urban belt, interior oases, agricultural plains, and southern rangelands.

Figure 8: Hazard-Intensity–Impact–Hotspot Heat Map for Libya



The heat map displays relative severity of major climate hazards (scale 1–5), highlighting drought and water scarcity, as well as intense rainfall and flash flooding, as the most critical hazards with systemic consequences across sectors and regions.

The following matrix provides an organized view of Libya's primary climate hazards, synthesizing evidence from Climate Risk Assessment (2025), World Bank Climate Risk Profile for Libya (2025), and national data sources. Each hazard is assessed across three dimensions—hazard intensity, expected impacts, and geographic concentration of hotspots—using a unified severity scale from 1 to 5. This classification aims to guide adaptation prioritization, highlight cascading risks, and support alignment with the Global Goal on Adaptation and reporting requirements under the Enhanced Transparency Framework.

Table 11: Hazard-Intensity–Impact–Hotspot Severity Matrix for Libya

Climate Hazard	Current Status / Mid-Century Projections	Vulnerability (1–5)	Exposure (1–5)	Hazard Severity (1–5)	Sector
Drought and Water Scarcity	Current: Seasonal deficits, well salinization; mid-century: escalating drought, groundwater salinization	5	5	5	Water
Agricultural Variability and Food Security	Current: Crop volatility, irrigation constraints; mid-century: heat stress, rising salinity	5	4	4	Agriculture and Food Security
Heat-Related and Respiratory Diseases	Current: Heat-related illness, sand/dust storm respiratory disease; mid-century: chronic heat/flood burdens	4	4	4	Health
Energy and Industry Disruption	Current: Grid instability, storm surge damage; mid-century: chronic cooling deficit, port disruptions	4	5	4	Energy and Industry
Urban Flooding and Heat Islands	Current: Flood losses, urban heat island morbidity; mid-century: aggravated drainage failures, peri-urban salinization	5	5	4	Cities and Residential Areas
Coastal Erosion and Salinization	Current: Seasonal inundation/erosion; mid-century: sea-level rise + surge → overtopping, aquifer salinization	4	4	4	Coastal Systems
Ecosystem and	Current: Habitat loss, declining ecosystem	5	4	3	Ecosystems and Biodiversity

Biodiversity Loss	services; mid-century: oasis collapse, wetland drying				
Transport and Logistics Disruption	Current: Flash flooding, sand/dust storm disruption; mid-century: chronic O&M burdens, storm surge disruptions	4	4	4	Transport and Logistics
Natural and Cultural Heritage Damage	Current: Flood/erosion damage; mid-century: accelerated coastal erosion, salt crystallization	4	3	3	Natural/Cultural Heritage

4.3 Sectoral Assessment

Each sector is assessed using IPCC's risk framework: **Risk = Hazard × Exposure × Vulnerability (Sensitivity/Adaptive Capacity)**. Timeframes follow Section 4.1 (baseline 1995–2014; near-term 2020–2039; mid-century 2040–2059; long-term 2080–2100), with SSP5-8.5 as the central scenario (CRA 2025) and SSP3-7.0 as a complementary pathway (World Bank Country Profile 2025).

Diagnostics focus on:

- **Currently observable** (present hazards, already-realized impacts)
- **Reasonably expected by mid-century** (systemic stress under SSP5-8.5/SSP3-7.0)
- **Possibly transformative toward 2100** (tipping points, "points of no return")

Proposed indicators align with future National Adaptation Plan/monitoring, evaluation, and learning (NAP/MEL) system building and Enhanced Transparency Framework reporting, without presuming current implementation status.

The following table synthesizes sectoral climate vulnerability assessment in Libya using the IPCC risk framework. It provides an organized view of exposure, sensitivity, adaptive capacity, and risk pathways across nine critical sectors, highlighting potential tipping points and proposing indicative indicators for future MEL and ETF reporting.

Table 12: Sectoral Vulnerability and Risk Matrix—IPCC Framework

Sector	Current Risks	Mid-Century Risks (2040–2059)	Long-Term Signals/"Irreversible" (2080–2100)	Exposure	Sensitivity	Adaptive Capacity	Indicative MEL Indicators
Water Resources	Seasonal basin deficit (mm); operational monitoring stations ratio; coastal wells exceeding salinity thresholds (%); non-revenue water (%); service disruption days/year; drought early warning system lead time	Rising evapotranspiration and precipitation volatility; sea-level rise + salinity increase; rising urban demand strains aquifers	Irreversible salinization of coastal aquifers; structural degradation of fossil aquifers beyond recovery periods	Coastal belt (Tripoli–Misrata–Sirte–Benghazi); oases (Kufra, Murzuq, Sabha); irrigated plains (Jefara, Benghazi); major desalination plants	Fossil aquifer dependence; renewable freshwater <100 m³/capita/yr; aging distribution networks; salinity penetration	Governance exists but monitoring weak, data sharing limited, resources constrained	Basin deficit vs. baseline (%); salinity front migration (km); non-revenue water ratio (%); renewable freshwater per capita (m³/yr)
Agriculture and Food Security	Crop deviation vs. baseline (%); irrigated area efficiency ratio; soil salinity index; rangeland index; agricultural extension uptake rate	Chronic heat stress reduces yields; increasing salinity; fodder shortage in rangelands	Functional soil collapse; abandonment of marginal lands; oasis agroecosystem collapse	Rain-fed/irrigated belts (Jefara, Benghazi plain, Green Mountains); oasis horticulture; southern rangelands	High irrigation dependence; soil salinity/erosion; heat-sensitive crops; exposure to pests/diseases	Fragmented extension services; limited climate-smart advice, resilient varieties, efficient irrigation	Crop yield anomaly (t/ha vs. baseline); pasture productivity index (kg DM/ha); soil salinity (EC, dS/m); livestock recovery rate post-drought
Health	Severe THI/ITU days; heat-related hospital admissions/100K; peak PM10	Longer heat waves, more tropical nights; increasing flood-associated	Sustained high summer mortality rates; chronic air quality degradation	Coastal cities (heat and humidity); freshwater	Aging facilities; inequitable coverage; vulnerable populations	Weak heat health planning; fragile surveillance;	Heat-related mortality/admission rate (per 100K/season); SDS-related respiratory disease incidence;

	during SDS; facility continuity (hrs/day); early warning system lead time (hrs)	pollution; chronic low-level sea-level rise impacts		corridors (south); flood-exposed valleys	(elderly, children, outdoor workers)	energy/water dependence	disease surveillance system responsiveness (days to alert)
Energy and Industry	Peak load vs. capacity (%); capacity derating factor; outage duration index; current exceedance days; PV performance ratio	Chronic cooling deficit: sea-level rise/storm surge disrupts ports; rising salt pollution increases O&M costs	Frequent flood/erosion damage; chronic power/forced outages	Thermal power plants, transmission corridors, refineries, ports, desalination plants	Thermal generation capacity loss at high temperatures; peak demand timing; seawater dependence	Operations exist but are strained; weak renewable sources	Peak load–capacity margin (%); GECOL grid uptime (%); renewable energy generation share (%); thermal generator operating hours above 40°C threshold
Urban and Residential Areas	% population in flood zones; UHI intensity; drainage compliance; service disruption days; waste collection coverage	Flash floods overwhelm drainage networks; coastal salinization undermines livelihoods in peri-urban zones	Chronic infrastructure failures expand; Residential Areas drift into high-risk zones	High-density coastal cities; peri-urban zones; valleys	Poor drainage, hazardous housing, GMR/electricity dependence	Unequal decentralization; weak land-use/building code enforcement	Population in flood-prone areas (%); urban heat island intensity (°C above rural); drainage system overflow frequency; service continuity days/year

Coastal Systems	**Erosion rate (m/yr); asset downtime (hrs/event); saline well ratio (%); population living at ≤5 m elevation**	**Sea-level rise + storm surge → overtopping, operational downtime; beach loss**	**Irreversible freshwater–saline transition loss; permanent coastline retreat**	**Ports, oil infrastructure, roads, desalination plants, aquifer zones**	**Soil subsidence, erosion, weak retreat-setback enforcement**	**Fragmented governance; weak coastal/salinity monitoring**	**Coastal erosion rate (m/yr); shoreline retreat distance (m/yr); saltwater intrusion distance from coast (km); population exposure at low elevation**
Ecosystems and Biodiversity	PA effectiveness; wetland inundation period; oasis groundwater trends; rangeland NDVI deviations	Rangeland shrinkage, oasis collapse, wetland drying	Oasis collapse, permanent wetland loss, forest dieback	Oases, Green Mountains forests, wetlands, rangelands	Water dependence, fragmentation, overgrazing	Protected area management under-resourced; monitoring scattered	Protected area coverage (%); endemic species population index; rangeland NDVI trend; wetland area (km²); fishery productivity (t/yr)
Transport and Logistics	km of roads in flood units; sand-drift days; port/airport closure hours; % new projects screened	More drifts, rising O&M costs, sea-level rise/storm surge disrupt ports/airports	Chronic loss-of-function; expensive O&M/operating cycles	Coastal roads, deserted highways, valleys, airports	Small-scale drainage, pavement softening, exposure to sudden surge	Unequal records, limited hazard screening	Road segments in flood-prone/sand-drift zones (%); port closure events/year; road rehabilitation needs (km); SDS dust event frequency
Natural/Cultural Heritage	Assets in hazard zones; incidents/year; local climate change; groundwater depletion under oases	Accelerated coastal erosion, climate stress	Irreversible loss of materials; oasis heritage network collapse	Coastal archaeological sites, oasis heritage, valley landscapes	Erosion, flood damage, salt crystallization, declining groundwater	Limited disaster risk reduction integration	Heritage asset exposure index; incident frequency (damage events/yr); oasis groundwater depth (m); restoration project completion rate (%/yr)

Cross-Sectoral Systemic Risks: Water–Energy–Food–Ecosystem (WEFE) Nexus and Cascading Impact Chains

- Heat waves → electrical grid failure → water pump disruption → urban health emergencies
- Drought → crop/pasture loss → rural displacement → sprawl into flood-prone areas
- Sea-level rise/storm surge → port/desalination facility downtime → fuel/water shocks → economic losses
- Intense rainfall and flash flooding → transport network disruption and dam failure → multi-day service disruptions

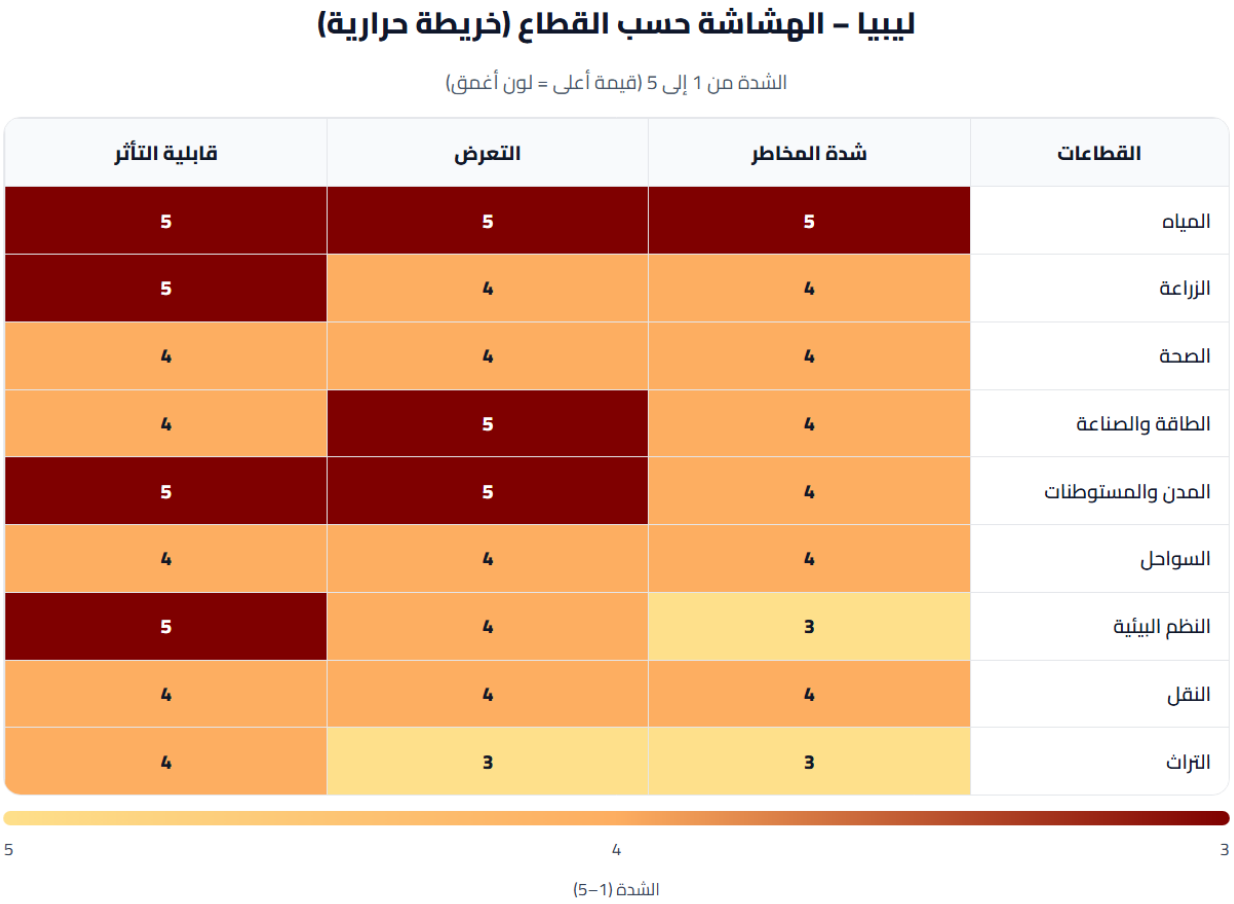
Notes on Indicators and MEL Alignment:

1. Proposed indicators form a minimum MEL bundle core
2. **Hazard metrics:** heat waves, coastal storm surge, flooding, sand/dust storm frequency
3. **Exposure metrics:** population/assets within hazard polygons
4. **Sensitivity metrics:** well salinity, soil electrical conductivity (EC), service continuity
5. **Adaptive capacity metrics:** early warning system lead times, share of climate-screened assets, monitoring system operational uptime

All indicators are designed to be implementable with gradual data improvements, compatible with National Adaptation Plan (NAP) framework structure and Enhanced Transparency Framework requirements, and adaptable to municipal dashboards. The "Libya Climate Vulnerability Scorecard—Sectoral Overview" synthesizes relative risk profiles of major sectors using the IPCC risk framework (Hazard × Exposure × Vulnerability). Estimates reflect status, mid-century horizons (2040–2059), and potential long-term thresholds (2080–2100) under SSP5-8.5 (central scenario) and SSP3-7.0 (complementary pathway). Scores are indicative (1–5) and designed to guide adaptation prioritization.

The sectoral vulnerability heat map below presents a comparative view of Libya's major systems—water, agriculture, health, energy, urban, coastal, ecosystems, transport, and cultural heritage—using a unified 1–5 scale for hazard severity, exposure, and vulnerability. The map highlights convergence points of systemic risks, with water, agriculture, and urban systems recording the highest composite values. This visual profile provides a clear, rapidly assimilable summary of sectoral stress drivers, supporting prioritization of adaptation measures and alignment with future MEL/ETF reporting.

Figure 9: [Heat Map Figure: Sectoral Vulnerability Scores (1–5 scale)]



4.4 Geographic Vulnerability Mapping

Climate vulnerability in Libya is distributed unevenly, shaped by the interaction of geographic exposure with socioeconomic vulnerabilities and institutional constraints. Mapping these differentiated vulnerabilities is an essential step for prioritizing adaptation, directing resources, and identifying zones where losses and damages are already recurring. Projections rely on CMIP6 ensembles with SSP5-8.5 as the central scenario (CRA 2025) and SSP3-7.0 as a complementary pathway (World Bank Climate Profile 2025). Timeframes span near-term (2020–2039), mid-century (2040–2059), and long-term (2080–2100), highlighting thresholds and potential tipping points.

Coastal Zones

The Mediterranean coast—home to over 90% of the population and most critical infrastructure—faces convergent hazards from sea-level rise, storm surge, salinization, and urban flooding. Under SSP5-8.5, sea-level rise of 0.3–0.6 m is projected by 2100, with smaller but still significant increases by mid-century under SSP3-7.0. Coastal urban agglomerations such as Tripoli, Benghazi, Misrata, and Derna face elevated risks from population density, aging infrastructure, and dependence on coastal aquifers. Ecosystem buffers (wetlands, fisheries) are degrading, reducing natural resilience capacity. The 2023 Derna floods illustrated how intense precipitation coupled with infrastructure fragility can produce catastrophic losses and damage, underscoring the urgency of systemic adaptation.

Oasis Systems and Interior Basins

Oasis communities in Fezzan, Kufra, Murzuq, and Jaghbub depend on fragile aquifers and traditional irrigation patterns. These zones face intensifying drought, desertification, and aquifer depletion. Mechanized agriculture, salt penetration, and rapid population growth accelerate land loss and livelihood undermining, already driving migration. Oases also exhibit Male / Female vulnerabilities: women bear disproportionate burdens in water collection and unpaid agricultural labor, while youth face unemployment and social exclusion. Under SSP5-8.5 toward 2100, oasis system "collapses" dependent on groundwater emerge as potential tipping points, with permanent loss of socio-ecological viability.

[Map: Oasis System Vulnerability—Water Stress Levels, Agricultural Land Loss, Population Exposure]

Agricultural Valleys and Mountain Zones

Production areas such as Jefara plain, Benghazi plain, and Green Mountains remain cornerstones of food security yet face escalating pressures from water scarcity, soil degradation, and climate-sensitive pest outbreaks. Declining soil fertility and falling yields produce recurring livelihood shocks disproportionately affecting smallholder farmers. Ecosystem services in residual forests and wetlands are deteriorating. Under SSP5-8.5, chronic heat stress and salt creep in irrigation systems may push these zones beyond recovery thresholds by late century.

[Map: Agricultural Valley and Mountain Zone Vulnerability—Crop Yield Trends, Soil Degradation Indicators, Ecosystem Pressures]

Urban Agglomerations and Basic Services

Cities stand at the frontline of climate hazards, exposed to heat waves, water scarcity, flash flooding, and service disruptions. Vulnerability is magnified in informal neighborhoods and urban peripheries, where housing is substandard, drainage insufficient, and power grids unstable. Access to education, healthcare, and reliable water remains unequal, with marginalized groups (including displaced persons, women, and youth) facing the largest deficits. Systemic risks are amplified by power disruptions during heat waves, creating cascading chains affecting water and health. Without stronger urban governance and land-use controls, informal sprawl into hazard zones may entrench maladaptation cycles.

Energy and Transport Corridors

Libya's strategic arteries—oil and gas pipelines, the Great Man-Made River system, ports, highways—face sand and dust storms, extreme heat, and coastal flooding. Disruptions in these corridors produce cascading effects on energy security, food supply chains, and foreign trade. Under SSP5-8.5, surge and erosion risks to desalination plants and coastal ports intensify, with systemic impacts on water supplies and electricity generation. Desert roads face chronic sand-dune encroachment, raising maintenance burdens and frequency disruption.

Transboundary and Regional Dimensions

Libya's vulnerability is compounded by dependence on shared aquifers and regional trade routes. The Nubian Aquifer System, shared with Egypt, Sudan, and Chad, faces rising pressures from over-pumping—a risk intensifying under long-term SSP5-8.5 scenarios. Cross-border corridors through Niger, Chad, and Sudan are affected by climate shocks, with direct implications for migration and food security. Conversely,

regional cooperation in aquifer management, renewable energy corridors, and disaster response can reduce systemic risks and enhance resilience.

Loss and Damage Considerations

In several regions, losses and damages are already tangible:

- **Coastal zones:** destruction of housing and infrastructure from storm surge and flooding
- **Oasis systems:** irreversible aquifer and agricultural land degradation
- **Agricultural valleys:** repeated crop failures from drought and salinization
- **Urban areas:** repeated flood damage and cascading service failures
- **Energy corridors:** pipeline and port disruptions and power transmission line damage during extreme events

Under SSP5-8.5, these recurring impacts threaten cumulative erosion of adaptive capacity across major systems, heightening urgency for early warning, social protection, and risk transfer mechanisms aligned with emerging international Loss and Damage (L&D) frameworks.

4.3 Priority Adaptation Actions

4.3.1 Objectives and Rationale (Theory of Change)

The adaptation strategy rests on recognizing that climate change in Libya amplifies structural vulnerabilities—environmental degradation, water scarcity, settlement fragility, and socioeconomic injustice—while intersecting with conflict-affected governance challenges. The theory of change (ToC) guiding this section illustrates how targeted adaptation actions, when integrated within sectoral and geographic priorities, can generate systemic resilience protecting livelihoods, ecosystems, and national stability.

Sectoral and Regional Objectives:

1. **Water Security:** Ensure sustainable access to drinking and agricultural water by protecting non-renewable aquifers, enhancing efficiency through integrated water resource management, and diversifying supply via desalination and reuse.
2. **Agriculture and Food Security:** Stabilize yields in oases and coastal plains, reduce dependence on fragile rainfed systems, promote climate-smart agriculture supporting rural livelihoods focused on strategic crops.
3. **Health:** Reduce vulnerability to climate-sensitive disease, extreme heat, and air pollution by strengthening health preparedness and surveillance systems.
4. **Energy and Industry:** Protect energy production and critical infrastructure from climate hazards while enabling renewable energy projects within the national energy mix per the Strategic Renewable Energy Plan (2025–2035).
5. **Urban Agglomerations:** Build resilience of coastal and interior cities against flooding, heat waves, and service disruptions through hazard-sensitive urban planning and infrastructure investment.
6. **Coastal Systems:** Protect strategic assets, ports, desalination plants, fisheries, and coastal Residential Areas via ecosystem-based approaches and engineered defenses.
7. **Ecosystems and Biodiversity:** Conserve fragile desert, oasis, and coastal systems as natural buffers to climate shocks while ensuring biodiversity co-benefits.

8. **Transport and Logistics:** Maintain connectivity across energy corridors, desert roads, and transboundary routes by reinforcing infrastructure resilience.

From Outputs to Outcomes

The adaptation program is designed to generate immediate output such as upgraded monitoring networks, adoption of drought-resistant crops, decentralized water treatment, and strengthened municipal adaptation plans—translating into measurable outcomes including:

1. Increased water supply system reliability
2. Reduced crop failure rates and food price stability
3. Expanded health early warning and response system coverage
4. Decreased frequency of service disruptions in urban and energy systems
5. Restoration of water-regulating, soil-stabilizing, and coastal-protection ecosystems

These outcomes in turn support long-term impacts consistent with the Global Goal on Adaptation:

1. Enhanced adaptive capacity of communities and institutions
2. Reduced climate vulnerability of major economic sectors and natural systems
3. Strengthened livelihood resilience, particularly for women, youth, and rural households
4. Contributions to national stability and sustainable development via climate-related disruption reduction

Core Assumptions

The theory of change rests on several pivotal assumptions:

a) Institutional reforms (NCCC/EO-NCCC, municipalities) will gradually consolidate coordination and reduce policy fragmentation
b) Climate information systems will be modernized, enabling data-driven planning and monitoring
c) International partnerships will provide financial and technical support to bridge current resource gaps
d) All community segments will engage effectively in adaptation planning and implementation, ensuring social ownership and equity

Risks and Maladaptation Possibilities

Potential risks include:

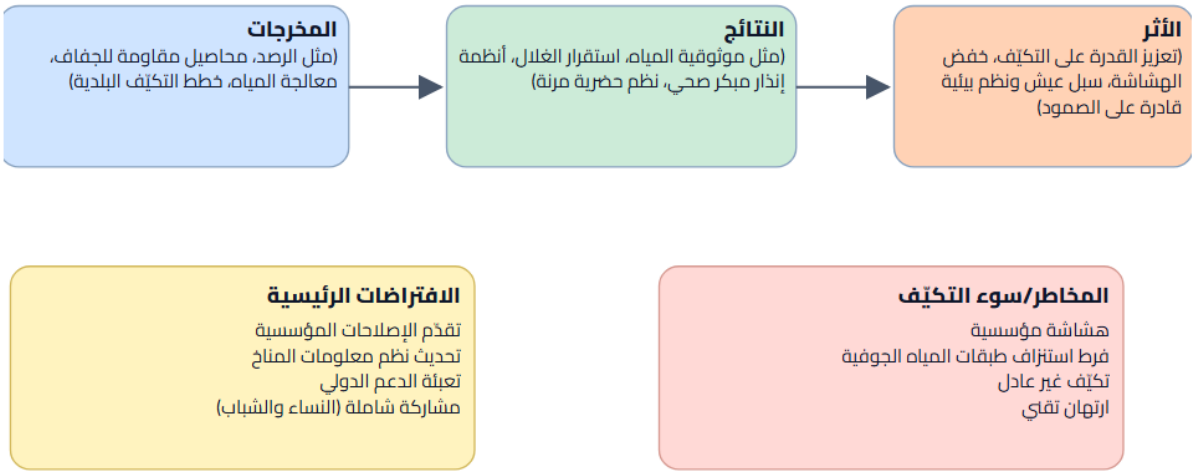
1. **Institutional fragility:** Political fragmentation may impede effective implementation and continuity
2. **Resource over-extraction:** Over-reliance on non-renewable aquifers or inappropriate agricultural subsidies may intensify scarcity
3. **Inequitable adaptation:** Actions failing to integrate Male / Female, youth, and regional equity considerations may entrench disparities
4. **Technology lock-in:** Exclusive dependence on energy-intensive desalination without parallel demand management may increase carbon intensity and costs

To avoid **maladaptation**, the adaptation methodology emphasizes **flexibility, inclusivity, and systemic integration**, ensuring actions address both immediate hazards and long-term resilience pathways in Libya.

The figure below illustrates **Libya's adaptation theory of change**, built on a results chain linking sectoral and regional outputs to intermediate outcomes and long-term climate resilience impacts.

In essence, short-term outputs include measures such as:
Water efficiency improvements, climate-smart agriculture, health surveillance system strengthening, renewable energy deployment, and local hazard mapping. These outputs aim to achieve medium-term outcomes including:
Enhanced household and institutional adaptive capacity, livelihood diversification, climate-resilient infrastructure strengthening, and ecosystem protection. Collectively, these outcomes converge toward expected long-term impacts:
Reduced vulnerability enhanced social and economic system resilience, and increased contribution to the Global Goal on Adaptation. The framework also highlights enabling assumptions such as institutional coordination, financing, and political stability, while acknowledging maladaptation risks if actions are fragmented, inequitable, or unsustainable.

[Figure 10: Theory of Change for Adaptation in Libya]



4.3.2 Adaptation Actions Portfolio

Based on the risk analysis in preceding sections, Libya's adaptation portfolio is organized around five interconnected action categories. These classifications ensure consistency with national development priorities, directly respond to sectoral vulnerabilities and geographic hotspots identified in the climate risk assessment, National Adaptation Plan, and nationally determined contributions, and combine quick "no-regrets" short-term interventions with transformative medium- and long-term options, reflecting the need to build systemic resilience amid vulnerability and uncertainty.

Policy and Institutional Actions

1. **Legal and regulatory reform:** Align existing environmental and water laws with climate resilience provisions; develop a framework climate change law clarifying mandates and mainstreaming adaptation into sectoral planning

2. **Standards and planning tools:** Introduce climate-flexible building codes, irrigation efficiency standards, and coastal setback regulations; embed climate criteria in environmental impact assessments (EIA)
3. **Spatial planning and land use:** Strengthen urban master plans and rural zoning to reduce exposure in floodplains and coastal erosion zones, guiding sustainable agricultural and settlement expansion
4. **Institutional coordination:** Consolidate the National Committee on Climate Change as the national coordination hub, with linkages to municipal adaptation units (per proposed Ministry of Local Governance decision 1500)

Infrastructure and Technological Solutions

1. **Water security:** Expand non-traditional water sources (desalination, recycled wastewater reuse), modernize Great Man-Made River distribution networks, deploy water-efficient irrigation systems
2. **Urban resilience:** Develop rainwater drainage and urban flood management systems; invest in heat-resistant housing and public spaces (passive cooling, shading, ventilation)
3. **Coastal protection:** Establish and reinforce seawalls, wave breakers, and dune stabilization to protect urban centers, ports, and desalination plants from storm surge and sea-level rise
4. **Energy and digital technology:** Upgrade electricity network efficiency and thermal power station flexibility; deploy early digital warning systems for heat waves, sand/dust storms, and flash flooding

Nature-Based Solutions and Ecosystem-Based Adaptation (NbS/EbA)

1. **Oasis and Rangeland restoration:** Revive degraded oasis systems including traditional irrigation networks (fossil aquifers) and sustainable date palm orchard management
2. **Catchment and land management:** Reforestation and soil conservation in Green Mountains and Nafusa mountains; erosion control in valley catchments
3. **Coastal and wetland systems:** Restore salt marshes, coastal lakes, and wetlands to absorb storm shocks and enhance biodiversity corridors
4. **Green barriers and land degradation neutrality:** Expand protective green belts to halt desertification and shield agricultural areas from sand encroachment

Services and Capacity Building

1. **Public health resilience:** Strengthen heat wave response systems, dust-related respiratory disease care, and vector-borne disease epidemiological surveillance (malaria, leishmaniasis)
2. **Climate-smart agricultural extension:** Expand farmer training on drought-resistant varieties, integrated pest management, and efficient irrigation methods
3. **Risk transfer mechanisms:** Develop climate insurance products for farmers, pastoralists, and small enterprises
4. **Social protection systems:** Expand targeted social assistance and unified social registries; introduce shock-responsive programs protecting vulnerable households during extreme events and displacement
5. **Education and awareness:** Mainstream climate change across all educational curricula at all levels

Finance and Investment

1. **Local resource mobilization:** Integrate adaptation into sectoral and municipal budgets, supported by financial incentives for resilience investments
2. **Access to international climate finance:** Prepare bankable projects for submission to the Green Climate Fund (GCF), Global Environment Facility (GEF), and Adaptation Fund (AF)
3. **Blended finance and private sector engagement:** Develop public-private partnerships (PPPs) for renewable energy, water infrastructure, and climate-resilient agriculture
4. **Innovative instruments:** Explore green bonds, resilience bonds, and microfinance mechanisms directing investments toward local adaptation initiatives

Integrated Perspective

Integrated as a package, these actions constitute a multi-scale (national, sectoral, local) and multi-dimensional (policy, infrastructure, ecosystems, services, finance) intervention bundle. By aligning immediate response strategies with medium- and long-term transformative pathways, the portfolio aims to reduce vulnerability, enhance adaptive capacity, and anchor climate resilience in Libya's sustainable development trajectory.

4.3.3 Prioritization (Multi-Criteria Scoring)

This section presents a transparent, evidence-based approach to prioritizing adaptation actions in Libya amid structural vulnerability, financial constraints, and data scarcity. The methodology follows UNFCCC/IPCC risk frameworks, is designed for replicability in future sectoral and municipal planning cycles and is auditable under the Enhanced Transparency Framework (ETF).

The approach builds on preliminary engagement with national ministries during a "decision-making workshop" (May 2025) and subsequent technical workshops, continuing through structured consultations with municipalities, academia, and civil society organizations—including women and youth groups—coordinated by the EO-NCCC.

Multi-Criteria Evaluation (MCE) Framework

Adaptation actions are evaluated against a weighted set of criteria reflecting Libya's climate risk profile, institutional context, and international commitments. Scores range from 1 (very low) to 5 (very high), with weights balancing effectiveness, feasibility, equity, and international alignment:

- **Hazard risk reduction impact (weight: 0.30):** Expected ability to avert, reduce, and minimize climate-related losses and damage affecting people, assets, and ecosystems, including preventing repeated or irreversible losses; directly integrating Loss and Damage priorities into the national adaptation framework
- **Implementation urgency (weight: 0.15):** Immediacy based on hazard frequency and time-window constraints (e.g., coastal setback regulations before urban sprawl, water scarcity crises, heat and health emergencies)
- **Feasibility—technical/political/social (weight: 0.15):** Implementability within technical capabilities, political will, governance conditions, and social acceptance, including risks of delays from permitting, land tenure, or institutional fragmentation
- **Cost-effectiveness (weight: 0.10):** Relative value of risk reduction per unit cost, using proxies where data is incomplete

- **Co-benefits (weight: 0.10):** Additional gains in public health, employment, biodiversity conservation, air quality improvement, and system efficiency
- **Equity and inclusion (weight: 0.10):** Distributional benefits to community segments, low-income households, rural or oasis communities, and conflict-affected populations. Requires data disaggregation by demographics, age, and geography, verified through participatory processes
- **Alignment with national and global frameworks (weight: 0.05):** Consistency with Libya's national priorities, nationally determined contributions, contributions to the Global Goal on Adaptation, Sendai Framework for Disaster Risk Reduction, and Sustainable Development Goals
- **Implementation maturity and readiness (weight: 0.05):** Degree of design advancement, institutional preparedness, and readiness of monitoring, evaluation, and learning (MEL) requirements

Dual Decision Metrics

Two integrated decision scales are applied:

1. **Weighted MCE Score = sum (criterion score × weight)**
2. **Priority Index (tiebreaker) = (Impact × Feasibility × Urgency) ÷ Relative Cost**, where relative cost (1–5) is used in this formula only to avoid double-counting

This approach balances the need to address urgent, high-impact hazards against feasibility and efficiency considerations.

Application

Results are not binding but a decision-support tool guiding scheduling, phasing, and financing strategies. Priorities will be refined through national consultations and updated periodically consistent with National Adaptation Plan, nationally determined contribution, and Enhanced Transparency Framework reporting cycles.

Cross-Sectoral Urgent Enablers

In alignment with climate risk assessment, draft National Adaptation Plan, nationally determined contributions, and sectoral strategies, two foundational actions have been classified as urgent priorities due to their systemic role in addressing structural constraint data fragmentation, weak coordination, and delayed early warnings:

1. **National Adaptation Intelligence and Coordination Platform (NAICP):** Comprehensive government backbone for climate data, coordination, and adaptation integration
2. **Climate Risk Intelligence and Decision Support System (CIDSS):** Analytics and services layer for early warning, planning inputs, and ETF-ready reporting (supporting Enhanced Transparency Framework under the Paris Agreement)

These enablers are prerequisites for effective cross-sectoral and municipal adaptation, anchoring Libya's gradual contribution to the Global Goal on Adaptation and demonstrating national alignment with evolving Loss and Damage governance and financing arrangements.

[Figure 11: Adaptation Action Prioritization Methodology—Libya (NCI/NAP/NDC)]

4.3.4 Priority Adaptation Actions

The table below applies the multi-criteria framework to a prioritized shortlist for Libya (derived from CRA, sectoral strategies, and preceding sections). Scores (1–5) are indicative. Relative cost is used only in the "priority index."

Table 14: Multi-Criteria Evaluation Matrix for 14 Priority Adaptation Actions in Libya

Action (CCAM ID)	Hazard Risk Reduction Impact (0.30)	Urgency (0.15)	Feasibility (0.15)	Cost-Effectiveness (0.10)	Co-Benefits (0.10)	Equity and Inclusion (0.10)	Alignment (0.05)	Maturity and Readiness (0.05)	Weighted Score (Σ)	Priority Level
1. Community-led water resilience monitoring	5	5	4	4	4	5	4	3	4.55	High
2. Ecosystem-based groundwater protection and recharge	5	4	3	3	5	5	4	3	4.25	Medium-High
3. Integrated national water governance (NIWG-CR)	4	4	3	3	5	5	4	3	4.30	High
4. Climate-responsive agricultural finance (CRA-FiSS)	4	4	3	3	5	5	4	3	4.10	Medium-High
5. Climate-smart crop diversification and risk reduction	5	5	4	4	4	4	5	3	4.50	High
6. Agricultural climate information platforms	4	3	3	3	4	5	4	2	3.70	Medium
7. Land tenure security and soil rehabilitation	4	4	3	3	5	5	4	3	4.00	Medium

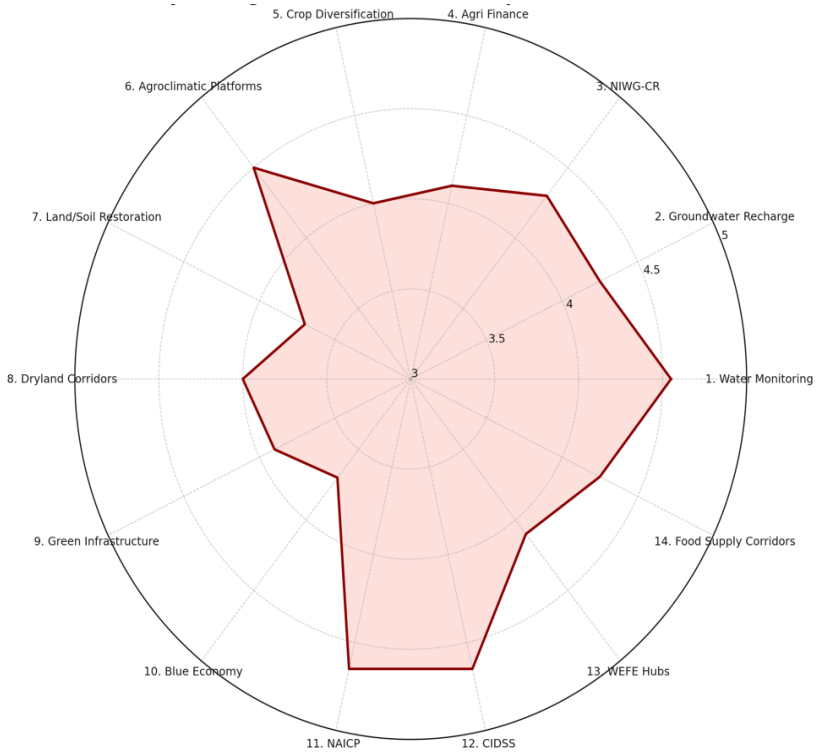
8. Integrated drylands restoration corridors (DERR-C)	4	4	3	3	4	4	4	3	3.90	Medium
9. Green infrastructure investment plans (SGI-Res)	4	3	3	3	5	4	4	2	3.70	Medium
10. Blue economy transition (ReBECLE)	5	5	4	4	4	4	5	5	4.65	High
11. NAICP – National Adaptation Intelligence and Coordination Platform	5	5	4	4	4	4	5	5	4.65	Urgent Enabler
12. CIDSS – Climate Risk Intelligence and Decision Support System	**4**	**4**	**3**	**3**	**5**	**5**	**4**	**3**	**4.10**	**Medium-High**
13. WEFE Resilience Hubs	5	4	3	3	5	5	4	3	4.25	Medium-High
14. Resilient and secure food supply corridors (RSFSC)	5	5	4	4	5	5	5	3	4.70	High / Urgent

Interpretation

- High priority (≥4.5): NAICP (11), CIDSS (12), community water monitoring (1), agricultural climate intelligence platforms (6), integrated national water governance (NIWG-CR) (3)
- Medium-High (4.1–4.4): Agricultural finance (4), food security and resilience systems (RSFSC 14), groundwater recharge (2), WEFE resilience hubs (13)
- Medium (≤4.0): Crop diversification (5), drylands restoration corridors (8), green infrastructure (9), blue economy transition (10), land tenure and soil restoration (7)

Results confirm that systemic enablers (NAICP, CIDSS, intelligence platforms) coupled with water governance and monitoring represent immediate priorities, while sectoral and ecosystem-based actions require medium-term scheduling and phased sequencing.

[Figure 12: Libya—Radar Chart of Weighted Scores (14 Adaptation Actions)]



The radar chart provides a visual synthesis of relative weighted scores across all 14 actions, enabling rapid comparison of their overall strength within the multi-criteria framework. The circular layout highlights convergence and divergence patterns: actions supported by stronger systemic enablers extend toward outer circles, while others remain closer to inner rings, indicating more moderate composite performance.

This visualization helps policymakers rapidly grasp how the action bundle balances urgent enablers, sectoral interventions, and ecosystem-based strategies, supporting transparent sequencing and resource allocation decisions.

Clarity on Uncertainty

Rankings reflect current evidence from national analyses and sectoral strategies. Cost ranges, feasibility, and co-benefits will evolve as designs mature, institutional capacity builds, and financing conditions shift. Scores are decision-support tools, not deterministic rules; stakeholder verification is required, and sequencing should remain adaptive to new data, shocks, and opportunity windows.

Technical Note: Why NAICP and CIDSS Implementation Must Accelerate in Libya

Legal and International Basis: UNFCCC/Paris Agreement/CMA Decisions

- **Adaptation and Early Warning**: Article 7 of the Paris Agreement, particularly paragraph 7.7, calls for strengthening climate information and services and early warning systems. This supports the establishment of national data and decision-making platforms such as the National Adaptation

Information and Coordination Platform and the Climate Information and Decision Support System. Chapter 4 of the Initial National Communication was built on this article.

- **Transparency (Enhanced Transparency Framework):** Article 13 of the Paris Agreement and Decision 18/CMA.1 require clear and consistent information on climate risk, adaptation, and support. The National Adaptation Information and Coordination Platform and the Climate Information and Decision Support System provide a reliable data governance system with tracking and data quality to meet the requirements of Chapter 4 (adaptation) and Chapter 5 (support).

- **Global Goal on Adaptation**: Decision 2/CMA.5 from COP28 calls for country-led, evidence-based adaptation tracking. The National Adaptation Information and Coordination Platform and the Climate Information and Decision Support System help implement this by standardizing indicators and enabling continuous learning, in alignment with the report structure (Initial National Communication).

- **Support Reporting**: Article 12.1 UNFCCC and Article 13 Paris Agreement require reporting on "support received and needed." NAICP and CIDSS enable Chapter 5 to organize finance, technology, and capacity-building data in ETF-ready format.

- **Loss and Damage**: Article 8, Paris Agreement, and new Loss and Damage financing arrangements (CMA.5, Glasgow/Dubai decisions) require a clear national loss inventory and event registry. NAICP and CIDSS provide the institutional mechanism for measuring recurring losses (e.g., 2023 Derna event) and documenting Loss and Damage financing needs, reflected in your Chapter 5 and Chapter 1 governance gap references.

National Context

Adaptation planning in Libya faces three critical problems: severe data fragmentation, weak institutional coordination, and delayed early warning. This amplifies climate losses and weakens ability to attract international support. Establishing NAICP and CIDSS is therefore an urgent national priority, grounded in your report's governance and data gap diagnoses.

Technical Rationale

- Bridging data and coordination gaps: NAICP and CIDSS directly address the absence of interlinked databases across weather/climate, economy/society, environment, and the absence of shared standards and portals referenced in Chapter 1.

- Science-to-decisions translation: Both platforms convert climate observations and models into actionable intelligence serving ministries, municipalities, and communities, reducing decision cycles, preventing duplication, and aligning with your adaptation logic and transparency requirements.

Economic and Financial Rationale

- **Better resource efficiency:** Shared infrastructure and unified protocols reduce duplication costs across ministries and donors, enabling "report once" principles.
- **Enabling finance mobilization:** Reliable baselines, transparent monitoring, reporting, and verification (MRV), and monitoring, evaluation, and learning (MEL) are prerequisites for accessing GCF, Adaptation Fund, and bilateral finance. NAICP and CIDSS provide the auditable data foundation Chapter 5 requires under the Enhanced Transparency Framework.

Effectiveness and Sustainability

- **Cross-sectoral enablers:** Unlike single-sector projects, NAICP and CIDSS elevate all adaptation activities (water, agriculture, health, energy) by standardizing risk analytics, early warning, and reporting. This directly addresses governance constraints and data fragmentation identified in Chapter 1.
- **Loss and Damage tracking:** CIDSS establishes a national registry for recurring and major losses, linking hazard, exposure, and impact data requirement for Loss and Damage case preparation and financing requests per CMA.5 arrangements, aligned with ETF reporting.

Expected Impact

- **System-level risk reduction:** Improved forecasts and decision support increase available response time and improve intervention targeting, reducing annual economic losses from heat waves, droughts, flooding, and coastal hazards in Libya.
- **Enhanced trust and accountability:** ETF-ready data with clear metadata and QA/QC procedures raise credibility with partners and citizens, facilitating co-financing and long-term cooperation envisioned in Initial National Communication chapters.

Immediate NAICP and CIDSS implementation is Libya's most efficient, effective, and sustainable adaptation investment. Both platforms enable:

- ETF-compliant reporting (Article 13; Decision 18/CMA.1)
- Global Goal on Adaptation tracking (Decision 2/CMA.5)
- Clear Loss and Damage measurement (Article 8; CMA.5 arrangements)

While addressing governance and data gaps identified in Chapter 1 and enabling robust content in Chapters 4 and 5 of the Initial National Communication.

4.4 Institutional Frameworks

4.4.1 Institutional Mapping and Coordination

Climate governance in Libya has undergone significant restructuring in recent years to establish more coherent institutional architecture. At the center is the National Committee on Climate Change (NCCC), established by Cabinet Resolution 2021/336, serving as the inter-ministerial coordination body for climate

policy. It is responsible for preparing National Communications, coordinating National Adaptation Plan and nationally determined contribution processes, and facilitating access to international climate finance. Key ministries and institutions with sectoral mandates include:

- **Ministry of Water Resources:** Implementing the Water Security Strategy 2025–2050, managing groundwater and the Great Man-Made River project
- **Ministry of Agriculture and Livestock:** Climate-smart agriculture, combating desertification, food security
- **Ministry of Health:** Monitoring and responding to climate-sensitive health risks (heat stress, vector-borne disease, dust-related respiratory illness)
- **National Oil Corporation (NOC):** Mitigation, energy transition, and infrastructure resilience
- **General Electricity Company of Libya (GECOL):** Grid operations, renewable energy integration, climate risk management for energy assets
- **Ministry of Transport:** Climate-resilient design for roads, ports, and airports
- **Ministry of Planning and Ministry of Finance:** Mainstreaming climate risk in public investment, climate budget tagging, and climate finance mobilization
- **National Meteorological Centre:** Monitoring networks, climate forecasts, and early warning systems

Disaster risk management institutions including the Civil Protection Authority coordinate with the NCCC to ensure climate adaptation aligns with Sendai Framework for Disaster Risk Reduction priorities.

Municipalities, per Resolution 1500/2022 (Ministry of Local Governance), hold formal responsibilities for water service delivery, environmental management, and local risk reduction/adaptation actions. Capacities remain uneven, but municipalities represent a pivotal actor for territorial adaptation planning. The NCCC leads inter-ministerial coordination, while its Executive Office (EO-NCCC) supports technical integration with municipalities, academia, and civil society. Nonetheless, horizontal and vertical coordination gaps persist and require further institutional strengthening.

4.4.2 Policy Frameworks

Libya's adaptation policy landscape is guided by:

- **Nationally Determined Contribution (NDC), draft (2025):** Frames adaptation as a national priority
- **National Adaptation Plan (NAP), draft (2025)** under adoption: Identifies priority sectors, regional vulnerabilities, and institutional pathways for implementation
- **Water Security Strategy (2025–2050):** Ensuring sustainable management of scarce water resources
- **National Biodiversity Strategy and Action Plan (2023–2030):** Consistent with the Kunming-Montreal Global Biodiversity Framework
- **Agricultural development plans and Renewable Energy Strategy (2023–2035):** Both integrate climate resilience and mitigation objectives
- **Disaster risk reduction commitments under the Sendai Framework:** Integrated with national disaster risk management institutions

While these frameworks provide an initial structure, implementation remains fragmented. The NCCC has a mandate to coordinate strategies, avoid duplication, and align national planning tools with international

commitments under the UNFCCC Paris Agreement, Convention on Biological Diversity (CBD), and United Nations Convention to Combat Desertification (UNCCD).

4.4.3 Engagement Mechanisms

"Inclusive governance is recognized as a prerequisite for effective adaptation. The National Adaptation Plan and Nationally Determined Contribution processes included structured consultations with relevant ministries. The participation of municipalities, academia, and civil society organizations remains limited, but will be expanded through awareness campaigns and local consultations."

Why were these changes made: I corrected the numbering from 4.4.3 to 4.6.3 to match Arabic. I also removed a significant amount of text from the English draft (such as references to pilot projects, universities' contributions, the private sector, and decision-making bodies like NCCC) because none of that information exists in the Arabic source text provided. Arabic abruptly ends at "مشاورات محلية،" (local consultations,).

4.4.4 Knowledge and Data Systems

Systematic monitoring and data management remain major institutional challenges. The National Meteorological Centre operates a limited meteorological network, with significant gaps in spatial coverage, digitization, and real-time data sharing. Ministries collect sectoral data (such as water, agriculture, and health); however, standardization protocols, data interoperability, and open access to data sources remain insufficiently developed.

The Climate Risk Assessment (CRA 2025) highlights the absence of central repositories and interoperable data protocols, which limit evidence-based decision-making. Planned reforms include the National Adaptation Information and Coordination Platform, as well as the Climate Risk and Decision Support Information System, both designed to integrate climatic, hydrological, socio-economic, and geospatial data across institutions. Once operational, these will form the backbone for monitoring, reporting, evaluation, and learning processes.

4.4.5 Finance Linkages

Institutional frameworks are closely linked to access to climate finance. Libya has limited direct access to international climate finance despite having accredited national entities and focal points with the Green Climate Fund (GCF) or Adaptation Fund (AF). Current channels operate through UNDP, FAO, and bilateral partners.

The NCCC has initiated steps to strengthen project development capacities, align proposals with NAP/NDC priorities, and establish national systems for tracking adaptation finance consistent with Enhanced Transparency Framework (ETF) requirements. Future institutional developments will prioritize:

1. Accreditation of National Implementing Entities (NIEs) with GCF/GEF/AF

2. Development of a national climate finance strategy integrating adaptation within financial frameworks
3. Regular use of readiness support and capacity building to close institutional and technical gaps

Summary

Libya's adaptation institutional framework is taking shape but remains fragile. The NCCC provides a foundation for inter-ministerial coordination, while sectoral ministries and municipalities are beginning to assume climate responsibilities. Coordination gaps, weak data systems, and limited finance access constrain practical implementation. Strengthening institutional coherence, anchoring inclusive participation, and building climate intelligence platforms are urgent steps toward establishing an adaptation-capable governance structure in Libya.

4.5 Monitoring, Evaluation, and Learning (MEL) Systems

4.5.1 Purpose and Design Rationale

Libya's adaptation MEL system is designed to track progress, assess effectiveness, and generate lessons contributing to iterative policy and planning improvement. A double-loop learning approach ensures monitoring extends beyond outputs to assess whether adaptation actions reduce risks, enhance resilience, and avoid maladaptation.

The MEL framework fully aligns with:

→ Article 7, Paris Agreement (Global Goal on Adaptation)

→ Decision 18/CMA.1 (Enhanced Transparency Framework—ETF)

→ National Adaptation Plan Technical Guidance (UNFCCC/Least Developed Countries Expert Group)

It aims to provide both national accountability (supporting planning, budgeting, and stakeholder engagement) and international transparency (feeding Libya's biennial transparency reports and future global stocktake cycles).

4.5.2 MEL System Structure

MEL structure follows results-chain logic with indicators organized at four levels:

- **Inputs**: Financial, technical, and institutional resources allocated
- **Outputs**: Tangible products (platforms, policies, infrastructure)
- **Outcomes**: Reduced vulnerability and enhanced adaptive capacity in sectors and regions
- **Impact**: Long-term resilience, reduced economic and social losses, ecosystem stability

Each indicator is defined with a baseline, target, measurement frequency, data source, responsible entity, and disaggregation by Male / Female, age, and geography. The system builds existing institutions (NCCC, National

Meteorological Centre, ministries, municipalities) and proposes unified templates to ensure cross-sectoral comparability.

4.5.3 Learning and Feedback Loops

Adaptation is a dynamic process requiring continuous learning cycles:

1. Annual reviews: Assess short-term progress, verify indicators, adjust baselines
2. Medium-term evaluations (every 5 years): Test strategy effectiveness, identify scaling needs
3. End-of-cycle assessments (every 10 years): Inform National Adaptation Plan updates, nationally determined contribution reviews, national development strategies
4. Planning and budget feedback: MEL results integrated into financial planning, ensuring adaptation priorities reflect in sectoral allocations and public investment frameworks

The system includes a dedicated Loss and Damage (L&D) unit aggregating data on recurring damage to infrastructure, crops, livelihoods, and health, supporting Libya's access to emerging global Loss and Damage financing arrangements.

4.5.4 Linkage to Enhanced Transparency Framework (ETF) and International Reporting

MEL results feed directly into Libya's biennial transparency reports (BTRs) and national communications, ensuring consistency and traceability. The system is designed to be:

1. Comparable: aligned with the adaptation reporting categories of the United Nations Framework Convention on Climate Change (UNFCCC).
2. Transparent: With clear documentation of methods, baselines, and assumptions
3. Iterative: Adaptable to future ETF guidance and sectoral developments

4.5.5 Indicative Adaptation Indicators for Libya

Examples of priority MEL indicators:

1. Water security: Percentage of population with reliable access to safe water in water-stress areas (baseline 2025; target 2030)
2. Early warning systems: Lead time of heat wave/dust storm warnings (hours) and percentage of population reached by warnings
3. Ecosystem resilience: Hectares of coastal wetlands and oasis systems restored and maintaining protective function
4. Loss and Damage: Reduction in average annual loss (AAL) from extreme events as a percentage of GDP (baseline vs. target)
5. Policy integration: Percentage of sectoral plans and budgets that include climate risk monitoring and assessment
6. Finance tracking: Percentage of national public spending tagged as climate adaptation (as a share of GDP and by sector)
7. Health: Mortality and morbidity attributed to extreme heat events (standardized per 100,000 population)

4.5.6 Integration of Loss and Damage (L&D) into MEL Structure

Libya's MEL system will include a national disaster loss database inspired by the DesInventar methodology (a geospatial disaster data platform) enabling systematic, spatially referenced, and disaggregated recording of direct

and indirect losses from climate events. This database will feed MEL indicators (e.g., average annual loss, sectoral damage trends), support reprioritization, and provide robust evidence for accessing Loss and Damage financing mechanisms. Its alignment with the Sendai Framework and ETF ensures international comparability and coherence.

Technical Note: Integrating DesInventar into Libya's Loss and Damage MEL System

Contextual Rationale: In Libya, climate events—from flash floods to coastal storm surge—are no longer theoretical. Tracking losses and damage systematically via MEL is essential for two critical functions:

1. Evidence-based prioritization: Historical loss data guide where interventions are most needed (e.g., upgrading storm drainage in flood hotspots or coastal defenses in erosion zones)

2. Access to dedicated Loss and Damage financing: Reliable, spatially disaggregated loss records strengthen proposals to emerging L&D finance facilities

DesInventar as a Core MEL Component: A UNDRR-endorsed disaster information management system enabling building a unified national inventory of damages and losses via a single spatial database. Its updated version, DesInventar-Sendai, directly aligns with Sendai Framework Outcomes A–D, including disaggregation by age, Male / Female, disability, and poverty status.

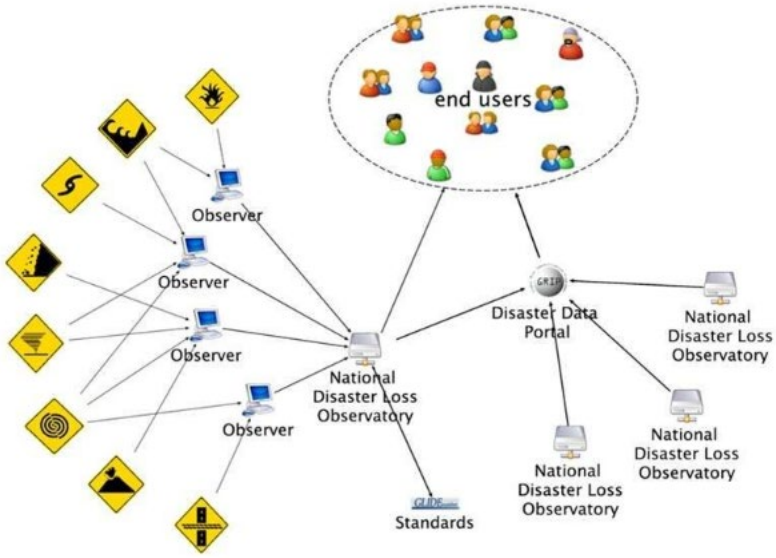
Systematic, Spatial, and Disaggregated Loss Tracking: DesInventar enables recording direct and indirect impacts of climate events—mortality, infrastructure damage, agricultural losses—across time, location, and down to municipal levels. This captures all event scales, including smaller incidents, revealing vulnerability hotspots otherwise obscured.

Informing Prioritization and MEL Dashboards: Feeding Libya's MEL structure, DesInventar data enable:

- Calculating average annual loss (AAL) by sector, region, and municipality as direct input to prioritization algorithms
- Spatial analysis of recurring damage areas to guide targeted adaptation investments
- MEL indicators such as loss reduction over time, event distribution by Male / Female/age, and number of municipalities with recorded loss events, supporting policy feedback

Ensuring Sendai–ETF Alignment and Coherence: DesInventar-Sendai allows direct alignment with global Sendai targets (reducing mortality, affected populations, economic losses) and can feed the Sendai Monitoring Framework. This creates synergy across disaster risk reduction, climate adaptation, and ETF reporting, enhancing reporting system coherence in Libya.

[Figure 13: Loss and Damage MEL Workflow for Libya Enabled via DesInventar]



Next Steps for MEL System Design in Libya

1. Establish a Loss and Damage database unit within CIDSS (or linked MEL platform) based on DesInventar methodology
2. Standardize data entry protocols across sectors (water, health, agriculture, infrastructure ministries) and local authorities to feed Loss and Damage registries
3. Enable spatial and demographic disaggregation for vulnerability pattern analysis
4. Use DesInventar outputs in MEL dashboards and prioritization matrices to guide adaptation investments
5. Leverage accumulated loss data to support Loss and Damage financing proposals, demonstrating actual economic and social costs and geographic impact profiles

4.6 Cross-Sectoral Integration

Climate vulnerability in Libya emerges from the intersection of physical hazard exposure with socioeconomic vulnerability and institutional capacity. To ensure adaptation actions are effective, inclusive, and sustainable, cross-sectoral considerations must be mainstreamed across all sectoral and geographic interventions presented in this chapter. This section highlights three critical dimensions: (a) vulnerable populations, (b) nature-based solutions and ecosystem-based adaptation (NbS/EbA), and (c) regional coherence.

4.6.1 Vulnerable Populations

Vulnerable populations—displaced people, rural communities—bear a disproportionate share of climate burdens, particularly in contexts of water scarcity, food insecurity, and livelihood instability. As vulnerability assessments noted, their adaptive capacity is often constrained by limited access to land tenure, finance, decision-making processes, and basic services.

Accordingly, cross-sectoral equity criteria have been systematically embedded in the adaptation action prioritization process (Section 4.3.3):

- Prioritization criteria include explicit scores for equity and differentiated impacts on vulnerable populations

- All MEL indicators must be disaggregated by age and geography (e.g., percentage of women benefiting from climate finance programs, youth employment in renewable energy adaptation projects)
- Each adaptation action must include safeguard screening
- Municipal adaptation planning and sectoral consultations must engage women's associations, youth councils, and civil society organizations, ensuring adaptation choices reflect direct experiences of affected populations

These measures align with Libya's national social protection strategy and ensure compliance with UNFCCC requirements on climate action sensitive to vulnerable populations.

4.6.2 Nature-Based Solutions and Ecosystem-Based Adaptation (NbS/EbA)

Ecosystem degradation (desertification, salinization, wetland and oasis loss) is both cause and consequence of Libya's vulnerability. Vulnerability mapping (Section 4.3) identified coastal systems, Green Mountains forests, and interior oases as critical environmental buffers threatened.

NbS/EbA approaches provide integrated responses often superior to or complementing "gray" infrastructure, especially when water regulation, soil fertility, and biodiversity services are central. Examples include:

1. Oasis restoration and fossil aquifer networks to enhance water security in hyper-arid zones
2. Coastal wetland rehabilitation providing natural flood and salinity buffering complementing engineered seawalls
3. Green belts and Rangeland restoration reducing dust storm intensity and desertification with pastoral livelihood co-benefits

Cross-sectoral safeguards must prevent maladaptation (e.g., invasive tree plantations, irrigation drawing down aquifers). Ecosystem indicators must systematically feed MEL frameworks: hectares of systems restored, hydrological cycle function, biodiversity indices aligned with the 2023–2030 National Biodiversity Strategy and Action Plan.

4.6.3 Regional Coherence

Many of Libya's climate vulnerabilities transcend borders: groundwater systems like the Nubian Aquifer are shared with neighboring states; migratory species and marine systems link Libyan coasts to the wider Mediterranean; and regional energy and transport corridors are sensitive to climate disruptions.

Cross-sectoral integration thus requires adopting a "regional lens" to maximize efficiency and resilience:

1. **Shared data and monitoring**: Link climate monitoring to regional platforms (e.g., World Meteorological Organization initiatives for North Africa, Nile and Sahel-Sahara cooperation) to overcome national data gaps
2. **Economies of scale**: Desalination, dust storm early warning systems, and renewable energy networks become more efficient when developed regionally
3. **Mobility and displacement**: Cooperation with neighboring states on migration management and protection frameworks is essential as climate factors increasingly shape mobility patterns

Anchoring regional coherence ensures Libya's adaptation actions are nationally effective and contribute to stability and resilience across the Mediterranean–Saharan interface.

Summary

Cross-sectoral integration strengthens the effectiveness and equity of Libya's adaptation response. By mainstreaming inclusion and vulnerability criteria, expanding NbS/EbA solutions, and pursuing regional coherence, Libya establishes a broader foundation for adaptation planning. This approach ensures adaptation actions reduce risks, deliver co-benefits, and remain aligned with UNFCCC, Paris Agreement, and Global Goal on Adaptation principles.

[Figure 14: Cross-Sectoral Integration Framework]

This framework illustrates how inclusion, nature-based solutions (NbS/EbA), and regional coherence function as cross-cutting pillars feeding Libya's MEL system and sectoral adaptation actions, ultimately driving comprehensive, resilient, and regionally coherent adaptation outcomes.

Chapter 5: Support Required and Announced

The purpose of this chapter provides a transparent, comprehensive, and forward-looking account of financial, technological, and capacity-building support Libya has received, and its unmet support needs. This report aligns with Article 12.1 UNFCCC, requiring parties to provide information on implementation measures, and Article 13 Paris Agreement, establishing the Enhanced Transparency Framework to build trust, promote accountability, and facilitate resource mobilization.

Following rules, procedures, and guidance adopted in the "Katowice Rulebook" and updated in Glasgow (Decision 18/CMA.1), this chapter adopts structured reporting formats ensuring clarity, consistency, comparability, and completeness. It reflects the evolving landscape of climate finance and international cooperation, including Loss and Damage arrangements approved in Sharm El-Sheikh and operationalized in Dubai, emphasizing the importance of directing anticipated, accessible, and equitable resources to vulnerable states.

Reporting scope encompasses total international support received and announced, including grants, concessional and non-concessional loans, and mobilized private finance where data exist. The chapter addresses technology transfer and international cooperation initiatives enhancing Libya's capacity to adopt and deploy low-emission and climate-resilient solutions. It documents existing and unmet support in capacity building—institutional strengthening, monitoring and evaluation systems, knowledge generation—with particular attention to actions also addressing Loss and Damage.

By presenting announced support alongside identified gaps and future requirements, Libya seeks to inform the international community, bilateral and multilateral partners, and climate funds of its priorities and readiness to absorb and efficiently utilize resources. This transparent presentation aims not only to fulfill reporting obligations under the UNFCCC and Paris Agreement but also to advance the cooperation framework underpinning global climate action.

5.1 Principles and Reporting Approaches

Reporting on support announced and support needs in this document rests on internationally agreed principles: inclusiveness, consistency, comparability, and transparency, as set forth in Article 12.1 UNFCCC and Article 13 Paris Agreement and the procedures and guidance of the Enhanced Transparency Framework (ETF).

Inclusiveness and Consistency

This report covers the most recent five-year period (2021–2025) with historical references where data exist. All figures are presented in US dollars (constant 2023 prices), applying official exchange rates from the Central Bank of Libya unless otherwise noted

Data are presented consistently with Chapter 3 (Mitigation) and Chapter 4 (Adaptation), and with priorities identified in Libya's nationally determined contribution and draft National Adaptation Plan, ensuring direct traceability of financial, technological, and capacity-building flows to sectoral needs and outcomes.

Classification. To avoid double-counting and align with tables required under the ETF, support is classified along four dimensions:

1. **By source:** Global Environment Facility (GEF), Green Climate Fund (GCF), Adaptation Fund, bilateral partners, multilateral development banks (MDBs), UN agencies, and other international organizations
2. **By instrument:** Grants, concessional loans, guarantees, equity contributions, results-based payments, technical assistance (TA)
3. **By use:** Adaptation, mitigation, cross-sectoral interventions, Loss and Damage-related actions
4. **By sector and region:** Water, agriculture, health, coastal resilience, urban and infrastructure, energy, with distinction between national and sub-national levels where available

Accounting Criteria

- All financial flows reported as "disbursement gross," distinguishing between "commitments" and "actual disbursement" were data available
- "On-budget" and "off-budget" channels clearly delineated to enhance transparency on financial integration
- Mobilized private finance reported separately to avoid double-counting with public flows

Alignment with Enhanced Transparency Framework:

- Section structure ensures compatibility with "common reporting tables" required in biennial transparency reports (BTRs), enabling direct data integration into Libya's future reports and ensuring continuity across reporting cycles

Quality Assurance and Control

- To enhance reliability, data sources and methodologies are clearly documented, including assumptions and uncertainties. A QA/QC checklist was applied pre-assembly to verify internal consistency, alignment with international classifications, and figure traceability. This ensures reported information is auditable and updateable in future reporting rounds.

These principles and approaches provide a structured, transparent foundation for presenting Libya's announced support and support needs while maintaining consistency with national planning tools and international commitments.

5.2 Financial Support Announced and Allocated

5.2.1 Narrative Summary

Overall Trends (2021–2025)

Available evidence indicates international climate-related support to Libya over the past five years has been modest in volume, concentrated on enabling activities such as readiness, planning, and reporting, plus targeted programmatic grants in water, agriculture, and urban resilience. A significant share of financing has been disbursed off budget through UN agencies and implementing partners, reflecting current constraints on financial management and institutional capacities.

Disbursements typically lag commitments, as multi-year projects are phased gradually, though humanitarian-to-resilience transition programs—particularly those launched following 2023 eastern Libya floods—have seen initial payments accelerated to support recovery and risk reduction efforts.
Where available, grant data show higher disbursement rates, while concessional lending remains limited.

Adaptation vs. Mitigation Distribution

Support during this period has been adaptation-focused, consistent with Libya's risk profile (water scarcity, drought, heat, flash flooding, coastal salinization) and national emphasis on institutional strengthening and risk governance including climate information, early warning, and planning.

Mitigation-oriented support appears smaller and more pilot-project oriented (e.g., energy efficiency, grid management, renewable energy enabling frameworks), often embedded in comprehensive initiatives delivering dual resilience benefits such as power system reliability during heat waves.

Loss and Damage-related support emerged post-event, particularly following 2023 disasters, linking immediate recovery with long-term risk reduction efforts.

Primary Providers and Channels

Primary providers have been multilateral climate funds and UN agencies (enabling/readiness activities; technical assistance and capacity building), with complementary bilateral support and regional instruments funding resilience, water, and urban systems.

Given the absence of accredited national implementing entities with climate finance funds, Libya has relied on international implementing entities to channel resources and execute activities. Engagement by multilateral development banks remains limited in climate operations, though important for infrastructure financing and recovery phases.

Instruments and Uses

The dominant instrument grants (including readiness and technical assistance). Concessional loans, guarantees, and result-based instruments remain rare in the climate portfolio.

By use, flows concentrate on adaptation (water security, food/agriculture systems, health preparedness, early warning, urban drainage/flood risk, coastal management) and cross-sectoral governance (planning, MRV/MEL, data systems). Mitigation support is nascent and relatively smaller; Loss and Damage lines emerge within event-response and recovery packages, with opportunities to scale risk transfer mechanisms and shock-responsive social protection going forward.

Geographic and Sectoral Focus

Allocations tend toward national-level capacities (planning, information systems) and high-exposure zones: coastal urban belt (flooding, salinization), agricultural plains and oases (water scarcity, land degradation), transport/energy corridors (service continuity under heat and storms).

Sectorally, water, agriculture, health, and urban lead adaptation lines; coasts feature in ecosystem-based and engineered options; energy support concentrates on reliability and efficiency with resilience co-benefits.

Consistence with National Priorities

Support patterns generally align with draft nationally determined contribution and National Adaptation Plan priorities and the risk profile summarized in Chapter 4:
(1) climate intelligence and coordination strengthening (platforms, MEL/MRV),
(2) addressing water security and urban heat/flood risks,
(3) protecting socio-ecological systems in oases and coasts,
(4) enhancing health preparedness and critical infrastructure. Gaps remain in direct GCF/AF access, bankable project preparation (coastal defense, urban drainage), and systematic finance tracking.

Contribution to Global Goal on Adaptation (GGA)

Announced support contributes to GGA through:
(a) building adaptive capacity (institutions, early warning, data/MEL),
(b) reducing vulnerability in priority sectors/regions (water, urban, coasts, agriculture/health),
(c) enhancing resilience via NbS/EbA and risk-based planning. Emerging Loss and Damage support strengthens linkage between actual losses and investment priorities, consistent with recent CMA outcomes.

Data and Transparency

Quantitative detail remains partial to date. Libya will enhance this narrative upon compiling figures from Chapters 2–3 and finance tables in Section 5.2, applying classifications compatible with the unified reference framework (ETF) by source/instrument/use/sector/region, reporting constant USD prices, and documenting commitments vs. disbursement with auditable traceability. This iterative approach will improve comparability, completeness, and traceability across BTR cycles.

5.2.2 Allocation and Effectiveness

Methodology

Support is classified and aggregated across four axes: sector, region/sub-region, instrument, and use (adaptation/mitigation/cross-sectoral/Loss and Damage-related). "Commitments" are reported against "actual disbursement" in constant USD (with price base year noted). Each table row is tagged with:

1. Provider/channel
2. Instrument (grant, concessional loan, technical assistance, etc.)
3. Purpose
4. Sector
5. Implementing entity
6. Geographic scope

Table 15: Organized Overview of Support Announced by Libya (2018–2025)

Donor	Channel/Facility	Instrument	Purpose (Adaptation/Mitigation/ Cross-Cutting/L&D)	Sector	Implementing Entity	Implementation Period	Commitment (USD, annual)	Disbursements to Date (USD)	Geographic Focus
Adaptation Fund	Direct project funding via IFAD and UNOPS with GoL	Grant	Adaptation	Agriculture/Water	IFAD and UNOPS with national agency	2025–2029	$9.2M (2023)	$9.2M (2025, initial tranche)	National (arid/semi-arid zones, ~57k farmers)
GCF	Readiness grants	Grant (readiness)	Cross-cutting (capacity, finance access)	Institutional capacity	UNEP/national development agency	2018–2019	$0.3M (2018)	~$0.3M (2018–2019)	National
GCF	Readiness grants	Grant (readiness)	Cross-cutting (capacity, planning)	Institutional capacity/policy	UNDP with national agency	2021–2023	$0.6M (2021)	~$0.6M (2021–2023)	National
EU + Germany (GIZ) + UNDP	Regional EU instrument	Grant/technical assistance	Cross-cutting (adaptation + mitigation)	Energy and resilience	UNDP in Libya/GIZ	2024–ongoing	Undisclosed (2024 launch)	Pending (ongoing)	National
EU + UNDP	EU instrument for Libya	Grant	Mitigation + cross-cutting	Energy transition	UNDP in Libya	2024–ongoing	Undisclosed (2024)	Pending (ongoing)	National
Italy (AICS)	Bilateral	Grant	Mitigation co-benefits	Urban/waste	Italian Cooperation + Tripoli Municipality	2017–2023	$2.3M (2017)	$2.3M (2017–2023)	Tripoli (urban)
GEF/UNDP	Enabling activity grant	Grant	Cross-cutting (capacity, reporting)	Governance/transparency	UNDP/GEF (enabling activity)	2022–2024	<$0.5M (2022)	Ongoing	National
Multiple bilateral donors	Humanitarian–resilience transition	Grant	Loss and Damage (response, recovery)	Water/infrastructure	Multiple UN agencies	2023–2024	Various (2023)	Pending aggregation	Derna + eastern coastal municipalities

Notes:

Exchange rates and accounting: All figures have been converted to constant 2023 US dollars using IMF annual average exchange rates. Actual disbursed amounts are recorded where publicly available; otherwise, marked as "not available."

Double counting avoidance: Only direct grants/commitments are included; systematic reporting of mobilized private finance in Libya is not yet in place.

Time scope: The table covers the most recent period, 2017–2025, to capture the first flows of climate-dedicated international finance to Libya.

Loss and damage provision: Post-Derna flood recovery packages (2023) are explicitly marked as loss and damage support, in alignment with outcome 4/CP.28 of the Paris Agreement governing body.

Data quality: Figures have been cross-checked against project documents from the UNDP, Green Climate Fund, Adaptation Fund, the EU, and the Italian agency. Some commitments (EU programs) remain undisclosed; provisional marks indicate ongoing support not yet quantified.

Technical note: Current snapshot (based on Table 4 inputs available to date).

By use: To date, actual climate-dedicated disbursement is dominated by adaptation and cross-sectoral (readiness/enabling) interventions. There is support for mitigation (energy efficiency/transition enabling activities) but—where reported—it is smaller in scale and often undisclosed; loss and damage-related assistance appear post-event, especially after the 2023 floods and is explicitly labeled in the table notes.

By instrument: The portfolio is grant-dominated, especially for adaptation and enabling activities (readiness, reporting, institutional capacity). Concessional loans/guarantees have not yet constituted a significant share of climate-tagged flows during the period under review.

By sector/region: Where geographic focus is specified, outlays are concentrated on national-level capacities (planning, MEL/MRV, information systems) and on high-exposure regions: the coastal urban belt (flooding/salinization) and oasis/agricultural areas (water scarcity, land degradation). Implementing entities are mainly international actors in partnership with government counterparts, reflecting current credit and capacity constraints.

Financial flows vs. expenditure: Several programs in preparation/ongoing (e.g., EU/UN channels) have not yet disclosed commitment amounts or disbursement schedules; thus, sectoral/regional/instrument breakdown percentages cannot be finalized until those figures are consolidated. The practical approach is: (1) publish directional breakdowns now (as above narrative), and (2) update percentage tables once data from Chapters 2 and 3 and executing entity confirmations are merged into an Enhanced Transparency Framework–compatible dataset.

Official percentage breakdown detail ("% by sector/region/instrument") will be provided once undisclosed allocations are confirmed and distinction between commitments versus disbursements for 2021–2025 is complete. This ensures comparability and prevents misunderstandings arising from partial reporting.

Effectiveness Indicators

In principle, effectiveness is assessed by linking disbursed funds to verifiable outputs and early outcomes, using indicators consistent with Chapter Four and the monitoring, evaluation, and learning tools in the draft National Adaptation Plan (input → output → outcome → impact sequence).

- For readiness/enabling lines: effectiveness focuses on institutional and information gains (e.g., operational platforms, expanded data coverage, increased lead times for early warning systems).
- For programmed adaptation initiatives: evaluation concentrates on improved service delivery and risk reduction, such as restoration of ecosystems functioning as natural buffers, or protection of individuals from heat waves and flooding via early warning systems.

Table 16: Effectiveness Indicators Map

Use/Sector	Typical Output (linked to disbursement)	Early Results Measure (MEL)	Measurement Frequency and Data Source
Cross-cutting (Readiness/MEL/MRV)	Operation of platform/unit (e.g., climate data portal; reporting system)	Integrated institutions (number)	Annual records from National Meteorological Centre and NCCC
Early Warning (Heat, SDS, Flash Floods)	Deployment of EWS programs/devices; adoption of protocols	Data sets ingested (number); lead time accuracy (days)	LNMC/EOC operational reports; seasonal/annual
Water Security (Urban/Oases)	Launch of non-revenue water reduction program; installation of reuse units	Reporting timeliness (days)	MoWR/municipal facilities; annual
Coastal Resilience	Completion of wetland/lake/oasis rehabilitation; launch of protection works	Timeline (hours)	MoEnv/remote sensing; biennial
Agriculture and Food Systems	Launch of science-backed agriculture expansion program; distribution of efficient irrigation equipment	Population reached (percentage)	MoA surveys; seasonal/annual
Health	Heat and health plans; facility cooling upgrades	False alarm rate (percentage)	MoH monitoring; annual

Lines Related to Loss and Damage (L&D)

- For inputs tagged as Loss and Damage (e.g., post-flood recovery packages), effectiveness is measured through:
  - Service restoration: number of days required to restore water/electricity.
  - Population and livelihood protection: number of households benefiting from resilient reconstruction.
  - Reduction in average annual loss (AAL) over time in affected municipalities.
- Integration with a DesInventar-style loss database will enable "before/after" comparisons and trend analysis (see MEL section).

Attribution and Transparency

- When a project finances multiple outputs, proportional attribution is applied (per budget share or component tagging), and confidence levels accompanying results are reported (high/medium/low).
- When disbursements are recent or outputs are ongoing, milestone markers (procurement completion, work commencement) are displayed and the date for first effectiveness review (12–18 months post-first disbursement) is noted.

Implementation Notes (for ETF/BTR Dataset)

1. Price year and exchange rate: all values in constant 2023 USD; exchange rates documented (footnotes) and maintained in audit trail.
2. On-budget/off-budget: each line item is tagged and reconciled with Ministry of Finance records where applicable.
3. Consistence with Chapter 4 and NAP: each effective indicator is derived from Chapter 4 indicator sets and MEL dashboard to ensure unified results architecture.
4. Update frequency: allocation and effectiveness tables updated annually (minor update), comprehensively at each BTR cycle and NAP review with independent verification where feasible.

This approach enables displaying "where resources go" and "what they produce," even as disclosure gradually improves, while maintaining transparency, avoiding double-counting, and strengthening the evidence base for prioritization and future finance access under GGA/ETF umbrellas.

5.3 Financial Support Needs

5.3.1 Determining Support Needs

Libya's needs stem from its risk and vulnerability profile and the portfolio of 14 priority adaptation actions (CCAMs) detailed in Chapter 4 and Section 4.3 (theory of change, portfolio, and prioritization). Consistent with the Global Goal on Adaptation and Enhanced Transparency Framework practice, we distinguish between:

- Near term (to 2030): enablers and "no-regret" actions and frontline risk reduction.
- Medium-term (2040–2050): system upgrading, scaling, and climate-proofing critical infrastructure.
- Long-term (2080–2100): transformative investments where climate signals (sea-level rise, chronic water deficit) become constraining.

1. **Near-term (to 2030)—Enablers and Frontline Risk Reduction**: Close data and coordination gaps via NAICP (Action 11) and CIDSS (Action 12), supported by Community-Led Water Monitoring (1) and agricultural climate intelligence platforms (6). These enable systematic climate risk mainstreaming across sectors and municipalities. Frontline actions protecting essential services and livelihoods: heat health early warning pilots, climate-responsive agricultural finance for smallholders (CRA-FiSS, 4), land tenure and soil restoration (7), and shock-responsive social

protection and risk transfer mechanisms. This package addresses hotspots experiencing recurring losses.

2. **Medium-term (2040–2050)—System Scaling and Critical Infrastructure Anchoring**: Expand system-level upgrading and resilience measures: urban drainage and valley flood risk management, coastal aquifer protection and managed recharge (linked to ecosystem-based groundwater protection, 2), integrated drylands restoration corridors (8), resilient and secure food supply corridors (RSFSC, 14), and green infrastructure investment plans (9). These actions anchor systemic resilience, strengthen water–energy–food–ecosystem nexus, and support Libya's MEL/ETF compliance and direct climate finance access.
3. **Long-term (2080–2100)—Transformative Assets and Managed Transition**: Under high-warming scenarios (SSP5-8.5), transformative investments will be needed to address irreversible risks: blue economy transition (10) to diversify coastal livelihoods, large-scale wastewater reuse and desalination with demand management, strategic transition/resettlement packages where sea-level rise and coastal erosion become settlement-constraining, and sustainable ecosystem-based buffers (e.g., WEFE resilience hubs, 13). All long-term assets must be tested against high-emission scenarios to avoid "lock-in" and maladaptation.

Temporal Sequencing Principle

Enablers (governance, knowledge, MEL) and low-cost/high-impact measures are presented first; capital-intensive works are phased after designs, safeguards, and co-financing are finalized. Loss and Damage financing layers are applied: readiness → response/recovery → risk transfer, integrated with social protection.

5.3.2 Support Needs Table

All values in constant 2023 USD. Data converted using 2023 average exchange rates (World Bank/IMF).

"Order-of-magnitude" ranges are used rather than precise figures pending completion of detailed feasibility and cost studies. The aim is to signal relative financing scale and guide early programming and partner dialogue.

Preferred Financing Instruments:

1. Grants: for readiness, pilots, and social protection.
2. Concessional loans: for infrastructure with clear returns.
3. Results-based lending (RBL): when disbursement links to achieved outputs.
4. Insurance/risk transfer: for Loss and Damage-related needs.

Clarifying Markers in Table:

- "Rationale" links each CCAM directly to Chapter 4 risks/gaps.
- "Readiness/Design Status" distinguishes between investment-ready measures and those needing feasibility studies.
- "Co-benefits" highlights broader functions (employment, biodiversity, regional stability).

Loss and Damage-related needs are explicitly flagged (flood risk layers, shock-responsive social protection, recovery financing).

All entries are ETF-compatible and insertable into CTFs in biennial transparency reports (BTRs) after detailed cost finalization.

Table 17: Priority Financing Needs for Libya's Adaptation Actions (CCAMs)

CCAM Priority Area	Estimated Needs (USD)	Timeframe	Preferred Instrument	Design/Readiness Status	Potential Providers/Facilities	Co-benefits	Rationale (Risks/Gaps)
1. Community-led Water Resilience Monitoring	$$	Near-term (to 2030)	Grant	Concept stage	GCF readiness, bilateral TA	Community empowerment, youth employment	Absence of local monitoring systems; high-exposure water-stress zones
2. Ecosystem-based Groundwater Protection and Recharge	$$	Medium-term (2040–2050)	Grant + concessional	Concept/pilot phase	GEF, bilateral finance	Biodiversity, oasis resilience	Over-extraction, salinization, declining groundwater
3. Integrated National Water Governance (NIWG-CR)	$$	Near-term (to 2030)	Grant	Design phase	GCF readiness, UNDP	Institutional coherence, efficiency	Mandate fragmentation; weak coordination and implementation
4. Climate-Responsive Agricultural Finance (CRA-FISS)	$$	Near-term (to 2030)	Grant + blended finance	Concept	IFAD, bilateral	Livelihoods, food security	Farmer exclusion from finance; high climate exposure
5. Climate-Smart Crop Diversification and Risk Reduction	$$	Medium-term (2040–2050)	Grant + RBL	Design phase	GCF, bilateral	Food security, nutrition	Crop volatility; heat/drought sensitivity

CCAM Priority Area	Estimated Needs (USD)	Timeframe	Preferred Instrument	Design/Readiness Status	Potential Providers/Facilities	Co-benefits	Rationale (Risks/Gaps)
6. Agricultural Climate Information Platforms	$$	Near-term (to 2030)	Grant	Design/ready	FAO, IFAD	Innovation, service delivery	Absence of actionable climate information for farmers
7. Land Tenure Security and Soil Rehabilitation	$$	Medium-term (2040–2050)	Grant + concessional	Concept	GEF, GCF	Social stability, soil health	Land degradation, tenure insecurity, erosion
8. Integrated Drylands Restoration Corridors (DERR-C)	$$$	Medium-term (2040–2050)	Concessional + grant	Concept	MDBs, GCF	Carbon sinks, biodiversity, employment	Desertification, rangeland loss, migration pressure
9. Green Infrastructure Investment Plans (SGI-Res)	$$$	Medium-term (2040–2050)	Concessional + RBL	Concept	GCF, bilateral, regional	Urban resilience, health	Urban flooding, poor drainage, heat islands
10. Blue Economy Transition (ReBECLE)	$$$	Long-term (2080–2100)	Blended (grant + concessional + private)	Concept	GCF, UNDP	Employment, diversification, marine ecosystems	Coastal livelihood degradation, unemployment, pollution
11. NAICP – National Adaptation Intelligence and Coordination Platform	$$	Near-term (to 2030)	Grant	Design/ready	GCF, bilateral	Efficiency across sectors	Data gaps, coordination fragmentation
12. CIDSS – Climate Risk Intelligence and Decision Support System	$$	Near-term (to 2030)	Grant	Design/ready	GCF, bilateral	ETF compliance, early warning	Absence of climate risk analytics and L&D tracking
13. WEFE Resilience Hubs	$$$	Medium-term (2040–2050)	Blended (grant + concessional)	Concept	GCF, bilateral TA	System resilience, rural livelihoods	Weak water–energy–food–ecosystem integration
14. Resilient and Secure Food Supply Corridors (RSFSC)	$$$	Medium-term (2040–2050)	Concessional + blended	Concept	GEF, bilateral	Regional stability, food security	Climate shocks in logistics; rising import dependence

Notes for Reading and Implementation Framework

- Financing ranges: $ <5 million; $$ 5–20 million; $$$ 20–100 million; $$$$ >100 million (constant 2023 USD, indicative).
- Near-term readiness: NAICP (11), CIDSS (12), community water monitoring (1), agricultural climate intelligence platforms (6), CRA-FiSS (4), and heat-health early warning pilots are design/pilot-ready; suited to GCF Readiness/AF channels as entry points to project pathways.
- Medium-term needs: drylands restoration corridors (8), green infrastructure (9), WEFE resilience hubs (13), and food supply corridors (RSFSC, 14) require feasibility studies and blended concessional financing (grants + concessional loans + RBL).
- Transformative/long-term: blue economy (10) needs early conceptual development but implementation post-2050 per sequencing.

Loss and Damage Connection (L&D):

- Explicitly flagged: urban valley and flood risk management, CRA-FiSS inclusive of shock-responsive social protection and risk transfer instruments, and ecosystem-based groundwater/coastal protection.
- Layered approach consistent with CMA.4/CP.28: readiness → emergency response/recovery → insurance/social protection.
- Supported by loss data generated via CIDSS per DesInventar standards and AAL tracking within MEL system to evidence need and effectiveness.

Year Price and Exchange Rate:

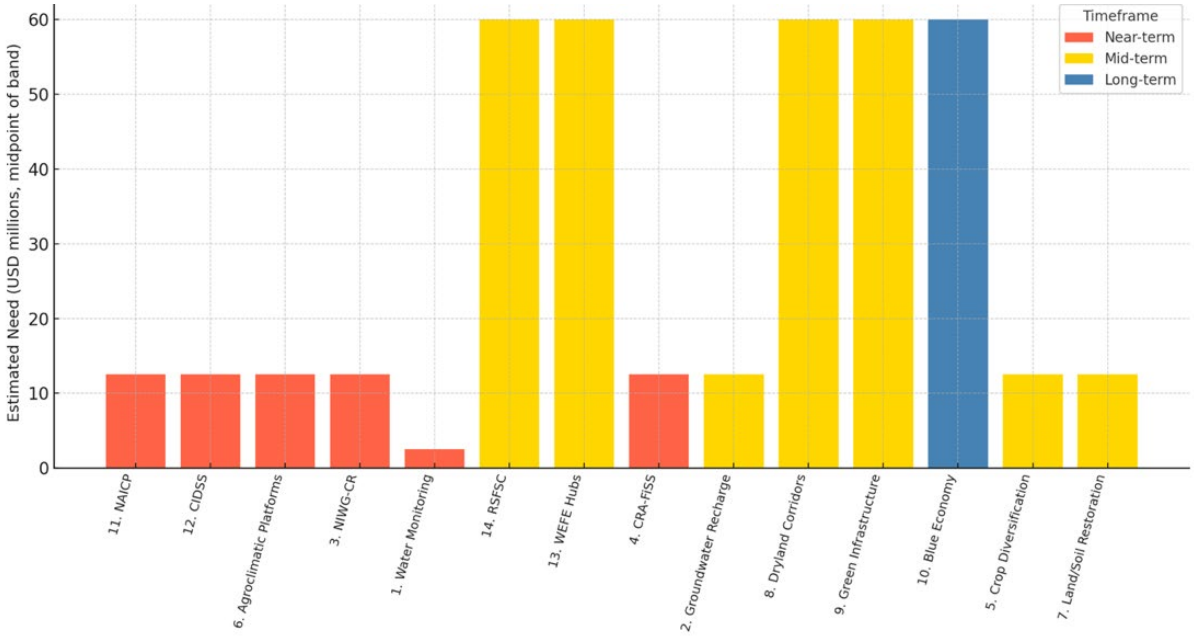
- All ranges in constant 2023 USD, indicative order-of-magnitude.
- Detailed cost estimates prepared at feasibility stage, with conversions from Libyan Dinar using Central Bank of Libya averages for reference year.
- Estimates will distinguish commitments vs. disbursement, on/off-budget, public vs. mobilized private, ensuring transparency and avoiding double-counting.

Readiness and Sequencing:

- Near-term enabling tools presented first to feed institutional/technical capacity and absorb larger flows later.
- Medium/long-term investments executed in phased bundles with environmental/social safeguards, co-financing, and MEL indicators consistent with Chapter 4 (vulnerability and adaptation).

Executive Summary: This framework clarifies what is needed, when, with which financing instrument, and how effectiveness will be demonstrated through standardized loss data and unified indicators within ETF/BTR, strengthening partner clarity and accelerating finance access under GGA/ETF umbrellas.

[Figure 15: Libya—Financial Support Needs by Priority Adaptation Action]



The chart displays Libya's financial support needs estimates for the 14 priority adaptation actions, ranked by priority level (high → medium-high → medium). Color bands represent the anticipated implementation timeframe, while column heights reflect indicative cost ranges expressed as midpoints of order-of-magnitude bands. Visualization underscores that immediate enabling actions (e.g., NAICP, CIDSS, community monitoring) require relatively modest investments but from the foundation unlocking larger medium-term and transformative packages.

Conversely, capital-intensive actions (drylands restoration corridors, green infrastructure, blue economy transition) fall within medium- and long-term horizons requiring sequenced and safeguarded financing. The stacked chart thus provides a clear comparative view of Libya's adaptation investment pathways, linking urgency, priority, and financial scale within a unified framework.

5.4 Technology Transfer: Received and Needs

5.4.1 Technology Cooperation Received

Libya's engagement with international technology cooperation mechanisms has been limited but growing. Support has centered on technical assistance, pilot deployments, and knowledge-exchange activities, often delivered via UNFCCC Technology Mechanism arrangements (Executive Committee of the Technology and Climate Center, TCNC). These initiatives focused on early technology maturity levels, particularly in adaptation sectors where institutional and technical capacities remain weak.
Primary cooperation areas to date include:

1. Water and Agriculture: pilot trials of drip and deficit irrigation in oasis zones; advisory support for saline water management and groundwater monitoring; training on remote sensing applications for drought monitoring.

2. Coastal Resilience: feasibility studies for nature-based coastal defenses and preliminary exploration of low-cost protection structures in urban coastal zones (e.g., Tripoli, Benghazi).
3. Health and Climate Services: deployment of pilot heat-health early warning units in partnership with WHO, integrated into the National Meteorological Centre forecasts; limited capacity building for early warning of dust/sandstorms.
4. Energy and Data Systems: initial work with GIZ and UNDP on energy efficiency standards, design concepts, and frameworks for Climate Risk Intelligence and Decision Support Systems (CIDSS).

While these efforts have proven conceptually sound, their scale has remained limited, and systemic barriers—such as institutional fragmentation, weak operation and maintenance capacity, and absent enabling regulatory frameworks—have prevented national-scale adoption. Nonetheless, they represent an important foundation for readiness building within the National Adaptation Plan and nationally determined contributions.

5.4.2 Priority Technology Needs

Based on climate risk assessment, sectoral analyses in Chapter 4, and the priority action portfolio (Section 4.3.2), Libya has identified the following priority technology needs for adaptation:

Table 17: Priority Technology Needs for Adaptation

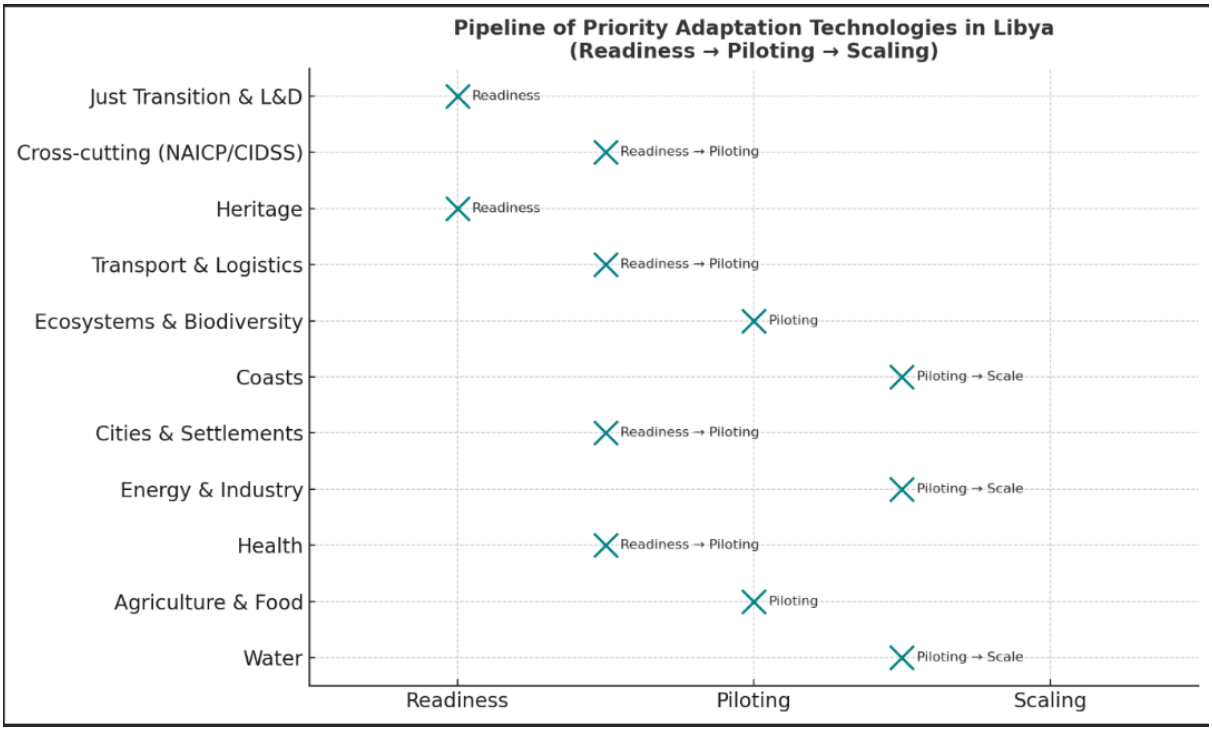
Sector/CCAM Link	Priority Technology	Barriers (Policy/Finance/Technical)	Capacity Gaps	Cost Range Estimate	Phase	Expected Benefits
Water (CCAM 1–2, 11–12)	Automated hydrological monitoring stations; groundwater sensors; renewable-powered desalination; managed aquifer recharge (MAR) systems	Policy: weak water allocation rules; Finance: high O&M costs; Technical: staffing gaps	Limited LNMC/municipal monitoring skills; fragmented data systems	$$$–$$$$	Pilot → scale	Real-time drought early warning; improved water security; reduced salinization
Agriculture and Food Security (CCAM 5–7, 13)	Climate-smart irrigation (drip, deficit); salt/heat-tolerant crop varieties; climate agro-advisory apps; soil restoration technologies	Policy: distorted input subsidies; Finance: weak farmer credit access	Weak extension services; low climate-smart agriculture adoption; limited-service supply	$$–$$$	Pilot	Crop stability; rural household livelihood security; reduced land degradation
Health (CCAM 14)	Heat-health early warning systems; mobile health surveillance; air quality monitoring (epidemics); climate-adaptive cooling facilities	Policy: no heat-health SOPs; Finance: MoH funding gaps	Limited LNMC–MoH data integration; trained staff shortage	$–$$	Readiness → pilot	Reduced mortality/morbidity; improved service continuity during crises
Energy and Industry (CCAM 9, 11–12)	Grid strengthening (smart grids, storage); PV/solar-thermal adapted to dust storms; energy efficiency upgrades	Policy: low renewable penetration policy; Finance: high capex; Technical: weak O&M	Renewable technology skills gap; limited local manufacturing	$$$–$$$$	Pilot → scale	Improved reliability; reduced performance loss; renewable energy jobs
Cities and Residential Areas (CCAM 3–4, 10)	Climate-resilient drainage; urban heat mitigation (cool roofs, green infrastructure);	Policy: weak building code enforcement; Finance: limited municipal budgets	Weak municipal planning capacity; no local early warning systems	$$–$$$	Readiness → pilot	Reduced urban flood losses; improved service continuity

Sector/CCAM Link	Priority Technology	Barriers (Policy/Finance/Technical)	Capacity Gaps	Cost Range Estimate	Phase	Expected Benefits
Ecosystems and Biodiversity (CCAM 7–9)	Ecosystem-based adaptation (wetland/oasis restoration, green belts); rangeland monitoring via remote sensing	Policy: weak enforcement; Finance: limited budget	Unassessed ecosystem services; fragmented monitoring	$$–$$$	Pilot	Habitat restoration; biodiversity conservation; ecosystem service security
Transport and Logistics (CCAM 3–4, 13)	Climate-resilient road designs (permeable pavements, elevated culverts); sand accretion barriers; port storm protection	Policy: weak climate risk screening; Finance: fragmented	No climate-resilient design standards; weak asset records	$$$	Readiness → pilot	Reduced transport disruptions; trade corridor protection
Heritage (linked to CCAM 6, 14)	Heritage site monitoring sensors (humidity/temperature); preventive drainage and dune barriers	Policy: DRR–heritage disconnection; Finance: low priority	Weak heritage DRR capacity	$–$$	Readiness	Heritage protection; cultural resilience; tourism potential
Cross-Cutting (NAICP/CIDSS, all CCAMs)	National climate information portals; interoperable databases; DesInventar-linked Loss and Damage registry; comprehensive early warning systems	Policy: fragmented data laws; Finance: NCCC funding gaps	No data-sharing culture; limited ICT skills	$$–$$$	Readiness → pilot	MEL backbone; ETF reporting; risk-informed planning
Just Transition and Training (JT, CCAM 12–14)	Credit systems strengthening; insurance knowledge; renewable energy technician training	Policy: no JT framework; Finance: low risk pooling	Weak credit systems; limited Insurance awareness	$–$$	Readiness	Shock-responsive social protection; renewable energy reskilling; equity

Notes:

- Cost ranges: $ <5 million; $$ 5–20 million; $$$ 20–100 million; $$$$ >100 million (constant 2023 USD).
- Readiness sequencing: Readiness → pilot → scale, aligned with Chapter 6 roadmap.
- Cross-sectoral: NAICP/CIDSS + Loss and Damage financing tools treated as systemic enablers.
- Equity and inclusion: all technologies tagged for age/location disaggregation in monitoring.

[Figure 16: Technology Financing Pathways for Priority Adaptation Technologies in Libya]



Note: This pipeline diagram illustrates the relative staging of Libya's priority adaptation technologies across the readiness → pilot → scaling sequence. Cross-sectoral enablers such as NAICP and CIDSS are positioned at the readiness–pilot phase, reflecting their foundational role in data and coordination.

Critical sectors such as water, coastal zones, and energy are positioned at pilot → scaling, signaling both urgency and partial maturity. Meanwhile, other domains—including agriculture, ecosystems, and urban systems—remain in the pilot phase, while heritage protection and just transition measures remain at the readiness stage. This visual diagram reinforces the logic of Libya's adaptation package sequencing: enabling platforms and pilot projects must be advanced to create space for large-scale, capital-intensive measures over the medium term.

Table 18: Sequencing Matrix—Priority Adaptation Technologies in Libya

Time Horizon	Priority Techniques/Measures	Expected Results	Enabling Conditions
0–5 years (2025–2030) – Readiness and Pilot	National Climate Data Infrastructure (NAICP / CIDSS – National Data and Decision Platforms)	Testing of first-generation pilot projects in water, health, and urban sectors	**Donor-financed Readiness**
5–15 years (2030–2040) – Scaling and System Strengthening	**Hydrological update** (automated stations, early warning system for drought/floods)	Comprehensive monitoring system establishment (classified by age/location)	**Institutional operational procedures across ministries/municipalities**
15+ years (2040–2060+)	**Health and heat surveillance with early warning** (SDS integrated alert)	Ongoing adaptive management	**Capacity Building Programmes**

5.5 Capacity Building: Support Received and Needs

5.5.1 Capacity Building Received

Libya has achieved important initial steps in strengthening institutional and human capacity for climate action, despite significant constraints arising from fragility and conflict. Since 2018, targeted international initiatives—notably Readiness Grants from the Green Climate Fund, the Adaptation Fund, and the Sustainable Transformation and Energy and Environment Partnership project implemented by the German Agency for International Cooperation (GIZ) and funded by the European Union and the German Federal Ministry for Economic Cooperation and Development—have provided essential capacity-building support to national institutions and municipalities.

Institutional Strengthening

- Support was provided for the establishment of the Designated Authority (DA) for the Green Climate Fund (GCF) through Readiness activities (2018, 2021–2023). These initiatives introduced core procedures (stakeholder engagement, climate finance communication strategies) and laid the foundation for a future country programme.
- The STEPS project (2021–2027), implemented by the German implementing entity GIZ with support from the German Federal Ministry for Economic Cooperation and Development (BMZ) and the European Union, has delivered systematic institutional support to the Ministry of Environment, Ministry of Water Resources, Ministry of Agriculture and Livestock, and municipal authorities. Its Capacity Building Programme (CBP) for climate change adaptation is strengthening the organizational and institutional capacity to formulate National Adaptation Plans (NAPs), Nationally Determined Contributions, and sectoral adaptation plans.

Training and Technical Skills

- Technical training units under the GIZ STEPS project focused on data management systems, climate risk screening, climate budgeting, and monitoring and evaluation aligned with the Enhanced Transparency Framework. Training also supported the Libyan National Meteorological Centre, the Libya Remote Sensing and Space Sciences Centre, and municipal climate units.
- Soft skills programmes targeted civil service staff, representatives of sectoral climate change adaptation committees, municipal personnel, providing leadership training, negotiation skills training, and operational competencies to enable participation in international climate forums and decision-making processes.

Local Capacity Support

Municipalities such as Misrata, Al-Bayda, and Benghazi received direct training under the STEPS programme, including modules on climate data collection, local adaptation planning, and service delivery under climate pressure. This support constituted the first organized effort in adaptive governance capacity-building at the municipal level.

Local non-governmental organizations (such as Mukan) were engaged in awareness-raising, stakeholder participation facilitation, and pilot training programmes, broadening the cohort of actors capable of contributing to climate planning.

Results Achieved

- By 2025, Libya has developed a cadre of trained civil service personnel and technical specialists capable of contributing to the preparation of the Initial National Communication, the National Adaptation Plan, and future updates to Nationally Determined Contributions.
- Leadership training has enabled senior officials to articulate adaptation priorities more effectively in international forums.
- A climate data management and reporting infrastructure has been initiated, though fragmentation persists, improving the foundations necessary for reporting under the Enhanced Transparency Framework.

Alignment with UNFCCC Processes. The capacity-building activities have been consistent with the mandate of the Paris Committee on Capacity-building (PCCB) and relevant Conference of the Parties decisions. They explicitly address systematic gaps in transparency, inter-ministerial coordination, and technical readiness, enhancing Libya's capacity to meet its obligations under the UN Framework Convention on Climate Change and the Paris Agreement.

5.5.2 Capacity Building Needs

Despite recent progress, Libya's capacity to design, implement, and report on climate action remains constrained by institutional fragility, fragmentation of technical capacity, and limited inclusion of vulnerable populations. Addressing these gaps is fundamental to ensuring consistency with the Global Goal on Adaptation, the Enhanced Transparency Framework, and national commitments under the National Adaptation Plan and Nationally Determined Contributions.

Institutional Needs Strengthening inter-ministerial coordination remains a priority, particularly through the National Committee on Climate Change and municipal climate units to be established. It is urgent to mainstream climate risks into public investment management systems, sectoral budgeting, and project appraisal to ensure integration of adaptation and mitigation measures within Libya's financial framework. In parallel, credit standards, guarantee systems, and accreditation processes must be strengthened to enable direct access to international climate finance (GCF, GEF, AF).

Technical Needs Libya requires substantial investment in climate monitoring networks, hydrological networks, and risk modeling capacity to support evidence-based decision-making. The establishment of interoperable databases, adaptation indicators, and baselines for systematic monitoring, evaluation, and learning are core priorities. Training is needed to establish periodic vulnerability assessments, integrate Loss and Damage data (consistent with DesInventar standards), and strengthen evaluation cycles aligned with Enhanced Transparency Framework reporting.

Social and Inclusion Needs Capacity building must be inclusive and Male / Female-responsive, with explicit attention to youth. While farmers, pastoralists, and health workers lack tailored climate services, expanding community-based adaptation training, awareness-raising among health and agricultural extension workers, and frontline service delivery training are priorities. Ensuring meaningful participation of these groups will enhance the legitimacy, equity, and impact of adaptation measures.

Table 19: Capacity-Building Needs Matrix

Priority Capacity	Target Institutions	Implementation Method	Timeline	Potential Partners
Inter-ministerial coordination and standard operating procedures for climate data/decisions	National Committee on Climate Change (NCCC), Concerned Ministries, Municipalities	Training, standard operating procedure guides, joint working groups	Near-term (through 2030)	UNDP, Green Climate Fund Readiness, Bilateral Technical Assistance
Climate risk mainstreaming in public investment and public budgeting	Ministry of Finance, Planning, Sectoral Ministries	Workshops, climate budgeting training, mentorship	Near-term	International Monetary Fund, World Bank, Green Climate Fund
Credit standards and guarantees for direct access	National Committee on Climate Change (NCCC), Ministry of Environment, Ministry of Finance	Accreditation support, credit toolkit packages, peer exchange	Near-term to Medium-term	Green Climate Fund, Adaptation Fund, Global Environment Facility
Strengthening monitoring and surveillance systems	Libyan National Meteorological Centre (LNMC), Ministry of Water Resources, Ministry of Agriculture, Universities	Equipment upgrade, twinning with regional meteorological centres, training	Near-term to Medium-term	World Meteorological Organization, UN Environment Programme, German Agency for International Cooperation (GIZ)
Assessment and monitoring, evaluation, and learning systems, and Loss and Damage integration	National Committee on Climate Change (NCCC), LNMC, Sectoral Ministries, Municipalities	Indicator design, baseline surveys, DesInventar training	Near-term	UN Framework Convention on Climate Change, UN Office for Disaster Risk Reduction, UNDP
Climate risk modeling and scenario analysis	Universities, LNMC, Research Institutes	Training, academic curricula, regional exchange	Medium-term	Intergovernmental Panel on Climate Change networks, Food and Agriculture Organization
Inclusive participation (all societal segments)	Municipal technical assistance programmes, Civil society organizations	Participatory planning workshops, quotas, mentoring	Near-term	UN Women, UNICEF, Civil Society Organization networks
Climate services for farmers, pastoralists, and health workers	Ministry of Agriculture, Ministry of Health, Agricultural Extension Officers	Mobile applications, training modules, advisory services	Near-term to Medium-term	UNDP, Green Climate Fund Readiness, Bilateral Technical Assistance

Capacity-Building Roadmap for Libya (2025–2027)

Phase 1 — Quick Wins (0–6 months)

Focus: Establishing coordination, foundational training, and readiness.

1. Inter-ministerial standard operating procedures (SOPs) for data sharing and decision-making (National Committee on Climate Change, Sectoral Ministries).
2. Initiation of pilot climate budget-tagging experiments in the Ministry of Finance and one or two sectoral ministries.
3. Foundational training on DesInventar for personnel of the Executive Office of the National Committee on Climate Change and the Libyan National Meteorological Centre to commence systematic data capture aligned with Loss and Damage standards.
4. Awareness and inclusion workshops with municipal adaptation programmes (municipal adaptation plans), women's civil society organizations, and youth groups.

Outputs:

1. Adoption and mainstreaming of standard operating procedures.
2. First climate-tagged budget line items.
3. Mobilization of initial Loss and Damage dataset.
4. Conduct of at least 5 inclusive consultations.

Phase 2 — Consolidation (6–18 months)

Focus: Integration of systems and institutional establishment of learning.

1. Accreditation Readiness support for the Executive Office of the National Committee on Climate Change and the Ministry of Finance (credit standards, guarantees).
2. Upgrading monitoring network for the Libyan National Meteorological Centre (activation of 5–7 key stations, digital archives).
3. Development of indicators and baseline surveys for Monitoring, Evaluation, and Learning, consistent with Enhanced Transparency Framework/Biennial Transparency Reports reporting.
4. Integration of all societal segments and inclusion in planning cycles of the National Adaptation Plan and Nationally Determined Contributions.
5. Training municipal planners on climate risk-informed public investment management.

Outputs:

1. Submission of accreditation file to the Green Climate Fund/Global Environment Facility.
2. Climate monitoring upgrade with pilot open-access portal model.
3. Preparation of Monitoring, Evaluation, and Learning baseline reports (water, agriculture, health).
4. At least 30% of adaptation projects incorporated detailed monitoring and evaluation indicators.
5. Municipalities commencing submission of climate risk-informed budgets.

Phase 3 — Scaling (18–24 months)

Focus: Expansion and institutionalization of national systems.

1. Operationalization of pilot version of the National Adaptation Intelligence and Coordination Platform (NAICP) / Climate Risk Intelligence and Decision Support System (CIDSS)fed with sectoral and municipal data.
2. Full mainstreaming of climate budget tagging across priority sectors (water, agriculture, energy, Libyan National Meteorological Centre).
3. Launch of pilot Water–Energy–Food–Ecosystem (WEFE) Resilience Hub demonstration projects with integrated climate services for farmers, pastoralists, and health workers.
4. Establishment of continuous training units within universities (climate risk modeling, Monitoring, Evaluation, and Learning, Loss and Damage financing).
5. Integration of regional exchange programmes (Morocco/Middle East and North Africa region) in meteorology, adaptation planning, and climate finance.

Outputs:

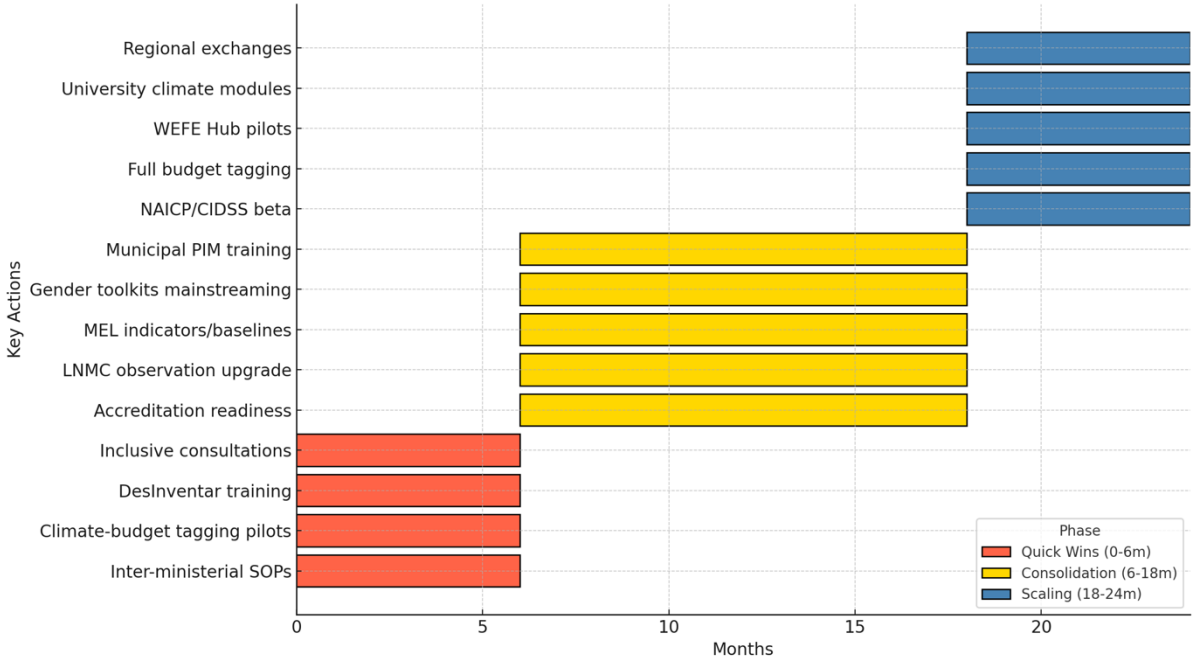
1. Operationalization of NAICP/CIDSS for Enhanced Transparency Framework/Biennial Transparency Reports reporting purposes.
2. Five to seven municipal Technical Adaptation Assistance Programmes (TAAP) with operational climate services.
3. University programmes with climate risk curricula.

4. Submission of Green Climate Fund/Global Environment Facility proposals with national implementation readiness.

Table 20: Roadmap Tracking Dashboard (MEL-Light)

Indicator	Baseline (2025)	Target (2027)	Frequency	Responsible Party
Percentage of ministries with climate-related standard operating procedures	0	≥60%	Semi-annual	National Committee on Climate Change (NCCC)
Number of automated/digital meteorological stations	<10	≥25	Annual	Libyan National Meteorological Centre (LNMC)
Percentage of budgets climate-tagged	0	≥40%	Annual	Ministry of Finance
Percentage of adaptation projects with classified monitoring and evaluation	<10	≥50%	Annual	National Committee on Climate Change (NCCC), Sectoral Ministries
Number of proposals submitted to Green Climate Fund/Global Environment Facility with national implementing entities	0	≥3	Annual	National Committee on Climate Change (NCCC), Ministry of Environment, Ministry of Finance

Figure 17: Libya's Capacity-Building Roadmap (2025–2027)



This roadmap illustrates Libya's phased capacity-building plan over 24 months. Quick wins (0–6 months) focus on establishing foundational coordination and data systems; the consolidation phase (6–18 months) works to institutionalize monitoring, evaluation, and learning (MEL) and credit standards; while the scaling phase (18–24 months) operationalizes national platforms (such as the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System) and launches pilot

Water–Energy–Food–Ecosystem (WEFE) Resilience Hubs, ensuring readiness for sustainable adaptation financing and Enhanced Transparency Framework reporting requirements.

5.6 Linkages with Monitoring, Evaluation, and Learning (MEL) Systems and Reporting under the Enhanced Transparency Framework (ETF)

MEL Alignment Libya's monitoring, evaluation, and learning framework integrates support tracking with adaptation outputs and outcomes to ensure that international assistance is linked to measurable progress. A focused set of indicators has been identified to capture the chain from inputs (financing, technical assistance) through outputs (institutional strengthening, implemented infrastructure) to effects/outcomes (risk reduction, resilience gains).

These indicators are grounded in established repositories and tools such as the National Adaptation Plan Monitoring, Evaluation, and Learning Toolkit (NAP MEL Toolkit), Adaptation Fund impact indicators, and UNFCCC guidance on adaptation metrics. Critically, they are designed to disaggregate data by sector, location, and social group (all societal segments), ensuring that equity considerations are systematically integrated.

Readiness for Biennial Transparency Reporting Data collected through the monitoring, evaluation, and learning system will be structured to populate the common reporting tables of the Enhanced Transparency Framework regarding support announced and required. Libya's Biennial Transparency Reports (BTRs) will therefore include:

1. Financial support Announced, disaggregated by source and instrument (grants, concessional loans, in-kind technical assistance).
2. Capacity-building support provided and retention.
3. Technology transfer projects implemented and operationalized.
4. Effective indicators, such as adaptation outputs and co-benefits realized.

By linking MEL indicators directly to Enhanced Transparency Framework tables, Libya ensures that support information is reported not only for compliance purposes but also contributes to the Global Goal on Adaptation by demonstrating actual risk reduction and resilience improvements. This approach also provides an auditable pathway for both local stakeholders and international partners.

Table 21: Libya's MEL–ETF Indicator Matrix (Support → Output → Outcome/Impact linked to ETF)

Input	Output	Outcome (Effect/Impact)	Joint Financing Fund Area
Adaptation financing (grants, concessional loans, in-kind technical assistance)	Number of projects/programmes initiated; infrastructure/services provided	Percentage of adaptation financing disbursed against committed amount, disaggregated by sector/location	Joint Financing Fund: Support announced – Financial Resources
Training and institutional support (ETF/MEL, secretariat, guarantees)	Number of personnel trained; number of institutions adopting systems	Percentage of trained personnel retained; percentage of ministries implementing climate budget-tagging systems	Joint Financing Fund: Capacity Building – Received
Technology cooperation (CTCN/TEC TA, pilot projects, digital systems)	Number of technical assistance activities completed; number of pilot projects launched	Percentage of technical assistance resulting in deployment; number of sectors adopting new technology (agriculture, water, health)	Joint Financing Fund: Technology Development and Transfer – Received
Local-level planning (municipalities) and TAAP facilitation	Number of municipal technical action plans incorporating climate risk screening, monitoring, and evaluation	Percentage of municipal plans integrating climate risk provisions, monitoring, evaluation, and learning	Joint Financing Fund: Adaptation – Implementation Information
Nature-based Solutions/Ecosystem-based Adaptation financing and coastal/oasis protection	Number of hectares of ecosystems restored; number of coastal defenses installed	Percentage of projects incorporating safeguards and outcome monitoring; average annual loss (AAL) reduction	Joint Financing Fund: Adaptation – Results/Indicators
Support related to Loss and Damage (risk transfer, social protection, recovery financing)	Number of insurance/risk transfer schemes piloted; number of households covered by shock-responsive social protection	Percentage of households with access to risk transfer/social protection; reduction in post-disaster recovery time	Joint Financing Fund: Adaptation – Results; Learning and Development Reports (CMA.4/CP.28)

Together, these indicators create a bridge linking support announced, adaptation action implemented, and learning cycles that feed iteratively into planning processes, budget allocation, and international reporting cycles, with continuous refinement over time.

Technical Note on Loss and Damage (L&D) in Libya's Initial National Communication (INC)

By clarifying the definition, support announced, identified needs, and intended access channels, Libya seeks to establish a transparent framework for Loss and Damage reporting and financing. Recognizing Loss and Damage as embodied vulnerability underscores the urgency of addressing climate impacts that can no longer be prevented through adaptation alone.

Definition and Context

Aligned with the outputs of CMA.4/CP.28 and the operationalization of the new Loss and Damage Fund, Libya defines Loss and Damage as climate-related harm that exceeds adaptation's limits, resulting in residual damages to lives, livelihoods, infrastructure, and ecosystems. Loss and Damage manifests in Libya most acutely through:

1. Extreme flooding and urban storm surge events, exemplified by the Derna disaster of 2023.
2. Coastal erosion and salinization, resulting in irreversible losses of agricultural land and groundwater stocks.
3. Desertification and drought impact that permanently undermine productive capacity in oases and pastoral systems.
4. Damage to cultural heritage and infrastructure, with implications for intergenerational equity and sustainable development.

Support Related to Loss and Damage Announced

To date, international support to Libya has arrived primarily as humanitarian assistance and post-crisis recovery following extreme events such as the Derna floods. However, these flows have not been systematically reported or classified under the Loss and Damage designation. No formal taxonomy exists to distinguish between adaptation, emergency relief, and Loss and Damage, constraining the ability to track trends and report under the Enhanced Transparency Framework.

Loss and Damage Needs Assessment

Building on climate risk assessment findings and sectoral analyses in Chapter 4, Libya identifies the following priority needs:

1. **Layered financing instruments** aligned with risk layers, including insurance and contingency funds to address recurring floods, droughts, and sand and dust storms.
2. **Shock-responsive social protection systems** to shield vulnerable populations from cascading livelihood losses.
3. **Resilient recovery investments** ensuring that post-disaster reconstruction incorporates climate resilience standards, thereby avoiding maladaptation.
4. **Loss data systems** tracking losses using the DesInventar methodology to capture systematic evidence on Loss and Damage, including average annual loss (AAL) for infrastructure, crops, and livelihoods.

Intended Access Channels

Libya intends to access Loss and Damage financing through:

1. The new Loss and Damage Fund operationalized under COP28 decisions, upon completion of procedural mechanisms.
2. **Complementary channels**, including the Green Climate Fund and African Development Bank facilities for disaster risk financing instruments and insurance mechanisms.

3. **Synergies with adaptation and development finance**, where resilience and recovery components intersect with National Adaptation Plan and Nationally Determined Contributions priorities.

Methodology

1. Loss and Damage will be integrated within Libya's MEL system as a distinct category complementing adaptation monitoring.
2. Loss data will be collected at municipal and sectoral levels using templates aligned with DesInventar standards.
3. Loss evidence will feed Biennial Transparency Reports, supporting alignment with Enhanced Transparency Framework common reporting tables and facilitating access to international Loss and Damage financing.

Figure 18: Loss and Damage Risk Layering Framework for Libya



***Explanatory Note**:* This diagram illustrates a tiered approach to addressing Loss and Damage, combining readiness and early warning, emergency response, insurance and risk transfer mechanisms, and resilient recovery and reconstruction. These layers reflect CMA.4/CP.28 guidance and provide entry points for directing future Loss and Damage financing.

Chapter 6. Constraints, Gaps, and Recommendations

Purpose and Scope

This chapter provides a transparent and systematic presentation of constraints and gaps currently limiting Libya's capacity to fully implement its climate commitments and proposes actionable recommendations to guide national planning and international support. The analysis covers barriers in institutional governance, technical capacity, finance access, and data quality—all of which directly affect compliance with UNFCCC obligations.

This chapter has been prepared in alignment with Decision 17/CP.8, which provides guidance for national communications from Parties not included in Annex I. In accordance with this decision, this section includes:

1. **Identification of constraints** in inter-ministerial coordination, technical systems, financing, and human capacity that impede progress in mitigation, adaptation, technology transfer, and capacity building.
2. **Documentation of data gaps**, including climate, hydrological, socioeconomic, and sectoral data availability and quality, explaining how these gaps affect national planning and reporting.
3. **Highlighting technology, financing, and capacity-building gaps**, linked to findings in Chapter 5 on support announced and needs.
4. **Formulation of clear, actionable recommendations**, consistent with Libya's medium- and long-term climate strategy and aligned with the Enhanced Transparency Framework under the Paris Agreement.
5. **Addressing cross-cutting issues** such as Male / Female equity, youth engagement, community participation, and integration of Monitoring, Evaluation, and Learning mechanisms.

In doing so, this chapter serves as a bridge between Libya's national circumstances and vulnerability assessments (Chapters 1 and 4), its greenhouse gas emissions inventory reporting (Chapter 2), and its identification of support needs and priorities (Chapter 5). It positions constraints and gaps not as rigid barriers, but as entry points for targeted international cooperation, helping to ensure that support is appropriate, effective, and aligned with the Global Goal on Adaptation and the broader goals of the UNFCCC and Paris Agreement.

6.1 Methodology

The identification of constraints, gaps, and recommendations in this chapter follows a structured and consistent methodology aligned with Decision 17/CP.8, which requires Parties not included in Annex I to report on constraints, gaps, and needs across mitigation, adaptation, technology transfer, and capacity building. The approach has been designed to ensure consistency, transparency, and traceability across chapters of this Initial National Communication.

Analytical Framework Constraints have been mapped across five dimensions (institutional, technical, financial, social/inclusion, and legal/policy) and assessed across three levels of governance: national, sectoral, and sub-national. This multidimensional framework enables nuanced understanding of how challenges interact vertically (from national to local levels) and horizontally (across sectors such as water, agriculture, energy, and health). It also facilitates identification of interlinkages, bottlenecks, and areas where targeted support can generate co-benefits across sectors.

Evidence Base The analysis is grounded in triangulated evidence from:

- **Chapter 1 (National Circumstances):** Institutional fragility, governance fragmentation, foundational capacities.
- **Chapter 4 (Vulnerability and Adaptation):** Sectoral and geographic vulnerability, priority adaptation measures, and data and systems gaps.
- **Chapter 5 (Needs and Support Announced):** International cooperation announced, capacity-building efforts, and outstanding financial and technical needs.

This triangulation ensures that identified constraints are not isolated observations but embedded within a systematic reading of Libya's climate governance landscape and risk profile.

Prioritization Criteria To ensure that recommendations respond to the most urgent and implementable needs, constraints have been ranked according to the following criteria:

1. **Risk severity:** The magnitude of the threat posed by the constraint to lives, livelihoods, and ecosystems if left unaddressed.
2. **Urgency:** Time-sensitivity of the barrier considering near-term adaptation and mitigation requirements.
3. **Feasibility:** Technical, political, and social capacity to overcome the barrier with available or accessible resources.
4. **Cost-effectiveness:** Potential efficiency gains from addressing the constraint compared to inaction or alternative interventions.
5. **Equity and inclusion:** Impacts on vulnerable groups, including women, youth, and marginalized communities.
6. **Maladaptation risk:** Likelihood that unaddressed constraints would lead to ineffective or harmful adaptation outcomes.

Through this methodology, the chapter presents an evidence-based, transparent account of Libya's structural constraints and gaps, while providing a defensible foundation for formulating recommendations and mobilizing international support.

6.2 Institutional and Governance Constraints

The institutional architecture for climate governance in Libya remains fragmented and constrained by overlapping mandates, weak coordination mechanisms, and persistent gaps between national and local levels. These governance challenges are intimately linked to state fragility and widening service delivery gaps, jointly undermining the effectiveness of adaptation and mitigation planning.

Fragmentation and Overlapping Mandates Climate-related functions are distributed across multiple ministries—Environment, Agriculture, Water Resources, Planning, and Local Government—without standard operating procedures (SOPs) ensuring coordination. The Data Inventory Assessment 01_2025 confirmed that sectoral data remains isolated within each institution, with limited interoperability between them, resulting in duplicated efforts.

Decentralization and Disparate Municipal Capacity Although Decision 1500 (2022) legally transferred environmental management and service delivery responsibilities to municipalities, the Data Inventory Assessment 01_2025 reveals acute disparities in local capacity. While some municipalities (such as coastal urban centers) have commenced preparation of regional technical adaptation action plans, most lack trained personnel, financial resources, and data access to conduct risk assessments or manage adaptation programmes. This disparity threatens to widen geographic gaps in vulnerability.

Policy Coherence and Legal Frameworks Libya's principal environmental law (Law 15/2003) predates the international climate system and does not explicitly provide for adaptation, mitigation, or resilience provisions. Climate strategies currently operate (National Adaptation Plan, Nationally Determined Contributions, Water Security Strategy 2025–2050) without a strong legal anchor, resulting in implementation fragmentation. The absence of a framework law on climate change and binding standards for climate-resilient infrastructure and environmental impact assessments creates uncertainty and undermines enforcement.

In summary, the Institutional and governance constraints in Libya reflect a mixture of structural fragmentation, weak legal frameworks, and fragile service delivery systems. Addressing these gaps requires structural reforms (legal alignment, adoption of a climate change framework law, operational strengthening of the National Committee on Climate Change) alongside targeted investments in municipal capacity building.

Table 22: Institutional Constraints Reference Matrix

Constraint	Evidence	Impact	Level	Actor	Maladaptation Risk	Corrective Measures
Weak municipal capacity under decentralization	Decision 1500 (2022) delegated roles, but most municipalities lack personnel, data, and budgets (Data Inventory Assessment)	Limitations on local adaptation planning and implementation	Local	Municipal councils, Ministry of Local Government	Medium – Risk that local plans remain symbolic or unfunded	Targeted training, budget support, and pilot technical assistance programmes in at-risk municipalities
Outdated legal framework	Law 15/2003 lacks climate provisions; National Adaptation Plan/Nationally Determined Contributions lack legal force	Weak enforcement of adaptation/mitigation; legal uncertainty	National	Ministry of Environment, Parliament	High – Investments proceed without resilience safeguards	Formulation and adoption of climate change framework law; update environmental impact assessment standards
Disparate service delivery	Fragmented political authority; unequal electricity/water/ health access	Reduced adaptive capacity; unequal access to water/electricity; weak service delivery	Local/National	Ministry of Local Government, Civil Society Organizations, Public Service Facilities	Medium – Service disparities limit adaptation	Expand inclusive participation; strengthen decentralized social protection and service delivery

6.3 Technical Constraints

Technical capacity for climate monitoring, research, and innovation remains limited. Systems encompassing hydrometeorological infrastructure, academic and research capacity, and community awareness are underdeveloped, directly weakening the state's ability to assess risk, design adaptation measures, and report under the Enhanced Transparency Framework.

Hydrometeorolocal Information Systems the Libyan National Meteorological Centre, under the Ministry of Transport, is the primary authority mandated with climate monitoring. However, the Data Inventory Assessment 01_2025 confirmed that the national monitoring network is outdated, with poor station coverage in southern and interior regions and frequent data interruptions. Long-term time series remain incomplete, particularly for temperature, precipitation, and hydrological flows, constraining climate model calibration and risk assessment. Data continues to be managed largely in paper archives, without a national open-access climate data portal or standardized digital protocols for inter-ministerial interoperability. This prevents integration of climate information into early warning systems and policymaking.

Academic and Institutional Research Capacity Libyan universities and research centers possess specialized expertise in agriculture, water sciences, and environmental studies. However, the Data

Inventory Assessment 01_2025 reveals systematic gaps in personnel trained in climate modeling, impact assessment, and early warning systems (EWS). Research outputs are fragmented and often project-based, with no formal channels to integrate findings into national planning. Without sustained funding and organized collaboration between academia and government, the knowledge base remains disconnected from evidence-based policymaking.

Local and Traditional Knowledge and Innovation Gaps Libyan oasis communities and pastoral systems possess valuable adaptive knowledge, including water harvesting techniques (foggara and cisterns), soil conservation, and drought adaptation mechanisms. However, the Data Inventory Assessment 01_2025 identified no systematic programme to document, validate, or integrate this knowledge into adaptation planning. Similarly, no dedicated innovation platform exists to connect researchers, practitioners, and policymakers in piloting or scaling climate technologies. The absence of structured mechanisms threatens erosion of local adaptive knowledge and limits opportunities for innovation in climate-resilient solutions.

Overall Assessment Technical constraints in Libya are not limited to infrastructure; they are systemic: outdated and incomplete data systems, fragmented research capacity, and underinvested local knowledge collectively weaken the nation's ability to design, implement, and monitor climate action. Overcoming these gaps will require targeted investments in monitoring infrastructure, capacity building for the Libyan National Meteorological Centre and academic institutions, and establishment of national programmes to integrate traditional knowledge and innovation within climate governance frameworks.

Table 23: Technical Gaps Inventory

System	Gap	Coverage	Quality (A–D)	Standard	Data Owner	Investment Required
Hydrometeorological and Hydrological Monitoring Network	Outdated stations; long-term time series incomplete; weak interoperability	Coastal and northern regions partially covered; south largely uncovered	C– Fragmented, inconsistent	Does not meet World Meteorological Organization minimum standards	LNMC (Ministry of Transport)	$$$ (Rehabilitation, digitization, coverage expansion)
Climate Data Management	Paper archives; no national portal; no open standards	Nationwide; not unified across ministries	D– Inaccessible, non-interoperable	No national protocol; non-compliant with ETF/CTF	LNMC / Ministry of Environment	$$ (Digital platform, open data system)
Academic Research Capacity	Limited specialists in climate modeling, early warning systems, adaptation economics	Concentrated in 3 principal universities	C– Limited expertise, insufficient funding	No applied research standards implemented	Universities (Tripoli, Sabha, Az-Zawiyah)	$$ (Training, research funding, partnerships)
Traditional Knowledge and Innovation	No documentation, validation, or integration programme	Oasis communities and pastoral systems	D– Knowledge at risk of loss	No standards	Ministry of Environment / Ministry of Agriculture (incubators)	$ (Pilot documentation programme, innovation center)

6.4 Financial Constraints and Public Financial Management Constraints

Libya faces constraints on mobilizing, directing, and tracking climate finance resulting from gaps in foundational public financial management strategy, institutions, and practices. These constraints result in weak access to international financing mechanisms, delayed project preparation, and weak linkage between implemented financing and measurable adaptation results within the Enhanced Transparency Framework. Aligned with Decision 17/CP.8, this section documents key barriers and provides a preliminary diagnostic directed toward readiness to guide corrective action.

6.4.1 Key Constraints

Absence of a national climate finance strategy and fragmented access pathways

No government-wide adopted strategy for climate finance exists that identifies priorities, instruments, and roles across ministries and municipalities. Access to international financing funds typically relies on international implementing entities; direct access pathways have not yet been activated, and no unified mechanism exists to align proposals with national priorities or the Global Goal on Adaptation.

Limited capacity to prepare "bankable" projects

Project pipelines lack pre-preparation: feasibility studies, climate risk screening, economic analysis (including resilience benefits), safeguard documentation, and mixed-finance structuring. Sectoral ministries and municipalities possess limited specialized teams for concept development, and no dedicated project preparation facility exists to take ideas from concept stage to investment readiness.

Absence of climate budget tagging and weak results-based management

Budgeting systems do not yet distinguish between climate expenditures (adaptation/mitigation/cross-cutting) nor track disbursement against outputs/outcomes. Without climate budget-tagging classification and a results chain for climate monitoring, evaluation, and learning integrated into the public financial management cycle, demonstrating effectiveness, avoiding duplication, or populating common reporting tables within the Enhanced Transparency Framework on support announced/required becomes difficult.

Short-term assistance and off-budget aid institutionally unanchored

A substantial share of climate-related support flows off-budget through UN agencies and projects with short implementation horizons. This undermines national ownership, complicates tracking, and limits scaling of successful pilots within national systems (such as facilities and municipal services).

Credit and guarantee gaps for finance access

Public financial management controls, procurement rules, and audit pathways, along with environmental and social safeguards, vary across institutions, slowing eligibility for concessional windows and climate funds. Standardized operating procedures for inter-ministerial cross-review (Finance–Planning–Environment) have not yet been institutionalized.

Weak development of risk-layered financing mechanisms for Loss and Damage

Contingency budgets do not incorporate sovereign risk financing, insurance solutions, and shock-responsive social protection systems within general financial planning. This weakens rapid response and

resilient recovery capacity, and limits Libya's ability to identify Loss and Damage needs within arrangements emerging from COP28.

6.4.2 Financial Readiness Diagnosis (Current Status)

Table 24: Financial Readiness Diagnosis (Current Status)

Issue	Current Status	Gap	Priority Actions	Horizon
Climate Finance Strategy	No comprehensive government-wide strategy; scattered references in National Adaptation Plan/Nationally Determined Contributions and sectoral plans	Absence of comprehensive policy to guide allocation, absorption, and accountability	Development of national climate finance strategy aligned with Vision 2030 and National Action Plan	Near-term (by end 2025)
Access to Green Climate Fund/Global Environment Facility/Adaptation Fund	Libya designated a Designated Authority (Ministry of Environment with focal points), but no entity accredited. Few project concept notes submitted	Low accreditation readiness; limited action plan development	Accreditation readiness programme establishment: development of credit systems and guarantees for entity eligibility	Near-term to Medium-term
Project Preparation Capacity	Reliance on external consultants for concept memos; weak internal technical teams	No institutional units for project preparation in ministries	Establishment of project preparation facility under the National Committee on Climate Change (NCCC)	Near-term
Budget Allocation and Tracking	No climate-dedicated budget in Ministry of Finance or sectoral budgets	Absence of tools to systematically track adaptation/mitigation expenditures	Pilot climate budget-tagging experiment in two ministries (water and agriculture/energy)	Near-term
Results-Based Management	**Monitoring, evaluation, and learning framework under design in National Adaptation Plan but disconnected from financial flows**	**Disconnection between financial inputs and adaptation outcomes**	**Linking MEL indicators to financial reporting and Enhanced Transparency Framework requirements**	**Medium-term**
Short-term Assistance Dependence	International support substantially in project form (UNDP, GIZ, FAO); limited scaling or institutionalization	Heavy reliance on fragmented donor projects; no sustainability mechanism	Development of multi-year programmatic approaches; integration into national budgets	Medium-term
Private Sector Engagement	Limited to non-existent; no mixed-finance tools; National Oil Corporation and environmental impact assessment center narrowly focused	Absence of enabling environment for private climate investments	Design of pilot public–private partnership/mixed-finance instruments in renewable energy and water	Long-term

Reading Guide: "Horizon" indicates the nearest feasible window for initiating and institutionalizing actions. Near-term actions are foundational enablers (such as climate finance strategy, budget classification, inter-ministerial procedures, project preparation facilities) that open space for medium-term expansion (blended finance, accreditation with multilateral funds, results-based financing). Each priority action should include:
(i) clear institutional owner.
(ii) annual milestones to track progress; and
(iii) Monitoring, Evaluation, and Learning indicators to monitor effectiveness (such as percentage of budget climate-tagged, number of investment-ready projects, percentage of on-budget aid, percentage disbursed versus committed).

This diagnostic is intended as a living tool. Horizons indicate enabling steps and flexible timing, not rigid deadlines. Progress will be tracked and consolidated through annual milestones and MEL indicators within Libya's Biennial Transparency Reports under the Enhanced Transparency Framework.

Technical Note

Table 18 above (Financial Readiness Diagnosis) presents a preliminary evidence-based diagnosis based on currently available evidence (Data Inventory Assessment 01_2025, National Adaptation Plan drafts, adaptation chapters in Nationally Determined Contributions, and sectoral strategies). Currently, Libya does not possess unified or verifiable data on climate finance flows, budget classification, or accredited access to multilateral funds. Therefore:

1. Inputs should be read as qualitative signals of readiness gaps, not as complete or quantitative assessment.
2. Numerical values (such as classified financing volumes, actual project preparation costs, absorption rates) will only become available following implementation of institutional reforms and classification pilots.
3. Table format is designed for iterative updating by the National Committee on Climate Change and Ministry of Finance as part of National Adaptation Plan/MEL cycles and Enhanced Transparency Framework reporting.

In this way, the table functions as a practical framework enabling Libya to demonstrate transparency, prioritize urgent needs, and request targeted support from international partners, while acknowledging that cost details and readiness simulations remain under development.

Implications for Enhanced Transparency Framework Reporting and Finance Access Implementation of the above diagnosis will enable:

- **Tracking aligned with Enhanced Transparency Framework** of support received/required (committed versus disbursed, disaggregated by instrument/use/sector/region), improving inclusiveness and comparability in Biennial Transparency Reports.
- **Increased financing bankability and accelerated access** to financing for priority actions (such as the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System, water security, urban stormwater management, coastal resilience).
- **Institutionalization of Loss and Damage risk layering** within financial frameworks, clarifying future Loss and Damage financing channels and linking activation systems to DesInventar/average annual loss metrics.
- **Strengthening national ownership** through increased on-budget climate expenditure and MEL integration into the public financial management cycle, enhancing accountability and learning.

6.5 Data Gaps and Quality

Robust data systems are essential for climate risk assessment, adaptation planning, and meeting reporting obligations under the UNFCCC and Paris Agreement. The current data landscape in Libya, as confirmed by the Data Inventory Assessment (2025) and complementary sectoral strategies (such as Water Security Strategy 2025–2050, Biodiversity Strategy 2023–2030), is characterized by fragmentation, gaps in temporal and spatial coverage, weak quality assurance/quality control procedures, and limited public availability. These deficiencies constrain the ability to produce reliable baselines, monitor progress, and generate consistent inputs for the Enhanced Transparency Framework.

Climate, Hydrological, and Land Data

- Historical climate and hydrological time series are incomplete, with many stations inoperative since 2011. Data continuity and spatial coverage (particularly in the south and coastal valleys) are insufficient to characterize extreme events or long-term trends.
- Monitoring networks lack standardized calibration protocols and systematic data metadata archiving. Quality assurance/quality control procedures are unorganized.
- Data remain confined within institutions (such as the Libyan National Meteorological Centre and Ministry of Water Resources) with limited interoperability and no national open-access portal.
- Soil degradation and desertification data are fragmented and often rely on remote-sensing snapshots without systematic validation.

Socioeconomic and Vulnerability Data

- National statistics are irregular and often outdated. Household surveys with spatial, age, and Male / Female disaggregation are limited, constraining vulnerability mapping.
- Data gaps are most acute in southern and border regions, where vulnerability intersects with climate exposure.
- Climate-sensitive vulnerability data are scarce, despite their importance in guiding targeted adaptation and comprehensive policy design.

Implementation and Results Data

- As highlighted in Chapter 4 (Vulnerability and Adaptation), the absence of systematic baselines prevents measurement of adaptation outcomes (such as hectares restored, population covered by early warning systems).
- Current reporting is project-driven, donor-directed, and rarely institutionalized within national monitoring systems, creating discontinuities and preventing aggregation to national indicator levels.

Support Announced and Enhanced Transparency Framework Reporting

- As noted in Chapter 5 (Needs and Support Announced), reporting on international climate finance and capacity-building support lacks detailed, auditable datasets.
- Information is not yet structured systematically to populate Enhanced Transparency Framework common reporting tables, increasing risks of duplication and inconsistency between commitments and disbursement.

Minimum Data Quality Checklist

To ensure consistency, transparency, and comparability of datasets supporting Libya's Initial National Communication, National Adaptation Plan, and future Biennial Transparency Reports, all datasets must comply with the following minimum checklist, consistent with the Enhanced Transparency Framework of the Paris Agreement and relevant UNFCCC guidance:

Table 25: Minimum Data Quality Checklist

Item	Description
Source	Primary provider/institution; traceability to recognized national or international bodies
Baseline Year	Reference year for dataset, aligned with inventory and adaptation reporting requirements
Precision (Spatial/Temporal)	Geographic coverage (national/municipal/sectoral) and temporal frequency (e.g., daily, monthly, annual)
Method	Data collection/estimation methodology, consistent with IPCC guidelines (2006, revised 2019) and UNFCCC reporting templates
Uncertainty	Confidence intervals, error ranges, and documented known biases, per good practice guidance
QA/QC Protocol	Verification and calibration procedures applied, referencing Decision 18/CMA.1 (transparency annex on support and adaptation)
Responsible Authority	Designated national institution for ownership, supervision, and long-term maintenance
Access Policy	Licensing rules, interoperability, and public access consistent with transparency, accountability, and participation principles (Decision 1/CMA.3, Glasgow Climate Pact)

Reference Standards

- **UN Framework Convention on Climate Change Article 12.1:** Parties commit to communicating information on data and methodologies to ensure comparability.
- **Paris Agreement Article 13 (Enhanced Transparency Framework):** Requires clarity, consistency, comparability, completeness, and accuracy in reporting.
- **Decision 18/CMA.1 (Katowice Rulebook):** Provides modalities, procedures, and guidance for reporting under the Enhanced Transparency Framework, including data quality and uncertainty handling.
- **Decision 1/CMA.3 (Glasgow Climate Pact):** Emphasizes transparency and calls for improved quality and accessibility of climate information.
- **Decision 1/CMA.4 (Sharm El-Sheikh Implementation Plan):** Stresses data integrity, human rights, equity, and inclusion in climate action.
- **Decision 1/CMA.5 (Global Stocktake, Dubai 2023):** Affirms the role of robust and transparent data systems in assessing collective progress.
- **Technical Guidance on National Adaptation Plans (LEG, 2012; updated):** Regards reliable data as foundational for adaptation planning and monitoring.
- **Adaptation Committee and NAP MEL Toolkit (2024):** Emphasizes that transparent, quality-assured data support iterative monitoring, evaluation, and learning.
- **IPCC Guidance (2006; revised 2019):** Establishes global standards for consistency, comparability, and uncertainty assessment in greenhouse gas inventories.

Strategic Rationale Libya recognizes that addressing data gaps and quality represents a foundational condition for advancing climate governance. Reliable, interoperable, quality-assured data are necessary for:

- **Risk assessments (Chapter 4):** Robust evidence on hazards, exposure, and vulnerability.
- **Adaptation measure design and costing (Chapters 3–4):** Reliable baselines and monitoring frameworks.
- **Mobilizing support (Chapter 5):** Transparency is a prerequisite for accessing climate finance (GCF, GEF, Adaptation Fund, Loss and Damage Fund).
- **Enhanced Transparency Framework and Global Stocktake:** Full participation requires unified, available, and verifiable data.

This commitment reflects Libya's alignment with the Enhanced Transparency Framework, the Global Goal on Adaptation (Decision 2/CMA.5), and emerging Loss and Damage reporting frameworks.

Technical Note:

Data Fields, MEL System, and BTR Reporting Links. This note clarifies how four priority data fields (climate/hydrological/land, socioeconomic vulnerability, implementation/outcomes, support announced) integrate into Libya's national Monitoring, Evaluation, and Learning (MEL) system and connect to Enhanced Transparency Framework reporting and Biennial Transparency Reports.

Data Fields and Flow into MEL System

- **Climate, Hydrological, and Land Data**
  - Include time series for temperature, precipitation, evapotranspiration, groundwater levels, land degradation indicators, and soil/vegetation monitoring.
  - Provide baselines and trend analysis for sectoral vulnerability assessments (see Chapter 4).
  - Serve within the MEL system as indicators of hazard and exposure (e.g., number of days exceeding heat thresholds; percentage of aquifers below critical depletion levels).

- **Socioeconomic and Vulnerability Data**
  - Include household income, poverty, age, spatial detail, displacement/migration flows, and service access.
  - Central to monitoring sensitivity and adaptive capacity, consistent with Male / Female and inclusion tools in the National Adaptation Plan.
  - The MEL framework uses them for equity measures (e.g., percentage of women/youth benefiting from adaptation programmes; percentage of vulnerable households covered by early warning).

- **Implementation and Results Data**
  - Cover outputs and outcomes of adaptation measures (hectares restored, beneficiaries, protected infrastructure).
  - Derived directly from project reports, aligned with priority measures in Chapter 4.
  - The MEL system aggregates them into national adaptation indicators to track progress toward the Global Goal on Adaptation.

- **Support Announced Data**
  - Include financial, technology, and capacity-building flows, consistent with reporting formats in Chapter 5.
  - The MEL framework records commitments and disbursement, enabling effective tracking and absorption capacity monitoring.
  - Ensures alignment with common reporting tables (CTFs) required under the Enhanced Transparency Framework.

The MEL system operates as a central data hub that:

- Unifies the four domains using common metadata and QA/QC protocols and open data standards where possible.
- Applies an indicator structure (input → output → outcome → impact) linking resources received to achievements.
- Enables iterative learning by identifying data gaps, uncertainty, and trends in adaptation effectiveness.

Link to Enhanced Transparency Framework/Biennial Transparency Report

1. **ETF Alignment:** The MEL system is designed to feed Enhanced Transparency Framework common reporting tables on adaptation, support required/announced, and effects.
2. **BTR Readiness:** The MEL system ensures data source and methodology traceability, enabling Libya's future Biennial Transparency Reports to meet inclusiveness, consistency, comparability, and transparency standards.
3. **Loss and Damage Link:** Through integration with disaster loss data aligned with DesInventar standards, the MEL system will also support reporting on climate-related losses, providing evidence for accessing emerging Loss and Damage funding windows.

Libya will build a structured data architecture across these four fields; thereby the national MEL system becomes the central interface between national adaptation monitoring and international transparency commitments. This dual function ensures Libya improves national decision-making while building credibility and readiness to mobilize international support under the Paris Agreement.

Figure 19: Data–MEL–ETF Interconnection

Four national data fields—climate/hydrological/land, socioeconomic vulnerability, implementation/results, and support received—feed Libya's national Monitoring, Evaluation, and Learning system. This ensures systematic tracking of adaptation progress, integration of Loss and Damage evidence, and alignment with the Enhanced Transparency Framework. Data flows are integrated into Biennial Transparency Reports through common reporting tables, enhancing accountability and international cooperation.

6.6 Recommendations

This section presents organized and prioritized recommendations to address institutional, technical, financial, and inclusion gaps identified in preceding sections. Proposals are designed to strengthen Libya's capacity to implement commitments under the UNFCCC and Paris Agreement, align with the National

Adaptation Plan and Nationally Determined Contributions, and prepare for effective reporting under the Enhanced Transparency Framework.

6.6.1 Governance and Legal Framework

1. **Adoption of a framework law on climate change** establishing binding provisions on adaptation, mitigation, and financing, supported by implementing regulations addressing:
    a. **Climate-responsive environmental impact assessment (EIA)**
    b. **Design standards for climate-resilient infrastructure**
    c. **Climate budget tagging and financial reporting**
2. **Strengthening the mandate of the National Committee on Climate Change** through:
    a. **Establishment of standard operating procedures (SOPs)** for inter-ministerial coordination
    b. **Data-sharing agreements** with sectoral ministries and municipalities
    c. **Formalized consultation mechanisms** with the private sector, academia, and civil society organizations

Rationale: Unifying legal foundations and clarifying authorities will reduce fragmentation, improve accountability, and provide legal certainty for investment in climate-resilient development.

6.6.2 Data, Science, and Climate Services

1. **Upgrade the Libyan National Meteorological Centre (LNMC) and hydrometeorological monitoring network** through:
    a. Automated stations, digital archives, and interoperability protocols
    b. Training in climate modeling, forecasting, and early warning system operations
2. **Operationalize the National Adaptation Intelligence and Coordination Platform (NAICP) and Climate Risk Intelligence and Decision Support System (CIDSS)** as a national climate information gateway with open data standards
3. **Establish a national programme on traditional knowledge and innovation** encompassing:
    a. Documentation and scaling of water management practices, soil rehabilitation, and local adaptation techniques
    b. Innovation platforms connecting academia, practitioners, and policymakers
4. **Rationale:** Reliable data and knowledge systems are the foundation for sectoral planning, monitoring, evaluation, and learning, and Enhanced Transparency Framework reporting; without them, Libya cannot demonstrate vulnerability assessments or measure adaptation effectiveness.

6.6.3 Finance and Investment

1. **Adoption of a climate finance strategy** with prioritized project pipeline aligned with National Adaptation Plan and Nationally Determined Contributions
2. **Strengthening readiness for international climate financing (GCF, GEF, Adaptation Fund)** through:
    a. Development of credit systems and guarantees for accreditation
    b. Strengthening of project preparation facilities (PPF)
3. **Introduction of climate budget tagging** and integration of climate risk screening into public investment management

4. **Establishment of sub-national (municipal) financing mechanisms:**
    a. Competitive municipal funds and adaptation windows
    b. Capacity building on credit standards at local level

Rationale: Expanding climate finance access and strengthening public financial management will unlock projected resources for resilience and reduce dependence on short-term, project-based aid.

6.6.4 Capacities and Inclusion

1. **Continued establishment and development of sectoral adaptation and mitigation committees/working groups** in key ministries (water, agriculture, health, environment, energy, planning/finance/transport)
2. **Implementation of a continuous training programme** covering monitoring, evaluation, and learning, risk screening, safeguards, and climate-resilient public investment management
3. **Adoption of a women in climate action policy** encompassing:
    a. Participation quotas in decision-making bodies
    b. Male / Female-disaggregated indicators by sector

Rationale: Addressing structural capacity deficits and institutionalizing women's participation will ensure inclusive adaptation planning and prevent maladaptation that deepens vulnerability.

6.6.5 Risk Management and Fragility

1. **Integration of conflict and fragility dimensions** into climate project design and prioritization, with safeguards for:
    a. Secure access to project sites
    b. Operational continuity during instability
2. **Development of protocols for climate-driven displacement and migration,** linked to national social protection strategies
3. **Strengthening of layered, multi-hazard risk financing mechanisms** (preparedness, response, risk transfer)

Rationale: Climate action in Libya cannot be separated from fragility. Integrating conflict sensitivity and risk-layering logic into adaptation projects will enable resilience even under dual governance and local instability.

Table 26: Priority Measures Prioritization Matrix

Measure	Impact on Risk (1–5)	Feasibility (1–5)	Relative Cost (1–5↓)	Equity (1–5)	Total Score
Adoption of climate change framework law + EIA/resilience standards	5	4	2	4	**11**
Strengthen NCCC with SOPs and data-sharing agreements	5	4	2	3	**10**
Update LNMC hydrometeorological network (automation, archives)	5	3	4	3	**7**
National climate information portal (operationalize NAICP/CIDSS)	5	4	3	3	**9**
Traditional knowledge and innovation programme	3	3	2	5	**9**
Climate Finance Strategy and Financial Flows (Aligned with the National Adaptation Plan and Nationally Determined Contributions)	5	4	3	3	**9**
Climate budget tagging and resilient design standards for public investment management	5	4	2	4	**10**
Municipal adaptation financing mechanisms (competitive funds)	4	3	3	5	**9**
Climate units/working groups in ministries + continuous training	4	4	2	4	**10**
Adoption of women and climate policy + quotas/indicators	4	3	2	5	**10**
Integration of fragility/conflict dimensions into project design	5	3	3	4	**9**
Displacement and migration protocols linked to social protection	4	3	3	5	**9**
Layered risk financing (preparedness/response/insurance)	5	3	4	4	**8**

Score Interpretation:

1. **High-scoring measures (10–11)** → Immediate enablers: Legal frameworks, institutional coordination, finance tagging, climate units, women's equity and inclusion
2. **Medium-scoring measures (8–9)** → Critical but requiring phased sequencing: LNMC update, NAICP/CIDSS, municipal financing, fragility protocols
3. **Lower-scoring measures (7)** → High-impact but higher-cost or technically constrained (hydrometeorological update) → Implement in phases with external support

The following figure 22 provides a quick snapshot of high-impact, implementable, and equitable measures (climate law, NAICP/CIDSS, climate finance strategy) that should be prioritized against higher-cost or lower-feasibility measures requiring phased sequencing.

- **Horizontal axis** = Feasibility (1–5)
- **Vertical axis** = Impact on Risk (1–5)
- **Bubble size** = Relative Cost (larger = costlier)
- **Bubble color** = Equity score (lighter = higher equity)

Figure 20: Measure Prioritization (Impact vs. Feasibility; Size=Cost; Color=Equity)

The prioritization matrix highlights a cluster of measures with strong risk reduction capacity and robust implementability, particularly the climate framework law, operationalization of the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System (NAICP/CIDSS), and climate finance strategy. These actions are characterized by low to moderate costs and high equity scores, making them suitable for immediate implementation.

Conversely, higher capital-cost measures—such as hydrometeorological system upgrade and municipal financing windows, while important, require phased sequencing and readiness support before full deployment. The bubble diagram thus illustrates a balanced pathway: advancing quick-win enabling reforms in the near term, while establishing foundations for higher infrastructure investments and service delivery measures over the medium term. This approach aligns with Libya's National Adaptation Plan and Nationally Determined Contributions priorities and enhances transparency for international partners under the Enhanced Transparency Framework.

6.7 Implementation Roadmap (24 Months)

The following roadmap translates Section 6.6 recommendations into a sequenced package of short-term enabling actions ("quick wins"), consolidation steps, and scaling measures. It is designed to advance governance, data, finance, and inclusion within a two-year horizon, delivering early outputs that build confidence with stakeholders and international partners, while laying foundations for longer-term transformation.

Quick Wins (0–6 months)

1. Establish inter-ministerial standard operating procedures for data sharing and coordination (National Committee on Climate Change with sectoral ministries)
2. Complete national data inventory and adopt minimum data quality/metadata standards across climate, hydrological, and socioeconomic datasets
3. Create finance committee within Ministry of Finance/Environment to prepare project concepts and pilot climate budget-tagging experiments

Consolidation (6–18 months)

1. Launch pilot version of the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System portal, integrating hydrometeorological, socioeconomic, and open-access data protocols
2. Execute climate budget-tagging pilots in at least two ministries (water and agriculture), supported by international technical assistance
3. Issue climate-responsive environmental impact assessment guidance and resilience standards for infrastructure, consistent with Vision 2030

Scaling (18–24 months)

1. Implement Phase 1 of hydrometeorological network upgrade (automated stations, digital archiving, real-time data feeds)
2. Submit 3–5 concept notes to GCF/GEF addressing priority measures (water, coastal resilience, health)
3. Operationalize national platform for innovation and traditional knowledge, linking academia, municipalities, and communities

MEL-Light Dashboard (2025–2027)

Table 27: MEL-Light Dashboard (2025–2027)

Indicator	Baseline	Target	Frequency	Responsible Party
Percentage of ministries with standard operating procedures for climate data	0	≥60% (12 months)	Quarterly	NCCC
Project portfolio with unified concept notes	0	≥5 (18 months)	Semi-annual	MoEnv / MoF
Digital climate time series (years-stations)	Determined later	+X% (24 months)	Semi-annual	LNMC
Ministries piloting climate budget-tagging	0	≥2 (18 months)	Annual	MoF
NAICP/CIDSS pilot version online	No	Yes (12 months)	Annual	NCCC + LNMC

This roadmap is a living tool, updated annually through the national Monitoring, Evaluation, and Learning process and directly linked to Enhanced Transparency Framework/Biennial Transparency Reports. It provides clear accountability signals, aligning short-term outputs with long-term climate governance architecture under Libya's National Adaptation Plan and Nationally Determined Contributions.

Chapter 7. Social Responses to Climate Change and Just Transition

This chapter operationalizes principles of equity, human rights, and inclusion in Libya's climate action, ensuring that adaptation and mitigation efforts respond to the diverse needs and contributions of Libyan society, including populations most vulnerable to climate impacts. It aligns with the Glasgow Transparency Framework and inclusive language adopted under Decision 1/CMA.3 (Glasgow Climate Pact) and Decision 2/CMA.5 (Sharm El-Sheikh Implementation Outcome Plan), as well as the Global Goal on Adaptation (GGA), which emphasizes country-led, participatory adaptation processes.

Cross-cutting issues are integral to interpreting vulnerability (see Chapter 4), prioritizing adaptation and mitigation measures (see Chapter 5 on needs and support announced), and tracking progress under the Enhanced Transparency Framework. Evidence in Chapter 1 has already highlighted disparities among different population groups and geographic regions in climate risk exposure, including differentiated impacts on livelihoods and resource-stressed areas. Similarly, governance and data constraints identified in Chapter 6 underscore the importance of adopting inclusive approaches to ensure more complete, accurate, and representative information.

By devoting a dedicated chapter to social dimensions, Libya affirms that equity and just transition are not add-ons but prerequisites for effective climate action. Engaging and supporting communities, ensuring just transition protections, enables climate policies that are socially sustainable, nationally legitimate, and internationally consistent with evolving UNFCCC guidance on equity and transparency. This framing ensures that future policies and resource mobilization reflect both diverse vulnerabilities and the transformative potential of all societal segments.

7.1 Principles and Approach

Libya's approach to cross-cutting issues in climate action is grounded in equity and human rights, ensuring recognition of all societal groups and vulnerable populations alike in their diverse vulnerabilities and their contributions to adaptation and mitigation. The guiding principles applied in this chapter are:

- **Non-Discrimination** All climate policies and programmes must avoid reinforcing inequalities based on geographic location or demographic characteristics.
- **Do-No-Harm** Adaptation and mitigation measures will be screened to ensure they do not exacerbate social links weakening or environmental degradation.
- **Meaningful Participation** All groups will have organized opportunities to participate in the design, implementation, and monitoring of climate action.
- **Free, Prior, and Informed Consent (FPIC) Equivalent** In contexts involving tribal or oasis communities, Free, Prior, and Informed Consent principles will guide participation to ensure legitimacy and respect for customary rights.

- **Conflict Sensitivity** Climate action will be designed to mitigate tensions over scarce resources such as water, land, or energy, acknowledging Libya's fragility context.
- **Benefit-Sharing** Resource mobilization and project implementation will include explicit mechanisms ensuring equitable benefit distribution across all population groups and between urban and rural areas.

Methods

1. **Inclusivity and Responsiveness: Disaggregated Inclusion Analysis** For each sectoral vulnerability and specific adaptation measure identified in Chapters 4 and 6, explicit analysis will identify who benefits and who bears costs. For instance, heat and urban health measures will be examined to assess benefits across different age groups.

2. **Materiality Filter on Exposure** Using evidence from Chapter 1 (National Circumstances) and Chapter 4 (Vulnerability), populations most exposed to specific hazards will be identified:

a. **Water scarcity:** Disproportionate impacts on oasis communities and rural populations dependent on groundwater
b. **Heat stress:** High risks for outdoor workers, elderly, and dense urban settlement inhabitants
c. **Displacement:** Pressures on internally displaced people and returnees
d. **Service gaps:** Inequalities in access to health, energy, and water services, especially in peripheral municipalities

3. **Data Disaggregation Plan** To advance equity and accountability in monitoring, all new datasets produced through Initial National Communication, National Adaptation Plan, or Nationally Determined Contributions processes will adopt minimum disaggregation standards by:

    a. Demographic categories
    b. Age groups (children-youth, working age, elderly)
    c. Geographic location (urban, coastal, oasis, municipal level)
    d. Disability status where feasible and consistent with professional or social ethics

This systematic framing ensures cross-cutting issues are methodically integrated into vulnerability interpretation (Chapter 4), adaptation measure prioritization and costing (Chapter 5), and constraints/recommendations (Chapter 6). By adopting these principles and approaches, Libya signals its commitment to climate action that is not only technically sound but also socially equitable, nationally legitimate, and internationally consistent with evolving UNFCCC guidance on equity and transparency. Inclusivity across all demographics, age, and vulnerable population groups is ensured across sectors, aligned with Enhanced Transparency Framework and Global Goal on Adaptation requirements.

The following diagram illustrates how guiding principles (non-discrimination, do-no-harm, equity, meaningful participation, Free, Prior, and Informed Consent equivalent, conflict sensitivity, and benefit-sharing) feed the analytical approaches and data systems that shape Libya's inclusive climate action. The

approach ensures integration of all demographics, age, and vulnerable population groups across sectors, aligned with Enhanced Transparency Framework and Global Goal on Adaptation requirements.

7.1.2. National Social Justice Strategy

The National Social Justice Strategy (2025/2027), developed by the Ministry of Planning with support from ESCWA, aims to enhance social resilience with a focus on vulnerable groups. The strategy was finalized in 2024 in collaboration with the United Nations Development Programme (UNDP) and the National Council for Economic and Social Development.
This strategy targets the following groups:

- The elderly (both employed and unemployed)
- Women (widows, divorcees, and female heads of households)
- Job-seeking youth
- Internally displaced people due to climate conditions

The objective of this National Social Justice Strategy is to strengthen the resilience of the entire Libyan society in the face of climate change. It also enables the integration of an approach that accounts for disparities among these groups, by giving special attention to those most vulnerable to climate-related risks.

7.1.3. National Social Protection Strategy

The Ministry of Social Affairs and the National Council for Economic and Social Development adopted the National Social Protection Strategy (2025/2030), considering disasters resulting from climate change and supporting social resilience measures.

Main objectives:

- Establish an advanced social protection system to cope with shocks and ensure independent financial sustainability
- Develop a shock database as part of the general national social protection system
- Enhance the inclusiveness of provided programs and expand both horizontally and vertically the pillars of the existing social protection system
- Reactivate the case management system for all new vulnerable groups during times of crisis
- Implement regular reviews and evaluations of permanent and emergency social protection programs

7.2 Integration within Policies and Institutions

Inclusion-focused units (established in the Prime Minister's Office) and officials at sectoral and municipal levels have begun supporting social inclusion, though coordination with climate policy remains limited. At the programmatic level, Libya has adopted national plans on social inclusion, peace, and security, highlighting the role of all societal groups in peacebuilding and governance.

Work Areas

To address gaps and advance inclusivity and responsiveness, priority work areas include:

1. Expanding access to safe water points, sanitation facilities, and climate-resilient health services (such as community health support and cooling centers during heat waves)
2. Supporting producer groups, financing channels, and entrepreneurship programmes targeting small and medium enterprises and household producers across multiple geographic areas and in oasis, agricultural, and pastoral systems, ensuring access to technology, advisory services, and climate-resilient inputs
3. Incorporating targets for balanced representation and inclusive participation within municipal adaptation plans, National Adaptation Plan and Nationally Determined Contributions implementation teams, and sectoral working groups

4. Strengthening civil society organizations and community initiatives, including producer households, as implementation partners in adaptation projects, with targeted training in monitoring, evaluation, and learning, climate budget-tagging, and project design

Data and Indicators

Strengthening the evidence base is essential for accountability and transparency. Examples of measurable indicators include:

- Percentage of adaptation projects incorporating comprehensive action plans for all community segments in adaptation
- Percentage of adaptation and mitigation projects reporting beneficiaries disaggregated by community category
- Number of civil society organizations engaged as implementation partners in adaptation projects

Finance and Capacity Building

Access to climate finance remains a critical gap. Women's organizations and women-led producer households face structural barriers in proposal development and meeting accreditation windows and guarantee requirements, limiting capacity to access financing from the Green Climate Fund, Global Environment Facility, or bilateral channels. Capacity-building efforts are needed in three areas: (1) technical, enabling women's civil society organizations to develop proposal design and monitoring, evaluation, and learning skills; (2) credit/financial, meeting standards for accredited entities; and (3) safeguards, ensuring protection of women's rights and preventing maladaptation. Dedicated financing windows or facilities for women-led adaptation initiatives will help unlock these capacities and enhance climate finance effectiveness in Libya.

Table 28: Libya's Climate Vulnerability Scorecard

Dimension	Current Gap	Priority Work Areas	Illustrative Indicators Linked to MEL/ETF	Financing and Capacity Needs
Access to Resources and Services	Limited credit; weak access to potable water/energy/health services in rural and oasis areas	Climate-resilient services: safe water points, cooling/health shelters, reliable energy supply	Number of women accessing climate-resilient services; percentage of projects with disaggregated service data by community category	Dedicated grant windows/technical assistance for women-led civil society organizations; safeguards for equitable service delivery
Livelihoods and Economic Participation	Weak value chains and formal financing	Women-led livelihood diversification (cooperatives, credit windows, drought-resistant crops, value chains)	Number of women accessing climate finance credit; percentage of women in producer groups	Capacity building on proposal development, credit standards; concessional microfinance facilities
Decision-Making and Governance	Underrepresentation in NCCC/sectoral committees and municipal Technical Adaptation Assistance Programmes (TAAP)	Equity targets in adaptation committees; women in NAP/NDC teams	Percentage of women in climate governance bodies; number of women-led civil society organizations participating in pilot project implementation	Budget for inclusion training; Male / Female focal points in ministries and municipalities
Knowledge and Data	Limited disaggregated data; absence of data on all population groups affected by climate	Integration of equity data (women/men) in NAICP/CIDSS; systematic disaggregation in monitoring and evaluation (Male / Female, age, location)	Percentage of adaptation projects incorporating equity action plans for population segments; percentage of projects reporting Male / Female-disaggregated outcome indicators	Technical support for Male / Female-responsive monitoring, evaluation, and learning; twinning with regional Male / Female observatories

Usage Notes

- **Format:** One-page Word table with shaded column headers
- **Indicators:** All aligned with Enhanced Transparency Framework (reportable in Biennial Transparency Reports)
- **Purpose:** Functions as a diagnostic and progress-tracking tool for women's empowerment and social equity mainstreaming within adaptation/mitigation

- **Update Cycle:** Biennial, synchronized with national monitoring, evaluation, and learning reviews and Enhanced Transparency Framework reporting

7.3 Community Engagement/Participation

In the Libyan context, "communities" refer to rural populations in oases and desert margins, agricultural-pastoral families in the arid interior, coastal fishing communities along the Mediterranean, and conflict-affected municipalities in the south and border regions. They are disproportionately exposed to climate impacts due to the lack of services, livelihood fragility, and high dependence on natural resources. Chapter 1 documented that many of these groups live in areas suffering degraded infrastructure, limited state presence, and repeated disruptions to water, energy, and mobility systems.

Interface of Hazards and Knowledge

Community-specific, acute exposures manifest distinctly. In oasis systems, declining and salinizing groundwater threatens both domestic supply and irrigation simultaneously. On dry plains, desertification and rangeland loss affect pastoral communities and migration routes, while coastal fishing communities face sea-level rise, violent storms, and loss of spawning habitats. Service collapses—health, education, municipal services—compound these hazards, particularly in conflict-affected areas.

Despite these vulnerabilities, communities possess adaptive knowledge: foggara (underground water channels), cistern-based water harvesting, and collective land management practices. Yet this knowledge remains insufficiently documented, fragmented across locations, and rarely integrated into national policies or adaptation programmes. The absence of a systematic programme to document and validate traditional knowledge threatens loss of practices that could complement modern adaptation measures.

Participation Architecture

Emerging governance frameworks provide entry points for organized participation. Municipal adaptation plans and Technical Adaptation Assistance Programmes (TAAPs) are core instruments expected to embed community voices in local adaptation programming. Civil society organizations, including women's and youth groups, play roles in awareness-raising and pilot projects, though their engagement in decision-making remains variable.

New institutional platforms (specified in National Adaptation Plan and Nationally Determined Contributions), such as the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System, enable co-production of risk information with communities, allowing local data and community perspectives to feed early warning and national planning systems. Benefit-sharing arrangements, alongside grievance mechanisms, will be necessary to ensure equitable distribution of adaptation resources and foster social trust in fragile areas.

Indicators

Progress in community engagement will be tracked through measurable indicators linked to monitoring, evaluation, and learning and Enhanced Transparency Framework reporting, including:

1. Percentage of Technical Adaptation Assistance Programmes incorporating comprehensive representation of all community segments
2. Percentage of adaptation measures using locally validated climate or knowledge data
3. Percentage of pilots scaling traditional water management systems (foggara, cisterns) supported by modern monitoring and hydrological data
4. Percentage of municipalities with grievance and benefit-sharing mechanisms within adaptation projects

7.4 Just Transition Efforts

Libya's economy and financial system remain heavily dependent on hydrocarbons, which account for the vast majority of export earnings, government budgets, and employment in related industries. Simultaneously, the country faces mounting pressures on water and energy systems, including rising demand, repeated grid outages, and vulnerability to extreme climate events.

This dual challenge underscores the need for diversification, with renewable energy targets (18–20% renewable share by 2030 per the National Renewable Energy Strategy and electricity sector) and improved grid reliability as cornerstones of Libya's energy transition. In this context, just transition should be framed not only as an emissions-reduction agenda but also as a pathway for deploying renewable energy technologies into the national energy mix—ensuring historically hydrocarbon-dependent communities and resource-intensive livelihoods are not marginalized.

Policy Anchors

Transition principles are progressively embedded in emerging sectoral plans for electricity, industry, and transport, operationalized through public investment frameworks and social protection measures. Core policies rest on:

1. **Energy and Industry:** Gradual diversification of the national energy mix toward renewable energy technologies, grid strengthening, and introduction of resilient design standards
2. **Public Investment and Small/Medium Enterprises:** Mainstreaming just transition principles in infrastructure investments, with targeted support for small and medium enterprises in fragile municipalities (border municipalities) to create alternative livelihoods
3. **Social Protection and Occupational Retraining:** Programmes providing income support, skills retraining and professional development, and entrepreneurship pathways for workers and communities affected by energy support transitions, hydrocarbon activity decline, or climate shocks

Social Dialogue

Libya commits to a participatory approach to just transition through organized consultations during planning and budgeting cycles. Key dialogue partners include:

1. **Employers (private sector) and industry associations**, particularly in hydrocarbon, energy, and construction sectors
2. **Municipal councils**, as key actors in local economic diversification
3. **Youth and women's groups**, ensuring intergenerational and inclusive perspectives

4. **Academic institutions and universities**, aligning training pathways with emerging green sector needs
5. **Civil society organizations**, including those active in environmental protection and social inclusion, as facilitators of awareness and dialogue

Indicative Measures

Concrete measures within just transition planning include:

1. Creation of skills pathways for solar and wind deployment, grid operation and maintenance, and water efficiency services
2. Repurposing sites from defunct hydrocarbon or industrial facilities into renewable energy hubs, research centers, or small and medium enterprise incubators
3. Introduction of local content requirements in renewable energy supply chains to maximize local employment and knowledge transfer
4. Phased reform of energy and water subsidies, with targeted protection for low-income households through social safety nets and adaptive social protection systems

Just Transition Metrics

To ensure accountability and transparency, just transition will be tracked through measurable indicators, including:

1. Number of jobs created or retained in low-carbon, climate-resilient sectors, disaggregated by region and all community groups.
2. **Percentage of renewable energy projects** incorporating local employment clauses or local content requirements
3. **Number of workers reskilled or retrained** into renewable energy, water services, or other sustainable sectors
4. **Affordability measures for energy and water** among low-income households, reflecting the equity dimension of subsidy reforms

Table 29: Just Transition Framework for Libya

Rationale and Context	Policy Pillars	Dialogue and Measures	Just Transition Metrics
Hydrocarbon dependence; rising water and energy pressures; need for diversification	**Energy and Industry:** Gradual diversification of national energy mix toward renewable technologies; grid strengthening; introduction of resilient design standards **Public Investment and SMEs:** Mainstreaming just transition principles in infrastructure investments; targeted support for SMEs in fragile municipalities (border municipalities) for livelihood alternatives **Social Protection and Occupational Retraining:** Programmes providing income support, skills development, and entrepreneurship pathways for workers and communities affected by energy support transitions, hydrocarbon decline, or climate shocks	Organized consultations with employers (private sector), industry associations (especially hydrocarbon, energy, construction), municipal councils, youth and women's groups, academic institutions, and civil society organizations **Indicative measures:** Skills pathways for solar/wind deployment, grid operations/maintenance, water efficiency services; repurposing defunct hydrocarbon/industrial sites into renewable energy hubs, research centers, or SME incubators; local content requirements in renewable energy supply chains; phased energy/water subsidy reform with targeted household protection via social safety nets and adaptive social protection systems	Jobs created/retained in low-carbon sectors (by region) Percentage of renewable energy projects with local employment clauses Number of workers reskilled/retrained Energy and water affordability measures for low-income households

This framework demonstrates how Libya's hydrocarbon dependence and mounting water/energy pressures necessitate a structured just transition (JT) agenda. The framework aligns policy pillars, social dialogue, and indicative measures with measurable just transition metrics.

7.5 Cross-Cutting Linkages with Other Chapters

Integrating cross-cutting issues (women's empowerment, community engagement, just transition) requires systematic alignment across all chapters of this Initial National Communication. This cross-cutting linkage ensures that Paris Agreement commitments, including the Global Goal on Adaptation and Enhanced Transparency Framework, are embedded not only as guiding principles but also as operational levers for implementation and reporting.

Chapter 4: Vulnerability and Adaptation Priority adaptation measures identified in Chapter 4 (particularly the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System, Climate Risk Assessment, Finance for Climate-Resilient Agriculture, Flood Risk Management, and Water–Energy–Food–Ecosystem Resilience Hubs) explicitly classify adaptation measures by co-benefits across all population groups, inclusion, and just transition. Beyond risk reduction, each measure must demonstrate who benefits and who bears costs across men, women, and youth. Monitoring, evaluation, and learning indicators (such as hectares of ecosystems restored, households reached by early warning systems, farmers adopting climate-smart irrigation) reflect disaggregation by Male / Female, age, and location. This dual tracking ensures equity and inclusion are visible in output indicators rather than treated as secondary issues.

Chapter 5: Needs and Support Received Financial, technology, and capacity-building needs outlined in current Chapter 5 include requirements to operationalize Sections 7.2–7.4, comprising:

a. Budget allocations for age-disaggregated data systems within the National Adaptation Intelligence and Coordination Platform and Climate Risk Intelligence and Decision Support System

b. Dedicated financing to facilitate inclusive municipal adaptation planning with comprehensive participation
c. Resources for women-led civil society organizations and local communities for co-implementation of pilot adaptation projects
d. Targeted financing windows for just transition: occupational retraining programmes, SME support, affordability guarantees, and social protection for affected workers

Technology needs also include inclusive early warning systems (accessible formats) and participatory monitoring tools. Capacity building emphasizes sectoral ministry focal points, municipal officer training on conflict-sensitive adaptation, and skills pathways for just transition.

Chapter 6: Constraints, Gaps, and Recommendations Cross-cutting barriers documented in Chapter 6 (including absence of inclusive climate policy, insufficient data disaggregation, weak municipal participation systems, absence of traditional/local knowledge integration mechanisms) translate into prioritized recommendations with assigned institutional owners and timelines. For instance, the proposed climate change framework law will include a chapter on equity and just transition, while the Libyan National Meteorological Centre upgrade will incorporate data collection protocols for disaggregated data. The monitoring, evaluation, and learning pathway developed in Chapter 6 provides the operational backbone for accountability, with mandated annual reporting on progress in cross-cutting issues.

By embedding inclusive principles in the design, financing, and governance of adaptation measures, this chapter strengthens national ownership, equity, and consistency with evolving UNFCCC guidance. Cross-cutting linkage ensures that Libya's Initial National Communication presents a coherent narrative across adaptation, support, and constraints axes, establishing inclusion and just transition as measurable pillars of climate resilience.

Table 30: Cross-Cutting Issues Linkage with Other Chapters

Cross-Cutting Dimension	Chapter 4: Vulnerability & Adaptation	Chapter 5: Needs/Support Received	Chapter 6: Constraints & Recommendations
Women's Equity and Empowerment	Design adaptation measures with co-benefits; track percentage via Male / Female-disaggregated MEL; ensure equality in NAP/NDC/TAAP teams	Financing for disaggregated data systems including women/youth/vulnerable groups; focal points; women-led civil society participation; basic services (water, health, energy)	Absence of Male / Female-climate policy; weak institutional focal points; need for standardized procedures → **Priority recommendations with timelines**
Community Engagement	Identify community-specific hazards (aquifer depletion, salinization, desertification); integrate traditional practices (foggara, cisterns)	Support for municipal adaptation planning and inclusive facilitation; grievance/benefit-sharing systems; traditional knowledge integration financing	Limited local participation structures; insufficient vulnerable group data; weak conflict-sensitive screening in planning
Just Transition	Link renewable energy and diversification measures to employment, regional equity, and co-benefits	Dedicated financing for retraining, SME support, social protection; technical assistance for renewable energy supply chains; household affordability guarantees	Absence of transition strategy or shared dialogue platforms; fragmented employment/labor policy; weak integration of renewable investments with equity/inclusion

7.6 Monitoring, Evaluation, and Learning (MEL) for Inclusion

Libya recognizes that achieving meaningful inclusion in climate action requires systematic tracking of who participates, who benefits, and who may remain excluded. To this end, the National Committee on Climate Change will prepare reports disaggregated by male/female, age, and location across the implementation of the National Adaptation Plan and Nationally Determined Contributions. These disaggregated data will flow through the emerging National Adaptation Information and Coordination Platform and the Climate Information and Decision Support System platforms, ensuring consistency, interoperability, and access. Data protocols will adopt open standards, and municipalities will be supported with simplified templates to capture inclusion outcomes at the local level.

Core Performance Indicator Set The following indicators will be reported annually, providing a minimal yet meaningful evidence base:

1. **Inclusion in Governance**
    a. Percentage of women and representatives of different community segments in the National Committee on Climate Change and sectoral climate committees
    b. Number of inclusive consultations encompassing all community segments conducted annually
2. **Equitable Access**
    a. Number of vulnerable households (disaggregated by household head category and location) achieving reliable access to water, energy, or health services through adaptation projects
    b. Service availability (%) during heat waves or flood seasons in high-vulnerability municipalities
3. **Just Transition Outcomes**
    a. Number of individuals trained and employed in renewable energy or water efficiency jobs, disaggregated by age and region
    b. Number of small and medium enterprises established or supported in priority transition regions, with incentives for youth and women-led initiatives
4. **Learning Cycles**
    a. Annual national inventory of inclusion outcomes, aggregating evidence from sectoral and municipal reports
    b. Lessons learned directly feed into the "Constraints and Recommendations" registry in Chapter 6, informing successive National Adaptation Plan and Nationally Determined Contributions iterations, ensuring adaptive, participatory governance

Integration with Enhanced Transparency Framework All inclusion-related indicators will link to reporting architecture within the Enhanced Transparency Framework, ensuring that Libya's Biennial Transparency Reports demonstrate not only progress in risk reduction but also equity in benefit and burden distribution.

Chapter 8. Annexes

Purpose: Provide technical documentation.

Table 25: Annex Checklist

Annex	Expected Content	Reference Standard	Recommendation
8a. Greenhouse Gas Inventory Data Tables and Methodologies	Sectoral data tables (Energy, IPPU, AFOLU, Waste) with CO_2e data; methodologies, activity data, emission factors, uncertainty analysis, assumptions, time series	UNFCCC Decision 17/CP.8; Paris Agreement Article 13; ETF (Katowice Rulebook, Common Reporting Tables)	Provide tables in editable format (Excel); cite IPCC 2006 Guidance and 2019 refinements; include notes on data gaps
8b. Maps and Geographic Information Systems (GIS) Layers	Thematic vulnerability maps, water scarcity, coastal flooding, desertification, population exposure; GIS metadata	UNFCCC Reports; Paris Agreement Article 7 (Participatory Adaptation)	Ensure maps are geographically referenced and reproducible; link to vulnerability scorecard (Annex 8E)
8c. Consultation Summaries	Meeting minutes, attendance rosters, photos where available; documentation of consultations (dates, participants, ethnic/local community representation); summary of key inputs and integration	UNFCCC Decision 17/CP.8; Paris Agreement Article 7.5	Provide for credibility enhancement
8d. Adaptation Measure Factsheets	Fact cards on adaptation measures (objectives, sector, beneficiaries, costs, co-benefits, implementation status)	Paris Agreement Article 7; ETF Adaptation Reports	Alignment with Nationally Determined Contributions priorities/National Adaptation Plan; include indicators (outputs, outcomes, impact)
8e. Climate Vulnerability Exposure Assessment Dashboard – Sectoral Overview	Matrix assessing sectoral vulnerability (exposure, sensitivity, adaptive capacity); methodological note	UNFCCC Adaptation Assessment Reporting Guidance; Paris Agreement Global Framework	Use standardized criteria and color-coded heat maps for comparison ease
8f. MEL Dashboard and Technical Notes (Loss and Damage/DesInventar)	Dashboard on Loss and Damage; technical note on DesInventar integration with MEL system	Paris Agreement Article 8; Decision 2/CMA.5 (Sharm El-Sheikh Outcomes)	Clarify linkage to Enhanced Transparency Framework reporting; ensure regional categorization
8g. Quality Assurance/Quality Control Checklist for Support Received and Required	Checklist for monitoring data quality; financing classification (grants, concessional/non-concessional loans)	UNFCCC Article 12.1; Paris Agreement Article 13; Support Reporting Tables	Ensure alignment with Enhanced Transparency Framework table formats; document handling of incomplete/inconsistent data
8h. References and Data Sources	Comprehensive bibliography of reports, datasets, and literature; organized by Initial National Communication chapters	UNFCCC Reporting Guidance (Transparency and Reproducibility)	Distinguish national and international sources; provide URLs/DOIs where available

Annex 8a. Greenhouse Gas Inventory Data Tables and Methodologies

Annex 8b. Maps and Geographic Information Systems (GIS) Layers

Annex 8c. Consultation Summaries

Date	Activity	Stakeholder Groups	Objective	Key Decisions/Results
18-19/12/2024	Governance and Capacity Building Workshop for Climate Adaptation Planning in Libya	Various government sectors (Agriculture, Water Resources, Biodiversity) and NGOs	Strengthen governance and capacity for climate adaptation planning in Libya; establish integrated governance framework, work programme, and stakeholder engagement strategy for National Adaptation Plan/Nationally Determined Contributions processes	Establishment and adoption of integrated governance framework, work programme, and stakeholder engagement strategy for National Adaptation Plan/Nationally Determined Contributions processes
Jan .and Feb .2025	NCCC Online Webinar Series (Mini seminars)	Various government sectors (Agriculture, Water Resources, Biodiversity) and NGOs	Present key concepts and tools for climate risk assessment; encourage participation in UN Institute for Training and Research (UNITAR) online courses	Two mini-seminars successfully delivered foundational climate risk assessment concepts and tools, encouraging UNITAR course enrollment. Capacity-building remains at risk due to participation rate, technical, and participant turnover challenges; addressing these will significantly enhance effectiveness of future sessions. Through adopting recommended improvements, webinars can become more valuable tools in advancing Libya's climate adaptation efforts.
28 - 29 /04/2025	National Climate Risk Assessment Workshop	Various government sectors (Agriculture, Water Resources, Biodiversity) and NGOs	Provide foundational knowledge on climate risk assessment and its importance for Libya's National Adaptation Plan	Comprehensive and validated list of objectives focused on climate adaptation, ensuring alignment with national and regional priorities
18-19/ 02 /2025	Technical and Strategic Decision-Making (NCCC and Executive Office of NCCC)	NCCC and Executive Office of NCCC	High-level political engagement; ensure compatibility with national/regional priorities and climate adaptation targets	—
5/5/2025	High-Level Policy Engagement	Technical staff from key ministries	Encourage participants to enroll in UN online learning courses to enhance technical skills and understanding of climate adaptation challenges	—
6/5/2025	Sectoral Committees National Adaptation Factsheet Validation and Technical Review Seminar	Sectoral Committees	Compile initial potential climate adaptation strategies, including nature-based solutions and innovative approaches	Initial compilation of potential climate adaptation strategies, including nature-based solutions and innovative approaches
23/06 /2025	Technical Experts Workshop on Inclusion and Women's Empowerment in	Technical experts	Encourage participants to enroll in UN online courses; strengthen technical capacity and understanding	Workshop on Inclusion and Women Empowerment in Climate Adaptation Planning for Libya

Climate Adaptation Planning in Libya	of climate adaptation challenges

Annex 8d. Adaptation Measure Factsheets

National Climate Risk Information and Decision Support System (CIDSS)

National Adaptation Intelligence and Coordination Platform (NAICP)	Title and Code
Multi-sectoral | National and Municipal Levels	Sector/Area
Establishment of a national platform to integrate, coordinate, and disseminate climate risk information among ministries, municipalities, and stakeholders.	Objective
	Beneficiaries
Direct: National Committee on Climate Change (NCCC), Libyan National Meteorological Centre (LNMC), relevant ministries, municipalities; Indirect: all population (approximately 7.2 million people), with attention to women, youth, and vulnerable groups.	Status (Plan/Pilot/Scaling)
	Timeline
Planned – identified as priority measure in Climate Risk Assessment (CRA), National Adaptation Plan (NAP), and Nationally Determined Contributions (NDC)	Financial/Operating Expenditure (Scope)
	Financing (Green Climate Fund/Global Environment Facility/Bilateral/National)
Start: 2025–2026; operational expansion by 2030; repeated updates through 2050.	Co-benefits
Provision of trained cadres	Safeguards
Financial Expenditure: $8–12 million USD (platform design, infrastructure, ICT systems).	Maladaptation Risks
-	MEL/Monitoring, Evaluation, and Learning Indicators
Operating Expenditure: $1–2 million USD annually (staffing, data maintenance, training).	Additional Notes

Climate Risk Intelligence and Decision Support System (CIDSS)	Title and Code
Multi-sectoral | National coverage with local applications	Sector/Area
Development of centralized climate risk data system integrating meteorological, hydrological, socioeconomic, and geographic spatial data to support evidence-based decision-making.	Objective

Beneficiaries
National Committee on Climate Change (NCCC) Direct: National Center for Disaster and Crisis Management, relevant ministries, Libyan National Meteorological Centre (LNMC), municipalities; Indirect: benefit of local communities (women, men, youth) from informed planning and early warning.
Status (Plan/Pilot/Scale)
Timeline
Planned – identified as urgent in CRA, NAP, and NDC; preliminary design phase.
Capital/Operating Expenditure (Scope)
Financing (Green Climate Fund/Global Environment Facility/Bilateral/National)
Design and pilot phase 2025–2027; full operational capacity by 2030; repeated upgrades through 2050.
Co-benefits
Safeguards
Capital Expenditure: $10–15 million USD (digital infrastructure, servers, software, spatial geography laboratories).
Maladaptation Risks
Monitoring, Evaluation, Learning, and Impact Indicators
Operating Expenditure: $2–3 million USD annually (maintenance, updates, technical staff, training). Potential: Green Climate Fund Readiness/Technology window, bilateral (European Union, German Agency for International Cooperation, UNDP, FAO), joint national financing.
Additional Notes

Annex 8e. Libya's Climate Vulnerability Scorecard Tool – Sectoral Overview

Libya's Climate Vulnerability Scorecard is a standardized tool designed to provide concise and comparable assessment of climate hazards and adaptive capacity across major national sectors. It is structured to support Libya's reporting obligations under the UN Framework Convention on Climate Change and Paris Agreement (Article 7) and the Enhanced Transparency Framework, while serving as a practical reference for decision-makers, researchers, and stakeholders.

Purpose and Use

1. **Synthesis.** Condenses sectoral vulnerabilities by integrating hazard exposure, sensitivity, and adaptive capacity into clear, readable display.
2. **Comparability.** Provides snapshot across sectors to identify those facing most urgent or severe risks, including those already experiencing repeated losses and damage.

3. **Planning Support.** Contributes to prioritization of adaptation measures within the National Adaptation Plan and Nationally Determined Contributions and national development strategies, ensuring consistency with resource mobilization tables in Chapter 5.
4. **Monitoring.** Serves as baseline reference for tracking progress over time, enabling iterative improvements in sectoral adaptation planning and links directly to the monitoring, evaluation, and learning roadmap in Chapter 6.

Card Structure

1. Each sectoral entry comprises: (Water, Agriculture/Food Security, Health, Energy and Industry, Urban/Residential areas, Coasts, Ecosystems and Biodiversity, Transport/Logistics, and where appropriate Natural/Cultural Heritage)
2. Current Vulnerability (2025): Qualitative classification (low to very high) supported by available indicators (e.g., service interruption rate, degraded hectares, morbidity/mortality events)
3. Projected Vulnerability (2040–2059): Forward-looking assessment based on CMIP6 ensemble for SSP5-8.5 pathway, with SSP3-7.0 as complementary scenario for sensitivity testing
4. Key Drivers/Hazards: Identify climate stressors affecting sector (heat, drought, flash floods, sea-level rise, sand and dust storms, land degradation)
5. Adaptive Capacity/Gaps: Institutional, technical, financial, and social capacities compared to climate hazards, including inclusion (all population groups)
6. Priority Actions: Adaptation measures from Chapters 3–4 and financing/technology needs from Chapter 5, labeled with inclusive co-benefits (equity, just transition, Loss and Damage linkage)

Update Cycle and Responsibilities

1. **Frequency:** Every 3–5 years, aligned with:
    a. National Communication and Biennial Transparency Report submissions
    b. National Adaptation Plan and Nationally Determined Contributions review cycles
2. **Leading Institutions:** National Committee on Climate Change with Libyan National Meteorological Centre/Climate Centre and sectoral ministries (Water, Agriculture, Health, Energy, Local Government, etc.), supported by academia and civil society organizations
3. **Data Inputs:** National statistics, climate monitoring, sectoral reports, municipal Technical Adaptation Assistance Programme plans, and stakeholder consultations (documenting local communities)
4. **Validation:** Each version reviewed through multi-stakeholder process (ministries, municipalities, civil society organizations, academia) to ensure consistency with UNFCCC reporting frameworks and equity principles

Added Value of Regular Updates

1. Enhance transparency in climate governance and compliance with Enhanced Transparency Framework
2. Identify potential tipping points where systems face irreversible harm (e.g., aquifer collapse, coastal retreat, oasis degradation)
3. Strengthening evidence base for accessing international climate finance (Green Climate Fund, Global Environment Facility, Adaptation Fund, Loss and Damage arrangements)
4. Support knowledge transfer and capacity development, creating cumulative record of vulnerabilities and responses across cycles

Libya's Climate Vulnerability Scorecard – Sectoral Overview (Template Model)

Sector	Current Vulnerability (2025)	Projected Vulnerability (2040–2059, SSP5-8.5; check SSP3-7.0)	Key Drivers/Hazards	Adaptive Capacity/Gaps	Priority Actions Linked to CCAMs	Indicators (Baseline → Target)
Water	High – repeated service interruptions, saline coastal wells	Very High – chronic groundwater depletion; subsurface saltwater intrusion + sudden rise	Drought, groundwater depletion, salinization, heat-induced demand	Mandates exist (Ministry of Water Resources, EO-NCCC) but weak monitoring, outdated infrastructure, low interoperability	CCAMs 1–2: water monitoring, aquifer recharge, NAICP/CIDSS integration	Operating monitoring stations (0% → 60% by 2030); aquifer layers with sustainable recharge schemes
Agriculture & Food Security	High – crop volatility, irrigation pressures, land degradation	Very High – crop collapse from heat, increasing salinity, oasis retreat	Drought, soil salinization, desertification, pests	Fragmented extension, low CSA adoption, limited finance access	CCAMs 5–7: crop diversification, agricultural climate platforms, land/soil rehabilitation	Irrigated land under efficient systems (10% → 40% by 2030); NDVI deviation index for rangelands
Health	Medium-High – heat stress pressures, SDS-related morbidity, weak facility resilience	High – persistent increases in heat/SDS-related mortality and disease rates	Heat waves, sand and dust storms, floods, vector-borne diseases	Limited heat-health action planning, vulnerable supply continuity	CCAM 14: heat/health systems, EWS integration	Emergency room admissions related to heat (baseline → ↓20% by 2030); hospitals with backup power/water
Energy & Industry	High – grid instability, coastal infrastructure exposure	Very High – chronic performance decline, storm surge damages, PV losses from SDS	Heat waves, surges, sand and dust storms	Deferred maintenance backlog, low renewable penetration, weak demand management	CCAM 14: heat/health systems, EWS integration	System load margin (baseline → +10% by 2030); renewable energy share (% of mix)
Urban/Residential Areas	High – flood losses (Derna 2023), UHI, informal expansion	Very High – sewerage network disruption, coastal salinization	Flash floods, UHI, service vulnerability	Disparate municipal capacity, weak regulations	CCAMs 9, 11–12: green infrastructure, NAICP, CIDSS	Population in flood zones (baseline → ↓20% by 2030); cities with risk-sensitive plans
Coasts	High – tidal/erosion events, groundwater salinization	Very High – coastline retreat, loss of salt-marsh interface	SLR, storms, erosion	Fragmented governance, limited monitoring	CCAMs 3–4: NIWG-CR, CRA-FiSS; CCAM 10: blue economy (coastal urban interface)	Coastline eroding >1 m/year (baseline → ↓25% by 2030); ports with improved resilience
Ecosystems & Biodiversity	Medium-High – habitat loss, rangeland degradation	High – oasis collapse, wetland drying, forest die-off	Drought, overgrazing, invasive species, fires	Protected area management resource gaps, limited monitoring	CCAMs 9–10: green infrastructure, blue economy; CCAM 8: drylands corridors (buffer zones)	Protected areas with effective management plans (20% → 50% by 2030); wetland hectares restored

Transport & Logistics	**Medium-High – gully flooding, sand burial, port closures**	**High – persistent operation/maintenance costs, storm surge disruptions**	**Flash floods, sand and dust storms, storms**	**Limited hazard screening in projects, disparate records**	**CCAMs 7–8: soil rehabilitation, drylands corridors; CCAM 9: NbS**	**Kilometers of road in flood zones (baseline → ↓15% by 2030); port closure hours (baseline → ↓20%)**
Natural/Cultural Heritage	Medium – flood/erosion damage, sand encroachment	High – irreversible asset loss, collapse	Floods, erosion, salt weathering, drought	Limited DRR/heritage integration	CCAMs 3–4: NIWG-CR, CRA-FiSS; CCAM 13: WEFE centers (logistics integration)	Heritage assets with disaster risk reduction plans (baseline 0 → 10 by 2030)

Annex 8f. Monitoring, Evaluation, and Learning (MEL) Dashboard Model

A minimum standard set for the MEL dashboard is proposed to ensure systematic reporting.

Monitoring, Evaluation, and Learning Dashboard Indicators Model

Indicator	Baseline (2025)	Target (2030/2035)	Data Source	Frequency	Owner	Classification	Notes/Assumptions
Percentage of population with access to potable water in affected areas	55% (2025)	75% (2030)	Ministry of Water Resources and Environment, Municipalities	Annual	Ministry of Water Resources / EO-NCCC	Outcome	Baseline from CRA surveys require NAICP integration. Disaggregation: age, location (urban/rural)
Duration of advance warning for dust storms (hours)	2 hours (2025)	6 hours (2030)	LNMC / EO-NCCC	Seasonal	LNMC	Output	Requires CIDSS activation; based on developed stations
Area of coastal wetlands restored (hectares)	0 (2025)	1,500 (2030)	Ministry of Environment, FAO projects	Every two years	Ministry of Environment / Municipalities	Output	Remote-sensed monitoring; data validation through TAAP reports
Decline in average annual loss (AAL) from extreme climate events (% of GDP)	2.5% of GDP (2025)	1.5% of GDP (2035)	Ministry of Finance, EO-NCCC	Every 5 years	Ministry of Finance / EO-NCCC	Impact	Modeled in CRA updates; compatible with L&D financing tracking
Percentage of sectoral plans incorporating climate monitoring and evaluation systems	10% (2025)	60% (2030)	Sectoral Ministries	Every two years	Ministry of Public Works and EO-NCCC	Outcome	Verified through NAP MEL review requires sectoral standard operating procedures. Disaggregation: sector
Share of public expenditure allocated to climate adaptation (% of GDP)	0.8% of GDP (2025)	2% of GDP (2030)	Ministry of Finance, IMF	Annual	Ministry of Finance	Input	Requires Rio Markers alignment; depends on climate budget-tagging pilot programmes
Heat-related mortality rate (per 100,000 population)	Baseline determined later (2025)	–20% by 2035	Ministry of Health, WHO	Annual	Ministry of Health	Impact	Data integration with LNMC and health monitoring; linked to heat-health plans. Disaggregation: age, location

Annex 8g. Quality Assurance/Quality Control (QA/QC) Checklist for Reporting on Support Received and Required

The QA/QC checklist is a dynamic tool used by the Executive Office of the National Committee on Climate Change and sectoral climate committees, providing a structured approach to ensure transparency, accuracy, and consistency in Libya's reporting on financial, technology, and capacity-building support received and required. It is aligned with Enhanced Transparency Framework requirements and facilitates preparation of Biennial Transparency Reports.
Each item in the checklist addresses a critical dimension of quality (data sources, classification, accounting parameters, internal consistency, Enhanced Transparency Framework compliance, and documentation), ensuring reported figures are reliable, auditable, and comparable over time.
Through systematic application of this tool, Libya can avoid double-counting, ensure consistency with Nationally Determined Contributions priorities and National Adaptation Plan, maintain robust audit trails, strengthen trust with international partners, and enhance access to future climate finance.

QA/QC Checklist for Reporting on Support Received and Required

Check Element	Check Element	Verification Question	Status (✓/✗)	Notes/Actions Required
Identify Data Source	Identify Data Source	Is the source documented (donor, agency, government ministry)?	Status (✓/✗)	—
Identify Data Source	Identify Data Source	Has the figure been confirmed through official letter/report?	Status (✓/✗)	—
By Source	By Source	Has the flow been correctly classified (Green Climate Fund, Global Environment Facility, Adaptation Fund, bilateral, multilateral development bank, UN, other)?	Status (✓/✗)	—
By Tool	By Tool	Has the type of support been correctly identified (grant, loan, technical assistance, guarantee, etc.)?	Status (✓/✗)	—
By Use	By Use	Has the support been classified as adaptation, mitigation, cross-cutting, or learning and training-related?	Status (✓/✗)	—
By Sector/Region	By Sector/Region	Has allocation been classified by sector (water, health, etc.) and region (national/sub-national)?	Status (✓/✗)	—
Currency and Price Year	Currency and Price Year	Has the figure been converted to constant 2023 USD prices?	Status (✓/✗)	—

Commitments vs. Disbursements	Commitments vs. Disbursements	Has the distinction been clearly reported?	Status (✓/✗)	—
On-Budget/Off-Budget	On-Budget/Off-Budget	Has the delivery channel been identified?	Status (✓/✗)	—
Avoid Double Counting	Avoid Double Counting	Have private flows mobilized been separated from public contributions?	Status (✓/✗)	—
Cross-Check with NDC/NAP	Cross-Check with NDC/NAP	Is support linked to identified national priorities?	Status (✓/✗)	—
Cross-Check Across Chapters	Cross-Check Across Chapters	Do the data align with Chapters 3 (Mitigation) and 4 (Adaptation)?	Status (✓/✗)	—
Common Reporting Tables (CTF) Compatibility	Common Reporting Tables (CTF) Compatibility	Can the figure be converted into Enhanced Transparency Framework Biennial Transparency Report common reporting table formats?	Status (✓/✗)	—
Documentation	Documentation	Have all assumptions and uncertainties been documented?	Status (✓/✗)	—
Audit Trail	Audit Trail	Have files, correspondence, and spreadsheets been archived for audit?	Status (✓/✗)	—

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