Terms of Reference (ToR)

Title: A Synthesis of Existing Knowledge on Black Carbon in the Hindu Kush Himalayan Region, Including Status Evaluation, Gap Analysis, and Recommended Improvements.

Background and context

The International Centre for Integrated Mountain Development (ICIMOD) is an intergovernmental institution working to improve the lives and livelihoods of the people of the Hindu Kush Himalaya (HKH) through science-based research and policy engagement. ICIMOD works across eight Regional Member Countries – Afghanistan, Bangladesh, Bhutan, China, Myanmar, Nepal, and Pakistan. It facilitates regional cooperation and bridges the gap between research and policy to develop scalable, gender-inclusive, and socially responsible solutions for the environment and the climate of the region.

As part of its Strategic Programme, ICIMOD's Action Area on Air supports regional governments in designing and implementing effective policies and technologies to reduce emissions of air pollutants and greenhouse gases. Building on this regional engagement, ICIMOD is focusing on Black Carbon (BC) as a critical short-lived climate pollutant with significant impacts on health, climate, and regional water security. As a regional facilitator and technical partner, ICIMOD supports governments and stakeholders in assessing key BC emission sources, identifying priority sectors, and designing evidence-based, sector-specific mitigation strategies to reduce BC emissions and improve air quality. This assessment will also serve as a baseline document for the establishment of a regional BC consortium, enabling coordinated action and knowledge sharing across countries in the HKH region.

BC is a major contributor to air pollution and climate change, with significant health, environmental, and socioeconomic impacts across the HKH region. Reducing BC provides near-immediate benefits, improving air quality, reducing health risks, and contributing to climate mitigation. BC is emitted from sources such as inefficient residential stoves, diesel engines, industrial processes, agricultural residue burning, and open waste burning. Targeting BC-rich sectors is key to maximizing both climate and health benefits.

BC deposition on snow and ice accelerates glacier and snowpack melting, affecting water security in downstream regions, while its radiative effects influence monsoon dynamics and regional climate patterns. These impacts make BC particularly relevant for glacier protection, regional water security, and broader climate resilience.

Current pathways for BC reduction remain insufficient. Analyses indicate that business-as-usual measures would achieve only minimal reductions, whereas technically feasible interventions—if scaled appropriately—could significantly cut BC emissions within a decade. Proven mitigation measures include clean household heating and cooking solutions, diesel

engine and vehicle emission standards and retrofits, industrial fuel switching, improved waste management to prevent open burning, and alternatives for agricultural residue management. Implementing these measures offers fast, tangible payoffs for climate, air quality, and public health.

Despite its relevance, BC remains underrepresented in national and regional air quality and climate policies. Existing policies often address BC only indirectly, and comprehensive, enforceable strategies are yet to be widely adopted. Financial, technical, and institutional gaps further hinder effective BC mitigation. Addressing these gaps is critical for mobilizing resources, scaling interventions, and ensuring effective implementation.

Effective BC management requires continuous and ample datasets, consistent methodologies, and regionally relevant evidence. Although numerous studies exist, the information is scattered across institutions, platforms, and scientific domains, making it difficult to form a unified understanding of BC levels, emissions, and impacts. Significant data and methodological gaps such as limited spatial coverage, inconsistent measurement approaches, fragmented emission inventories, and limited impact assessments are challenge and it needs to be systematically identified and assessed. This study compiles and synthesizes existing datasets and literature to develop a clearer regional understanding, maximise the use of available resources, and provide an informed basis for future monitoring, policy development, and mitigation planning in the HKH region.

Purpose and objectives

The purpose of the consultancy service is to compile and synthesise existing data, studies, and evidence on BC in the HKH region to assess its status and impact, identify critical data and methodological gaps, and develop actionable recommendations that strengthen future monitoring, analysis, and policy planning.

The objectives are to:
i. Assess the status and impacts of Black Carbon in the HKH region using existing data, published literature, and available observational, reanalysis, satellite, model, and emission datasets, as well as existing impact assessment studies.
ii. Identify key data, methodological, spatial, and institutional gaps related to BC observations, emissions, and impact assessments.
iii. Develop evidence-based recommendations and roadmap to strengthen BC monitoring, emission reporting, modelling, for the HKH region.
iv. Assessing the impacts of BC on Cryosphere, Hydrosphere and Health in the HKH region.

i. Scope of work

The contractor is responsible for performing the tasks mentioned in the table below:

Main Task 1: Mapping and Analysis of In-Situ Black Carbon Measurements and Monitoring Networks in the HKH Region

Activity 1.1 Compile peer-reviewed literature and relevant reports to develop a BC literature database focused on BC ambient, deposition and ice-core measurements in the HKH region.

Activity 1.2 Extract BC measurements from published studies and open-access repositories to develop a structured BC ambient, deposition and ice-core observation database (including metadata on location, instrument type, measurement method, temporal resolution, and uncertainty) in an MS-Excel format and include existing open accesses BC database from the region.

Activity 1.3 Map ground-based monitoring stations, instrumentation, operational periods, and geographic/altitudinal coverage. Identify spatial, temporal, methodological, and data gaps in the current observational network.

Activity 1.4 Identify Black Carbon hotspots in the region

Activity 1.5 Perform analysis to generate BC status report including historical trend in HKH based on prepared database and consolidate findings to produce the in-situ black carbon measurements BC status Report, including monitoring status.

Main Task 2: BC Assessment over HKH region using Reanalysis and Model-Based datasets

Activity 2.1 Compile peer-reviewed literature and reports describing BC distribution over the HKH using satellite retrievals, reanalysis products, and chemical transport models.

Activity 2.2 Summarise BC level from reanalysis and atmospheric modelling dataset for spatial and temporal patterns, transport pathways, seasonal variability and future projections reported in these studies.

Activity 2.3 Compare study outcomes and quantify methodological differences, including distinctions in reanalysis data, model configurations and emission inputs.

Activity 2.4 Synthesize results to produce the Reanalysis and Model-Based BC Status Report including gaps**.**

Main Task 3: BC Impact Assessment on Cryosphere, Hydrosphere, Climate, and Health

Activity 3.1 Compile observational, modelling, and satellite-based studies quantifying BC impacts on:

Cryosphere: Snow/ice albedo reduction, surface darkening, and radiative forcing,Glacier melt rates and mass balance changes

- Weather and regional climate responses (temperature, precipitation, monsoon dynamics)

- Health: Define the epidemiological approach for linking BC exposure to health outcomes such as respiratory and cardiovascular diseases, mortality, and vulnerable population effects, using appropriate statistical models and concentration–response functions.
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Activity 3.2 Develop a structured impact assessment database categorised by:
- Type of evidence (observational, satellite, model-based)
- Type of impact (cryospheric, hydrosphere, radiative, meteorological, climatic, health)
- Spatial/temporal coverage, methods, and key metrics

Activity 3.3 Compare and evaluate findings across studies to identify:
- Regional and methodological differences
- Key sources of uncertainty, including data limitations and model input constraints
- Consistent and recurring evidence across the literature

Activity 3.4: Policy and Intervention Evaluation:

Based on literature, include source attribution and scenario modeling to estimate health benefits from BC reduction strategies, and provide actionable recommendations for policy translation, including cost-effectiveness and equity considerations.

Activity 3.5 Compile results to deliver the BC Impact Assessment Report.

Main Task 4: Assessment of BC emissions in HKH at regional to local scale

Activity 4.1 Compile open-source global, regional, and national/local BC emission inventories relevant to the HKH and document their strengths and limitations.
Activity 4.2 Compare at least one global, regional, and local inventory in terms of spatial resolution, temporal coverage, sectoral contributions, methodology, and uncertainty.
Activity 4.3 Summarise key limitations and propose improvements for HKH-specific emission estimates.
Activity 4.4 Produce the BC Emission Inventory Analysis Report, including statistical comparisons.

Main Task 5: Final Integrated HKH BC Assessment and gap report

Activity 5.1 Integrate findings from the BC status assessment, emission analysis, impact studies, gap analysis, and uncertainty evaluation into a comprehensive final report.
Activity 5.2 Recommend improvements to monitoring networks, data harmonisation, emission reporting, and impact modelling to support future BC assessments.

Project Deliverables and Timeline

Sl. No.	Deliverables	Timeline
1.	Main Task 1: Mapping and Analysis of In-Situ Black Carbon Measurements and Monitoring Networks in the HKH Region & Main Task 2: BC Assessment over HKH region using Reanalysis and Model-Based datasets	25 Jan 2026
2.	Main Task 3: BC Impact Assessment on Cryosphere, Hydrosphere, Climate, and Health & Main Task 4: Assessment of BC emissions in HKH at regional to local scale	15 Feb 2026
3.	Main Task 5: Final Integrated HKH BC Assessment and gap report	10 Mar 2026
4.	Final report	25 Mar 2026

ii.   Qualifications and experience

The consulting institution should demonstrate strong institutional capacity and relevant expertise to deliver the Black Carbon (BC) assessment, literature search, and scientific analysis.

Institutional Requirements:

- Proven experience in scientific assessment of air pollution and SLCPs at local to regional scale particularly in South Asia.
- Demonstrated track record of producing high-quality technical reports on air pollutions, stakeholder materials, and capacity-building outputs.
- Experience working with governments, regional institutions, and international development partners in environmental, air pollution, or climate sectors.
- Capacity to synthesize technical, policy, financial, and social inclusion knowledge into actionable recommendations.

The proposed team should comprise the following key experts with relevant qualifications and experience:

1. Team Lead

- Advanced degree (Master's or PhD) in environmental science, climate, air quality, public policy, or related field.
- 15 years of professional experience in environmental management, air pollution, climate change, or environmental/climate policy analysis.
- Proven experience leading multi-disciplinary teams, managing complex consultancy projects, and coordinating with government and development partners.
- Strong analytical, report writing, and communication skills in English.

2. BC Emission Analyst

- Advanced degree (Master's or PhD) in environmental science, atmospheric chemistry, or related field.
- 7 years of experience in BC emission measurements, source apportionment, and modelling, particularly in South Asia/HKH region.
- Knowledge of SLCPs, emission factors, and air quality monitoring techniques.
- Experience in compiling technical reports and integrating scientific findings into policy-relevant outputs.

3. BC Monitoring Analyst

- Advanced degree (Master's or PhD) in environmental monitoring, air quality science, or related field.
- 7 years of experience with BC monitoring networks, instrumentation, QA/QC protocols, and data management.
- Knowledge of reporting mechanisms and integration of monitoring data into decision-making frameworks.

4. BC Modelling Analyst

- Advanced degree (Master's or PhD) in environmental monitoring, air quality science, or related field.
- 7 years of experience with Air quality modelling, Aerosol research including BC, Satellite datasets and data analysis.
- Knowledge of reporting mechanisms and integration of model and satellite data into decision-making frameworks.

5. Atmospheric Data Analyst

- Advanced degree (Master's or PhD) in atmospheric science, environmental data science, geoinformatics, or a related field.
- Minimum 7 years of experience handling and analysing atmospheric and environmental datasets.
- Strong expertise in processing diverse data formats (CSV, Excel, HDF, NetCDF, etc.) and integrating multi-source datasets.
- Proven skills in data compilation, cleaning, quality control, statistical analysis, and visualisation for atmospheric and climate applications.
- Experience with programming and data analysis tools (e.g., Python, R, MATLAB) and spatial analysis using GIS platforms.
- Knowledge of satellite, observational, and model-derived atmospheric datasets and their application in environmental assessment and reporting.

6. Policy Analyst

- Advanced degree (Master's or PhD) in environmental policy, climate change, or related field.

- 7 years of experience in policy analysis, regulatory review, or program evaluation in environmental/air quality sectors.
- Familiarity with cross-sectoral policy coordination, institutional mapping, and NDC implementation frameworks.

7. Climate Specialist

- Advanced degree (Master's or PhD) in climate science, atmospheric sciences, or environmental science.
- 10 years of professional experience linking SLCPs/Black Carbon to climate impacts.
- Expertise in integrating climate considerations into policy analysis, technical assessments, and financing recommendations.
- Experience working with governments, regional institutions, and international development partners in climate and air quality initiatives.

iii. Evaluation criteria

The technical proposal will be evaluated based on the following table:

Criteria	Maximum Score	Details
Quality of Proposal, Understanding, and Approach	30	Clarity, structure, and comprehensiveness of the proposal; demonstrated understanding of black carbon science and its relevance in the HKH region; clear and robust methodology for synthesizing existing literature, datasets, and reports; approach for status evaluation, gap analysis, and development of evidence-based recommendations.
Organizational Experience	25	Relevant past experience in black carbon research, air quality assessments, climate change studies, or regional synthesis studies; demonstrated experience working in the HKH region or similar transboundary contexts; capacity to manage multi-country/regional analytical assignments.
Human Resources (Experts and Team Composition)	25	Qualifications and expertise of proposed team members in atmospheric science, air quality, climate impacts, or environmental assessment; experience in conducting regional reviews, data analysis, and scientific reporting; familiarity with national and regional institutions, datasets, and research initiatives related to black carbon in the HKH.
Proposed Timeline and Deliverables	10	Realistic and well-structured timeline aligned with the proposed analytical approach; clear definition of milestones, intermediate outputs, and final deliverables (e.g., synthesis

		report, gap analysis, recommendations); feasibility of completing tasks within the proposed timeframe.
Proposed Management and Operational Plan	10	Clarity of overall management and coordination arrangements; mechanisms for ensuring analytical rigor, quality control, internal review, and timely delivery of outputs; communication and coordination plan with the commissioning organization and key stakeholders.

The service provider will be selected on the basis of the highest cumulative scores obtained in the technical and financial proposals using the following formula:

- Technical score = Score obtained based on technical proposal (total 100)
- Financial score = Score obtained based on financial proposal (total 100)
- Total weightage score = 60% of technical proposal + 40% of financial proposal

The service provider scoring the maximum weightage score based on the criteria will be awarded. However, the service provider should score at least 60 % in the technical proposal.

iv.   Duration and timeline

The contract period for this assignment will be from January-March 2026.

The consultant will report to the Intervention Manager - Air Quality Monitoring and Action Area Air Lead, while providing regular updates on progress and challenges to the Action Area on Air Lead. All deliverables must be submitted as draft for review and approval by ICIMOD team before final submission.

v.   Budget

The budget for this consultancy will be determined based on the scope of work and deliverables agreed upon.

vi.   Method of application

The completed proposal should be submitted through email to Consultancy.int@icimod.org by 6 PM (Nepal Standard Time), on 2 February 2026. Two separate files of technical and financial proposals should be submitted along with the valid legal documents as follows:
- Company registration certificate
- Tax registration certificate (i.e. VAT/PAN/TPIN registration)
- Tax clearance or annual tax return of last fiscal year
- Audit Report of the last 3 years

For further inquiries or to submit proposals, please contact:
 consultancy.int@icimod.org
+977-1-5275222 | ICIMOD | Kathmandu, Nepal