

SIMPLIFIED CONCEPTUAL FLOWCHART

Multi-Decadal Assessment of Wetland Carbon Dynamics

PHASE 1: STUDY DESIGN & AREA

STUDY AREA SELECTION

Sunamganj Haor Basin, Bangladesh
Seasonally Flooded Lowland Wetlands
9 Strategic Sampling Locations | ~1,235 km²
Temporal Focus: 1985 vs 2025 (40-year comparison)



PHASE 2: DATA COLLECTION

SATELLITE REMOTE SENSING

Landsat (1985-2024)
Sentinel-2 (2015-2025)
ESA CCI Biomass
Multi-temporal imagery

FIELD SOIL SAMPLING

1985 & 2025 campaigns
Topsoil & subsoil
Lab analysis
SOC & properties

LULC MAPPING

Annual maps 2017-2024
5 land cover classes
High-resolution (10m)
Change detection



PHASE 3: MULTI-SOURCE ANALYSIS

VEGETATION ANALYSIS

NDVI time series
37-year record
Productivity trends
Biomass estimation

HYDROLOGICAL ASSESSMENT

LULC change detection
Flooding patterns
Water extent
Environmental indices

SOIL CARBON DYNAMICS

SOC stocks
Temporal changes
Spatial distribution
Driver identification



PHASE 4: DATA INTEGRATION

MULTI-PARAMETER INTEGRATION

Spatial & Temporal Alignment
Correlation Analysis | Pattern Recognition
LULC-SOC Relationships | Environmental Drivers
Statistical Synthesis | Mechanism Identification



PHASE 5: KEY FINDINGS

MAIN RESULTS

Vegetation: 202% peak NDVI increase | Agricultural intensification

Biomass: 0.28-0.55 t ha⁻¹ yr⁻¹ | Regional stocks 25-38 M Mg

LULC: -16.3% flood-prone areas | +10.2% vegetation | +12.5% urban

SOC: 96-351 Mg ha⁻¹ | Apparent stability | Clay control

Climate: +4°C warming | Altered hydrology | Urbanization



PHASE 6: INTERPRETATION

KEY MECHANISMS & PROCESSES

Equilibrium Dynamics: Input-output balance maintaining SOC

Compensatory Processes: Enhanced productivity offsetting decomposition

Clay Stabilization: Physical protection of organic matter

Hydrological Control: Flooding regime influences on carbon preservation

Climate Impacts: Temperature sensitivity & threshold responses



PHASE 7: MANAGEMENT IMPLICATIONS

CONSERVATION PRIORITIES

Maintain flooding regimes
Protect high-SOC areas
Limit urban expansion
Monitor carbon stocks

CLIMATE MITIGATION

Substantial C storage
25-38 M Mg regional
Threatened stability
Protection critical

FUTURE RESEARCH

High-frequency monitoring
Process-level studies
Socioeconomic drivers
Scenario modeling



OVERALL CONCLUSION

40-year SOC stability amid substantial environmental change

Reduced flooding (~16.3%) and warming (+4°C) threaten future carbon storage
Integrated wetland management essential for sustaining
climate mitigation services and agricultural productivity

*Multi-decadal monitoring reveals complex interactions between
hydrology, land use, and soil carbon in seasonally flooded ecosystems*

STUDY COMPONENTS

Temporal Scope:
40 years (1985-2025)

Spatial Extent:
~1,235 km²

Data Sources:
4 satellite platforms

Sampling Points:
9 locations

Parameters:
20+ variables

