

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

