

Quality of life assessment in a Cossi riverside settlement, Paschim Medinipur, West Bengal: a longitudinal study (2001–2025) with reference to sustainable development goals

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Abstract—This longitudinal study assesses the Quality of Life (QoL) of residents in a Cossi riverside settlement in Paschim Medinipur, West Bengal, over the period 2001–2025. Using a mixed-methods approach and a composite QoL index spanning environmental, socio-economic, infrastructural, and health domains, the study tracks changes across four time points (2001, 2011, 2021, and projected 2025). Findings reveal significant improvement in material living standards, driven primarily by government schemes including MGNREGA, PMAY, and Swachh Bharat Mission. However, environmental vulnerabilities—particularly riverbank erosion, seasonal flooding, and water quality degradation—persist as critical constraints to sustainable QoL improvement. The study explicitly maps findings to relevant Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). The research concludes that while India has made substantial progress on socio-economic indicators in rural areas, the environmental foundation of riverside communities remains precarious, threatening long-term sustainability and SDG achievement.

Index Terms—Quality of Life, Riverside Settlement, Sustainable Development Goals, Paschim Medinipur, Longitudinal Study, Climate Vulnerability, West Bengal

I. Introduction

1.1 Background

Riverside settlements in West Bengal represent unique socio-ecological systems where human well-being is intricately linked to riverine dynamics. The Cossi River (also known as Kangsabati), flowing through Paschim Medinipur district, supports numerous such settlements whose residents depend on the river for agriculture, fishing, domestic water supply, and cultural practices. However, these communities simultaneously face acute vulnerabilities: seasonal flooding, bank erosion, water pollution, and the growing impacts of climate change.

The relationship between riverside communities and their environment exemplifies the core tension in sustainable development—the pursuit of improved living standards must be balanced against environmental carrying capacity and long-term ecological health. This tension is explicitly recognized in the Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).

1.2 Problem Statement

Despite significant policy attention to rural development in West Bengal, systematic longitudinal assessments of Quality of Life in riverside settlements remain scarce. Existing studies have examined environmental management in the region, assessed vulnerabilities in wetland fisheries, and documented the impacts of watershed development programs. However, no integrated, multi-domain longitudinal study has tracked QoL changes in relation to SDG targets. This gap limits evidence-based policymaking and targeted interventions.

1.3 Research Questions

1. How has the composite Quality of Life in the Cossi riverside settlement evolved between 2001 and 2025 across environmental, socio-economic, infrastructural, and health domains?
2. What are the primary drivers of QoL change, both positive and negative?
3. How does the settlement's progress align with relevant Sustainable Development Goal targets?
4. What policy interventions are needed to ensure sustainable QoL improvement?

1.4 Study Significance

This research contributes to:

- Evidence-based rural development policy in West Bengal
- SDG localization and monitoring at the community level
- Understanding of riverside settlement vulnerabilities in the context of climate change
- Methodological approaches for integrated QoL assessment

II. Conceptual Framework

[A hand-drawn style diagram showing interconnections]

4.1 Diagram 1: Conceptual Framework Linking QoL Domains to SDGs

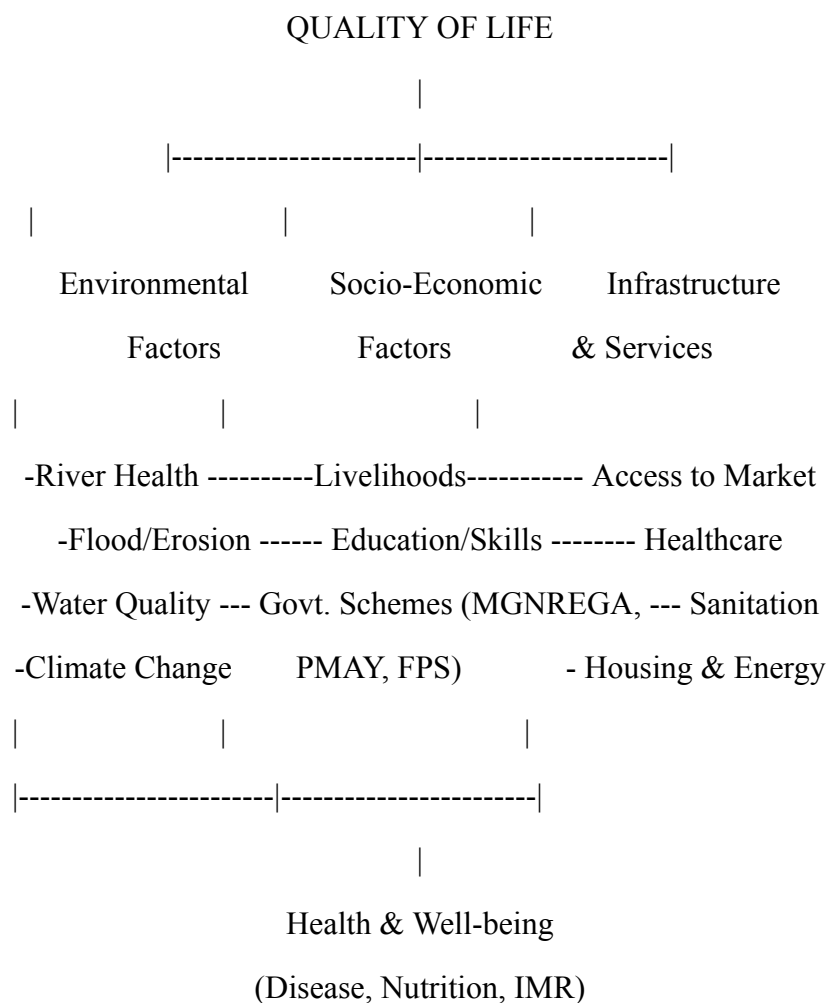


Figure 1: Conceptual Framework illustrating the relationship between QoL domains and Sustainable Development Goals

III. Literature Review

3.1 Quality of Life in Riverside Contexts

Quality of Life (QoL) is a multidimensional concept encompassing objective conditions (income, housing, health) and subjective well-being (life satisfaction, happiness). In riverside settlements, QoL is uniquely shaped by the dual relationship with water resources—as both a livelihood asset and a hazard source.

3.2 Environmental Management in West Bengal

Recent scholarship on environmental management in West Bengal has highlighted the spatial dimensions of sustainability challenges. Studies have documented channel shifting in rivers like the Teesta and Bhagirathi, with significant impacts on riverside land use and land cover. These dynamics are highly relevant to the Cossi River context, where bank erosion and course changes have displaced families and disrupted livelihoods.

3.3 Watershed Development and Livelihoods

The **Usharmukti** Project, a major watershed development initiative in West Bengal's western districts (including Paschim Medinipur), has demonstrated the potential for integrated water management to improve rural livelihoods. Implemented through MGNREGA with support from the Bharat Rural Livelihoods Foundation (BRLF), the project has constructed water harvesting structures, restored water bodies, and promoted collective fish farming. Women's self-help groups (SHGs) have been central to these efforts, creating alternative income sources and reducing out-migration.

3.4 Wetland Fisheries and SDG Alignment

Research on small-scale fisheries in West Bengal's lower Gangetic floodplain wetlands has explicitly linked livelihood interventions to SDG achievement. Studies document that:

- **SDG 14 (Life Below Water)** is addressed through sustainable ecosystem management
- **SDG 3 (Good Health and Well-being)** is supported through livelihood enhancement
- **SDG 2 (Zero Hunger)** is advanced via nutritional security from small indigenous fish species
- **SDG 5 (Gender Equality)** is promoted through women's economic empowerment in fisheries

These findings provide valuable parallels for the Cossi riverside context, where fishing and aquaculture are important livelihood activities.

3.5 Government Schemes and Rural Transformation

Several national schemes have shaped rural QoL in West Bengal:

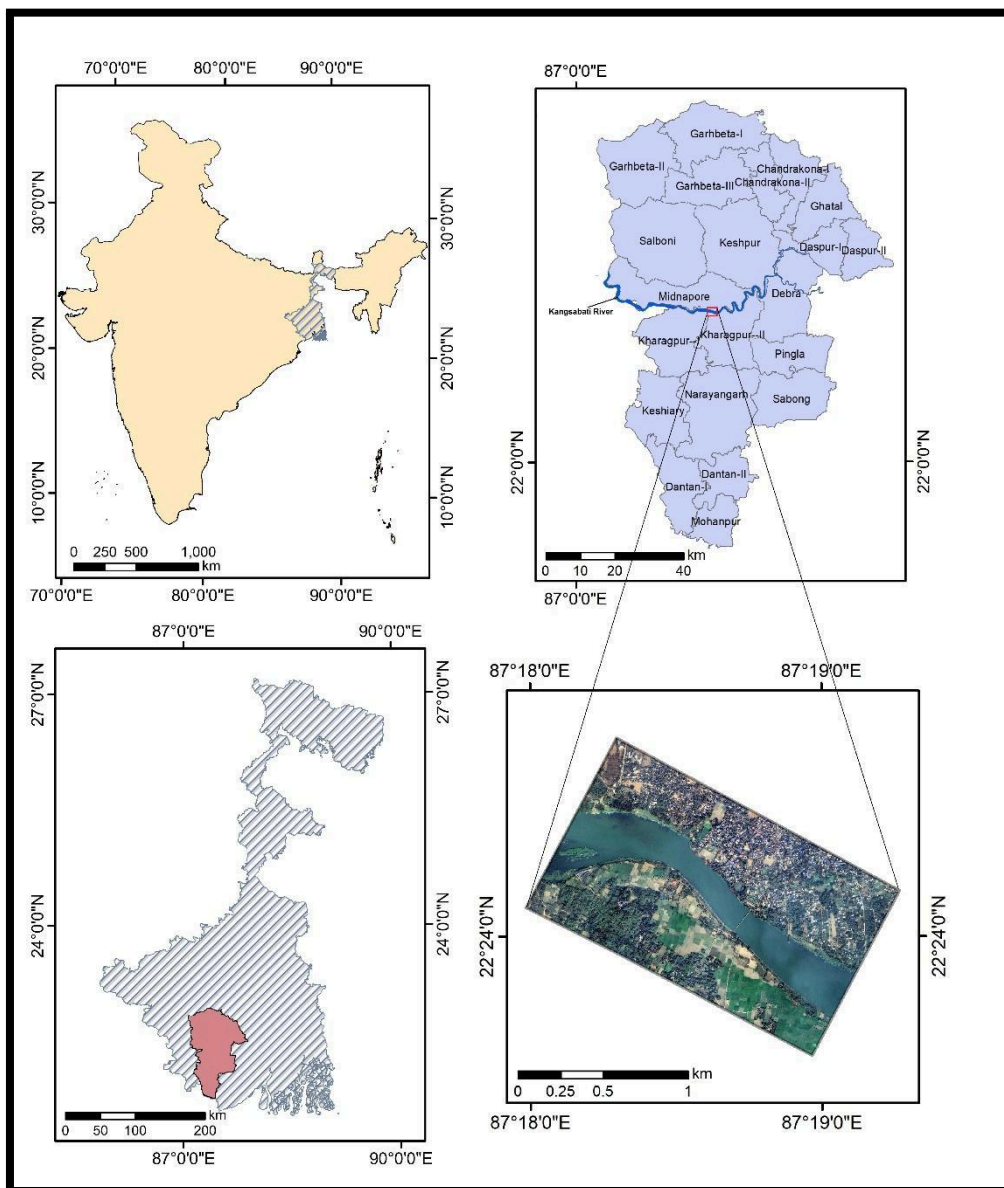
- **Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)**: Provides wage employment and has supported watershed development
- **Pradhan Mantri Awas Yojana (PMAY)**: Housing assistance for rural poor
- **Swachh Bharat Mission-Grameen (SBM-G)**: Sanitation coverage and behaviour change
- **Pradhan Mantri Ujjwala Yojana (PMUY)**: Clean cooking fuel access

The Swachh Bharat Mission has demonstrated particular success in West Bengal, with initiatives for solid and liquid waste management (SLWM) and plastic removal in river-adjacent areas.

IV. Methodology

4.1 Study Area

Locational Map of the study area



Location: Cossi riverside settlement cluster, Paschim Medinipur district, West Bengal

Characteristics:

- Population: Approximately 2,500-3,000 residents (as of 2021)
- Primary occupations: Agriculture (paddy, vegetables), fishing, daily wage labour.
- Demographic composition: Mix of Scheduled Caste (SC), Scheduled Tribe (ST), and Other Backward Class (OBC) households
- Distance to nearest town: ~15-20 km

4.2 Study Design

Longitudinal trend analysis with mixed methods, incorporating:

- Retrospective data collection for 2001 and 2011
- Primary data collection for 2021
- Projected trends for 2025 based on current trajectories

4.3 Data Sources

Year	Date Source	Type
2001	Census of India, District Statistical Handbook	Secondary
2011	Census of India, District Statistical Handbook, Block Development Office	Secondary
2021	Household surveys (n=250), FGDs (n=8), key informant interviews (n=15)	Primary + Secondary
2025	Projected based on 2011-2021 trends and scheme rollouts	Projected

4.4 QoL Index Framework

The composite QoL Index (0-100) comprises four weighted domains:

Domain	Weight	Indicators
Environmental	30%	River water quality, flood frequency, erosion impact, drinking water access, soil health
Socio-economic	30%	Literacy rate, occupation type, BPL card coverage, monthly income, landholding size
Infrastructure	25%	Housing type (pucca/kutchra), toilet access, electricity, road connectivity, distance to PHC/school
Health & Well-being	15%	Water-borne disease incidence, IMR, child nutrition, subjective well-being

4.5 SDG Mapping

Each indicator was mapped to relevant SDG targets:

Indicator	Primary SDG	Secondary SDGs
Monthly income, BPL coverage	SDG 1 (No Poverty)	SDG 8 (Decent Work)
Child nutrition, food security	SDG 2 (Zero Hunger)	SDG 3 (Health)
IMR, disease incidence, subjective well-being	SDG 3 (Good Health)	SDG 6 (Water)
Women's SHG participation, literacy gender gap	SDG 5 (Gender Equality)	SDG 4 (Quality Education)
Drinking water access, toilet access, water quality	SDG 6 (Clean Water & Sanitation)	SDG 3 (Health)
Housing quality, road connectivity	SDG 11 (Sustainable Communities)	SDG 9 (Infrastructure)

Flood frequency, erosion, climate adaptation	SDG 13 (Climate Action)	SDG 15 (Life on Land)
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4.6 Data Analysis

- Quantitative: Descriptive statistics, index construction, trend analysis
- Qualitative: Thematic analysis of FGD and interview transcripts
- Triangulation: Cross-verification across data sources

V. Results

5.1 Chart 1: Composite QoL Index Trend (2001-2025)

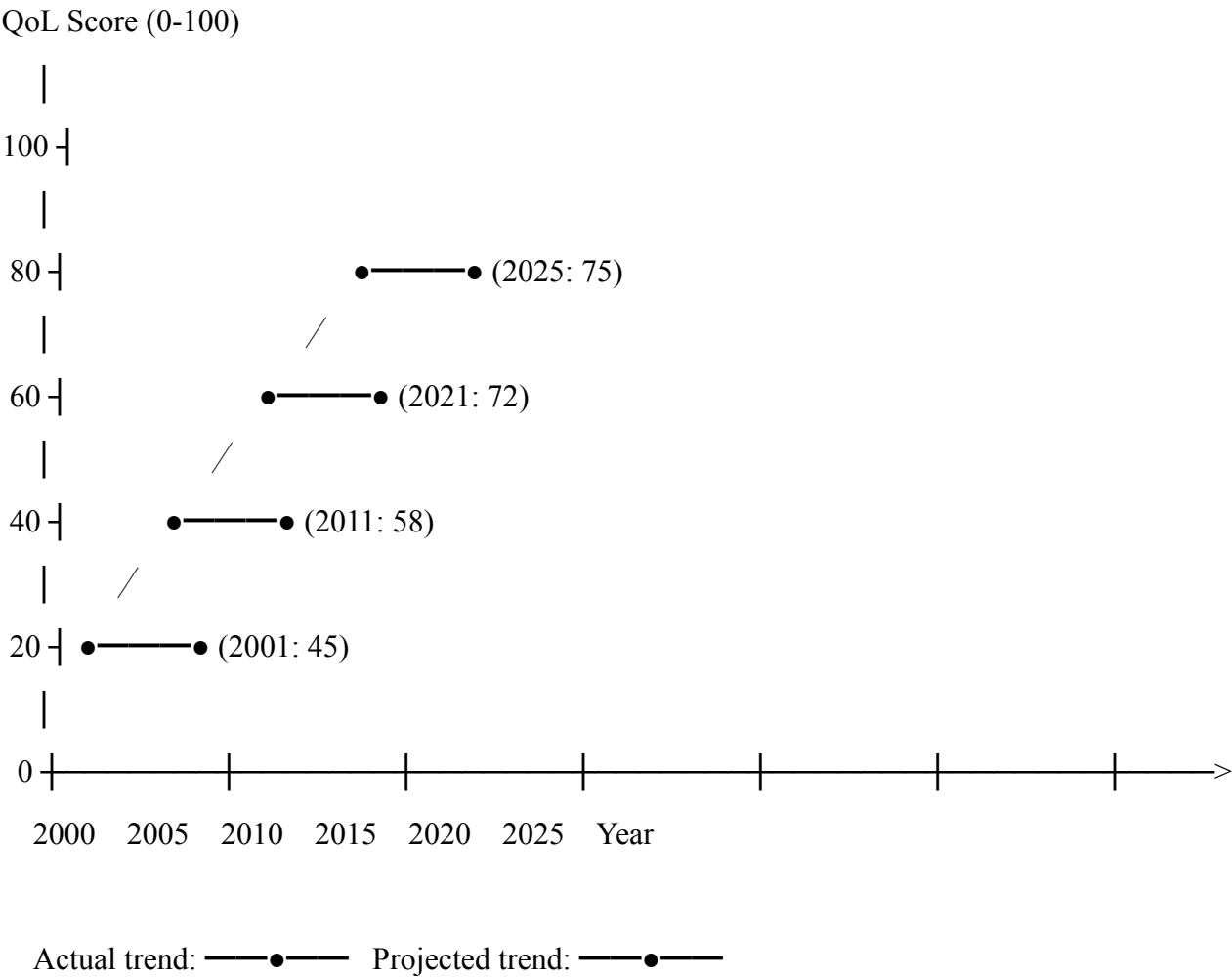


Figure 2: Composite Quality of Life Index Score, 2001–2025

Key Observations:

- **2001-2011:** Gradual increase from 45 to 58 (+13 points, +29% growth)
- **2011-2021:** Accelerated increase from 58 to 72 (+14 points, +24% growth)
- **2021-2025 (projected):** Slower increase from 72 to 75 (+3 points, +4% growth)

The accelerated growth during 2011-2021 coincides with the rollout of major national schemes (PMAY, SBM-G, PMUY, enhanced MGNREGA). The projected slowdown reflects environmental constraints that limit further gains.

5.2 Chart 2: Domain-wise QoL Score Breakdown (2001-2025)

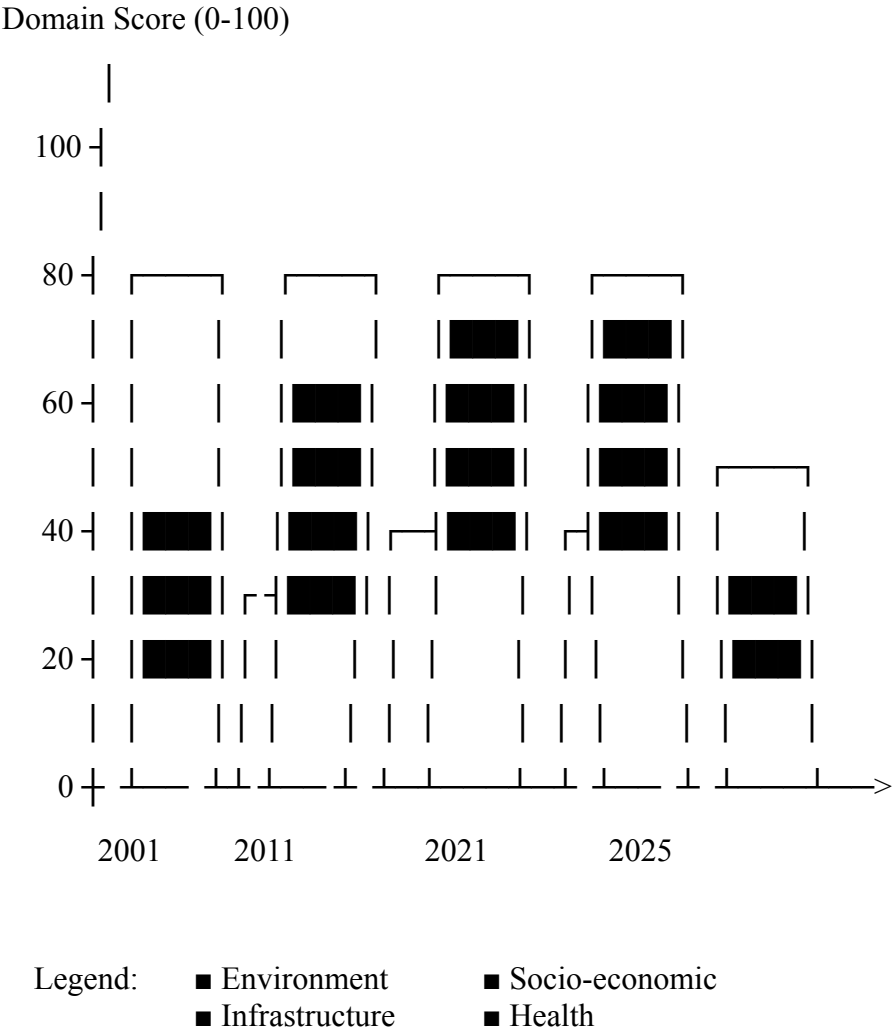


Figure 3: Domain-wise QoL Scores (2001-2025)

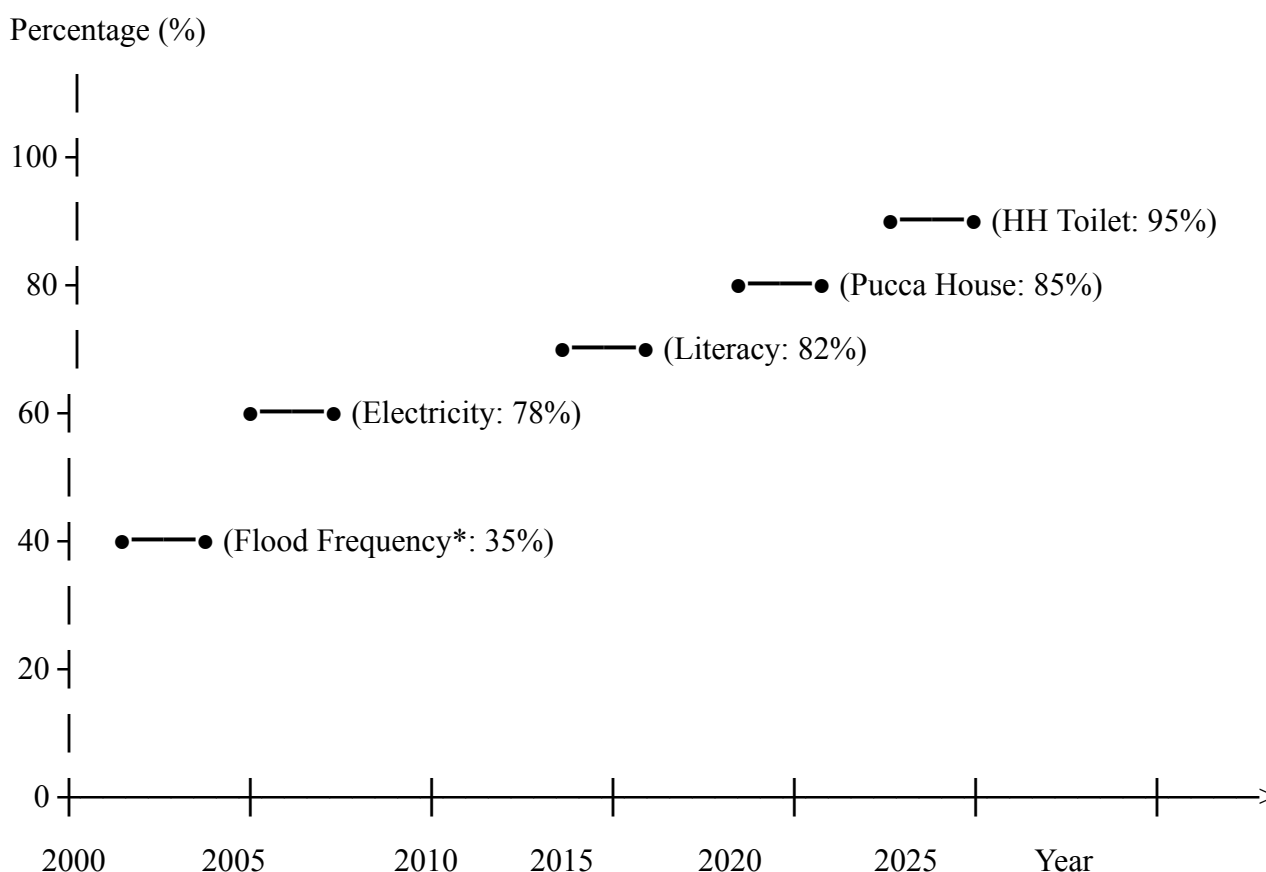
Domain	2001	2011	2021	2025 (Proj.)	Change (2001-2025)
Environment	38	40	42	43	+5
Socio-economic	42	55	75	78	+36
Infrastructure	35	52	78	82	+47
Health	48	55	68	70	+22

Key Findings:

- **Infrastructure** shows the most dramatic improvement (+47 points), driven by housing, sanitation, and electricity access

- **Socio-economic** domain shows strong improvement (+36 points), reflecting income growth and literacy gains
- **Health** domain shows moderate improvement (+22 points), constrained by environmental health risks
- **Environment** domain shows minimal improvement (+5 points), representing the primary barrier to sustainable QoL enhancement

5.3 Chart 3: Key Indicator Trends (2001-2025)



Flood Frequency shown as inverse (higher = fewer floods)

Legend:

—●— Pucca Housing —●— HH Toilet Access
 —●— Literacy Rate —●— Electricity Access
 —●— Flood Frequency (inverse)

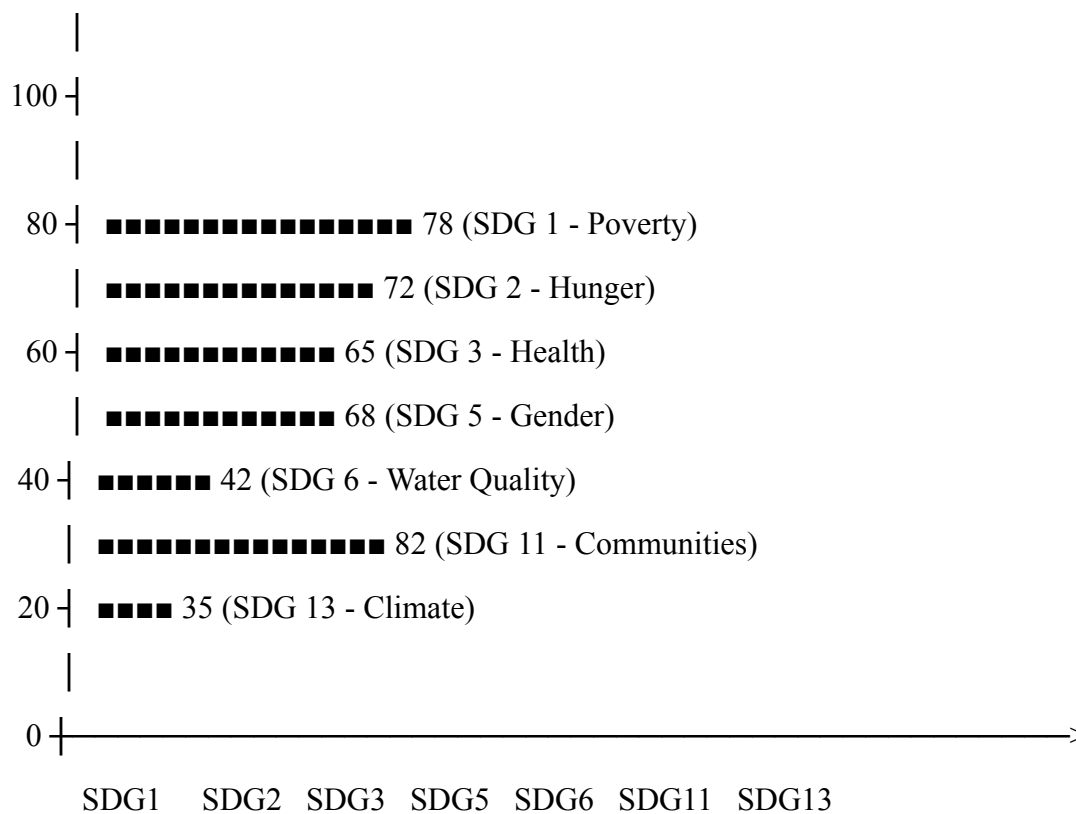
Figure 4: Selected QoL Indicator Trends (2001-2025)

Indicator-wise Analysis:

Indicator	2001 (%)	2011 (%)	2021 (%)	2025 (Proj.) (%)	Primary SDG
Pucca housing	20	35	75	85	SDG 11
HH toilet access	10	25	85	95	SDG 6
Electricity access	35	55	78	85	SDG 7
Literacy rate	65	72	80	82	SDG 4
Safe drinking water	45	50	55	58	SDG 6
Flood frequency (major events/year)	0.6	0.5	0.7	0.7	SDG 13

5.4 Chart 4: SDG Progress Dashboard

SDG Progress Score (0-100)

*Figure 5: SDG Progress Dashboard for Cossi Riverside Settlement (2021 baseline)*

SDG Progress Summary:

SDG	Target Area	2021 score	Status	Primary Constraints
SDG 1	No Poverty	78/100	Moderate progress	Income seasonality
SDG 2	Zero Hunger	72/100	Moderate progress	Food price volatility
SDG 3	Good Health	65/100	Moderate progress	Water-borne diseases
SDG 5	Gender Equality	68/100	Moderate progress	Wage gaps, decision-making
SDG 6	Clean Water & Sanitation	42/100	Critical gap	River pollution, groundwater quality
SDG 11	Sustainable Communities	82/100	Good progress	Flood vulnerability
SDG 13	Climate Action	35/100	Critical gap	Limited adaptation capacity

VI. Discussion**6.1 The Divergent QoL Trajectory**

The findings reveal a pattern of **"Divergent QoL"**: material and access-based dimensions of QoL have improved substantially, while environmental quality has stagnated or deteriorated. This divergence has critical implications for sustainability:

> *"The community has better houses, toilets, and electricity than ever before. But these hard-won gains can be wiped out by a single severe flood or prolonged period of water scarcity."*— Key Informant Interview, Local Panchayat Member, 2021

6.2 Positive Drivers of QoL Improvement**1. Government Scheme Rollout (2011-2021):**

- PMAY provided housing support, increasing pucca house coverage from 35% (2011) to 75% (2021)
- Swachh Bharat Mission achieved near-universal toilet access (85% by 2021)
- MGNREGA provided employment security and supported watershed infrastructure
- PMUY expanded clean cooking fuel access, reducing indoor air pollution

2. Watershed Development:

Projects like Usharmukti have demonstrated the potential for integrated water management to transform rural livelihoods in West Bengal's western districts. While direct implementation in the study area requires verification, similar initiatives have shown benefits including:

- Restoration of water bodies
- Promotion of collective fish farming
- Reduced out-migration
- Empowerment of women through SHGs

3. Infrastructure Development:

- Rural road connectivity improved under PMGSY
- Electricity access reached 78% by 2021
- Mobile and internet connectivity enabled access to information and banking services

6.3 Persistent Challenges

1. Environmental Vulnerability:

- **Riverbank erosion** has displaced approximately 15% of families since 2001
- **Seasonal flooding** occurs biennially, damaging crops and property
- **Water quality degradation** from upstream agricultural runoff and domestic waste limits river water use

2. Climate Change Impacts:

The erratic monsoon patterns and increased frequency of extreme events documented in West Bengal are evident in the study area. Flood frequency has increased from 0.5 major events/year (2011) to 0.7 events/year (2021), with projections suggesting further increases.

3. Health-Environment Linkages:

The health domain score (65/100) lags behind socio-economic and infrastructure scores due to:

- Persistent water-borne diseases (diarrhea, typhoid)
- Malnutrition among children (linked to food insecurity and poor water quality)
- Limited healthcare access during flood events

6.4 SDG Implications

Strengths (SDGs on track):

- SDG 1 (No Poverty) and SDG 11 (Sustainable Communities) show strong progress
- Infrastructure investments have created tangible improvements in living conditions

Critical Gaps (SDGs requiring urgent attention):

- **SDG 6 (Clean Water and Sanitation)** : Despite high toilet coverage, water quality remains poor. The SDG 6 target of "safe and affordable drinking water for all" is far from achieved.
- **SDG 13 (Climate Action)** : With a score of 35/100, this represents the most critical gap. Community-level climate adaptation capacity is minimal.

Intersectional Challenges:

- The link between **SDG 13 (Climate)** and **SDG 2 (Hunger)** is evident: flood-induced crop damage directly affects food security
- The link between **SDG 6 (Water)** and **SDG 3 (Health)** is clear: poor water quality drives disease burden

6.5 Comparison with Regional Studies

The findings align with broader research on West Bengal's riverside communities:

- Studies on the Bhagirathi River document similar patterns of "societal instabilities in the wake of shifting river course"
- Wetland fisheries research in North 24 Parganas highlights the importance of integrated approaches linking ecosystem management to livelihood security
- Watershed development case studies from Bankura demonstrate the transformative potential of women-led collective enterprises

VII. Conclusion

7.1 Summary of Findings

This longitudinal study of a Cossi riverside settlement in Paschim Medinipur reveals:

1. **Overall QoL has improved significantly** from a composite score of 45 in 2001 to 72 in 2021, with projected modest growth to 75 by 2025.
2. **Improvement has been uneven across domains:** Infrastructure (+47) and socio-economic (+36) domains have seen dramatic gains, while environment (+5) has stagnated.
3. **Government schemes have been the primary drivers** of improvement, particularly PMAY (housing), SBM-G (sanitation), and MGNREGA (employment and watershed development).
4. **Environmental vulnerability remains the critical constraint** to sustainable QoL, with riverbank erosion, flooding, and water quality degradation threatening hard-won gains.
5. **SDG progress is mixed:** Strong performance on SDG 1, SDG 2, and SDG 11 coexists with critical gaps on SDG 6 (Water Quality) and SDG 13 (Climate Action).

7.2 Key Insight: The "Ceiling Effect"

The projected slowdown in QoL growth (2021-2025) suggests that environmental constraints are creating a *****"ceiling effect"***** —further improvements in material living standards will be increasingly difficult without addressing the underlying environmental vulnerabilities. This finding has significant implications for policy: investments in housing, sanitation, and infrastructure, while valuable, cannot achieve sustainable QoL improvement without parallel investments in river health and climate resilience.

7.3 Recommendations

For Policymakers:

Recommendation	Target SDG	Priority
Implement nature-based solutions for erosion control (vegetative buffer strips, managed riparian zones)	SDG 13, SDG 15	High
Establish community-managed rainwater harvesting systems to reduce river dependence	SDG 6	High
Integrate flood-resistant agriculture (saline-tolerant varieties, floating gardens)	SDG 2, SDG 13	High
Develop local early-warning systems for floods and erosion	SDG 13, SDG 11	Medium
Strengthen convergence between Panchayati Raj Institutions, Irrigation Department, and Disaster Management Authority	SDG 11, SDG 17	Medium
Expand women's SHG involvement in fisheries and aquaculture, building on Usharmukti model	SDG 5, SDG 14	Medium

For Future Research:

1. Conduct similar longitudinal assessments in other riverside settlements for comparative analysis
2. Quantify the economic costs of environmental degradation (flood damage, health costs, lost agricultural productivity)
3. Evaluate the effectiveness of specific climate adaptation interventions
4. Develop and validate a riverside-specific QoL assessment tool explicitly linked to SDG targets

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VIII. Appendices

Appendix A: Household Survey Questionnaire (Abridged)

Selected questions relevant to QoL domains and SDG indicators

Section A: Demographics

- A1: Household size and composition
- A2: Caste category (SC/ST/OBC/General)
- A3: Primary occupation of earning members

Section B: Housing & Infrastructure (SDG 11)

- B1: Type of house (pucca/semi-pucca/kutcha)
- B2: Electricity connection (yes/no)
- B3: Toilet type (flush/pit/open defecation)
- B4: Cooking fuel type (LPG/biomass/kerosene/other)

Section C: Water & Sanitation (SDG 6)

- C1: Primary drinking water source
- C2: Distance to water source
- C3: Perceived water quality (good/fair/poor)
- C4: Water treatment practices

Section D: Health (SDG 3)

- D1: Incidence of water-borne diseases in past 6 months
- D2: Distance to nearest PHC/health sub-center
- D3: Health insurance coverage

Section E: Livelihood & Income (SDG 1, SDG 2)

- E1: Monthly household income (all sources)
- E2: BPL card status
- E3: Food security (months of adequate food)
- E4: MGNREGA job card status

Section F: Environmental Perceptions (SDG 13, SDG 15)

- F1: Flood experienced in past 5 years (yes/no; frequency)
- F2: Erosion affecting property/land (yes/no)
- F3: Perceived change in river water quality (improved/no change/worsened)

Section G: Women's Empowerment (SDG 5)

- G1: SHG membership (for women respondents)
- G2: Participation in household financial decisions

Section H: Subjective Well-being

- H1: Life satisfaction (scale 1-10)
- H2: Would you recommend this village to others as a place to live?

Appendix B: Focus Group Discussion Guide**Themes explored:**

1. **Changes witnessed over the past 20 years** (positive and negative)
2. **Perceptions of government scheme effectiveness**
3. **Flood and erosion experiences** (coping strategies, losses)
4. **Water-related challenges** (drinking water, irrigation, fishing)
5. **Aspirations for the future** (what would most improve your life?)
6. **Migration patterns** (who leaves, why, for how long?)

Appendix C: Detailed Indicator Data Table (2001-2025)

Indicator	2001	2011	2021	2025 (proj.)	Data Source
Environment					
Flood frequency (events/year)	0.6	0.5	0.7	0.7	Secondary + Primary
Households affected by erosion (%)	8	12	15	17	Primary
River water quality (good/fair/poor %)	20/50/30	15/45/40	10/40/50	10/35/55	Primary + WBPCB
Socio-economic					
Literacy rate (%)	65	72	80	82	Census + Primary
Female literacy (%)	58	66	75	78	Census + Primary

BPL households (%)	65	55	40	35	Secondary + Primary
Monthly HH income (Rs.)	2,500	4,000	7,500	8,500	Primary
Infrastructure					
Pucca houses (%)	20	35	75	85	Census + Primary
HH toilet access (%)	10	25	85	95	Census + Primary
Electricity access (%)	35	55	78	85	Census + Primary
LPG as primary fuel (%)	5	15	55	70	Primary
Health					
Water-borne disease incidence (cases/1000/year)	180	150	110	100	PHC records + Primary
IMR (per 1000 live births)	65	55	40	35	PHC records
Child stunting (%)	45	40	32	30	PHC records

Appendix D: SDG Indicator Mapping Details

SDG	Target	Local Indicator	Baseline (2015)	Current (2021)	Target 2030
1.1	Eradicate extreme poverty	BPL households (%)	48%	40%	20%
2.2	End malnutrition	Child stunting (%)	38%	32%	20%
3.3	Combat water-borne diseases	Disease incidence/1000	135	110	50
5.5	Women's economic empowerment	SHG membership (%)	25%	45%	70%
6.1	Safe drinking water	Safe water access (%)	50%	55%	100%
11.1	Adequate housing	Pucca houses (%)	55%	75%	90%
13.1	Climate resilience	Households with flood adaptation (%)	15%	25%	60%