

What is the temperature of 'Progress'?

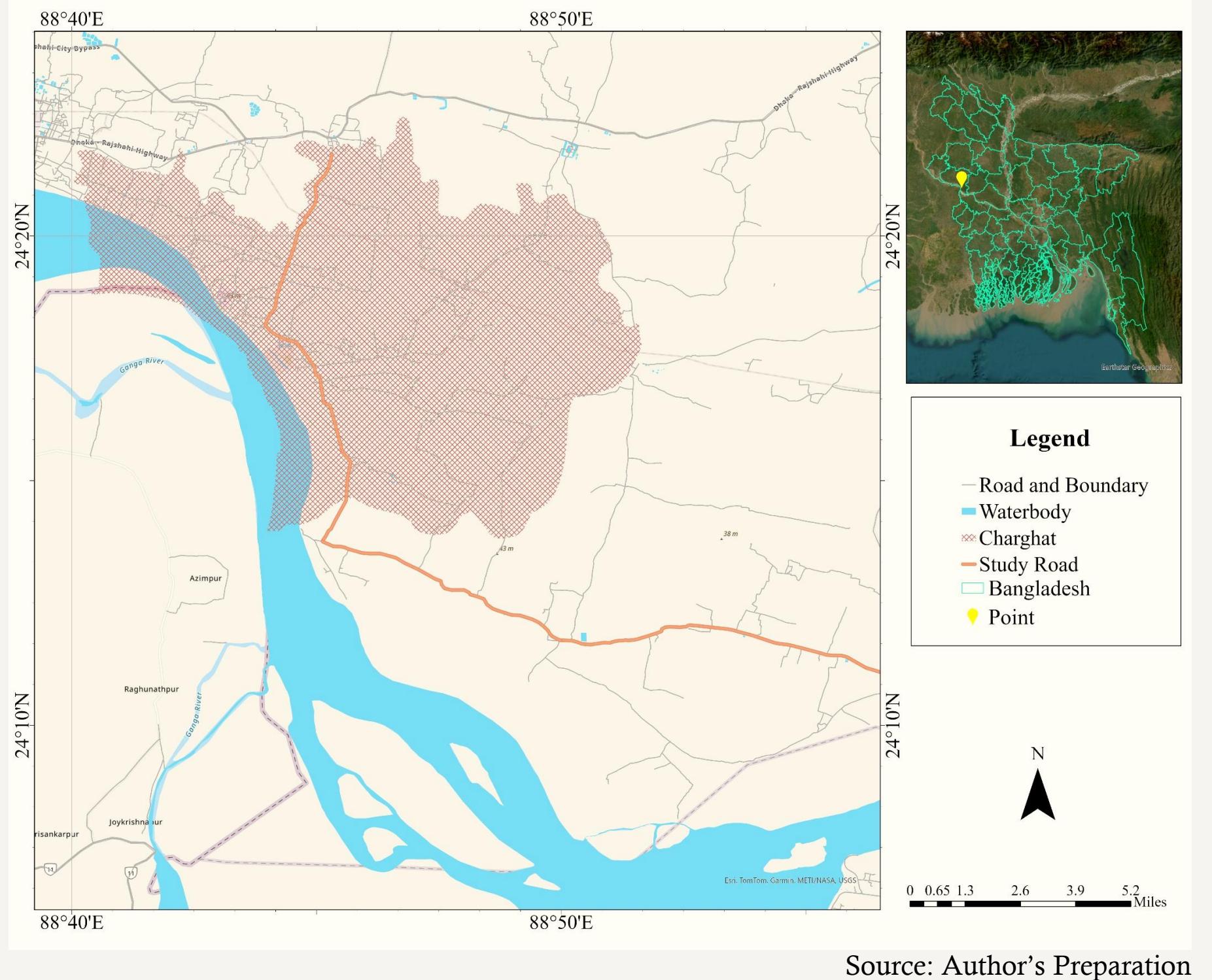
A Participatory Assessment of Roadside Deforestation Impacts and Locally Led Adaptation Strategies in Charghat: A Panarchy Theory-Based Framework

Presented By:

Group 06

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Study Area Map



Development came at a cost: a sudden ecological collapse

- ❖ **The Trigger:** The widening of the Z 6006 highway in Charghat Upazila.
- ❖ **The Shock:** In 2023, nearly 4,000 mature roadside trees were removed, erasing decades of accumulated ecological and social capital.
- ❖ **The Consequence:** This event plunged the local social-ecological system into a “Release” (n) phase—a period of rapid loss, instability, and vulnerability.
- ❖ **The Human Impact:** Communities immediately faced cascading crises: intense heat, dust pollution, and the loss of livelihoods and social spaces.

OBJECTIVES

Our mission was to understand the full story, from impact to adaptation.



Assess the Impacts: To assess the physical, social, and environmental effects of the deforestation and interpret them through the Panarchy adaptive cycle.



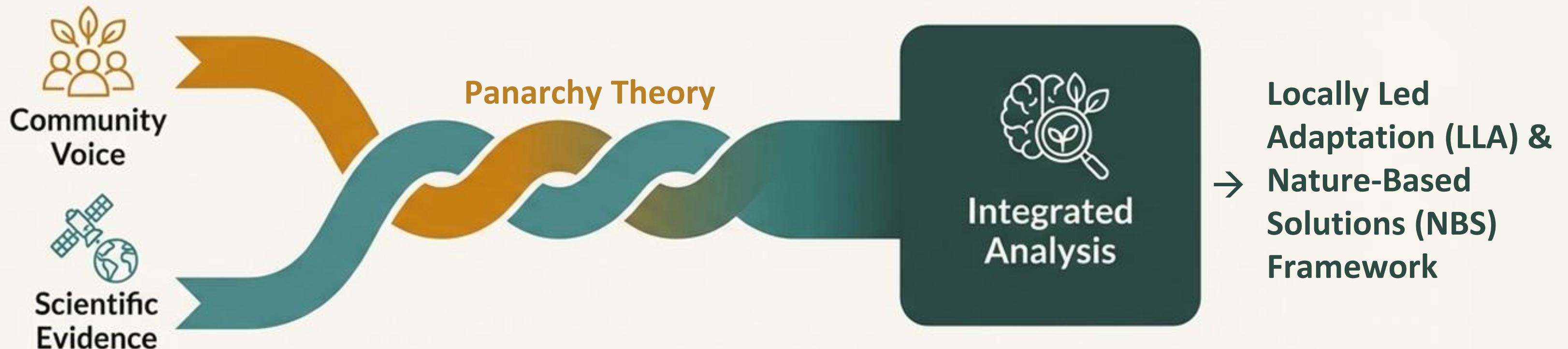
Investigate Adaptation: To identify existing community-led practices for coping with the loss of trees and increasing climate stress.



Co-develop a Framework: To build a community-driven framework integrating Locally Led Adaptation (LLA) and Nature-Based Solutions (NBS) for future resilience.

METHODOLOGY

Local knowledge with scientific evidence for a complete picture



Participatory Rural Appraisal (PRA)

The Voice of the Community

Social Mapping, Problem Trees, Focus Groups, Ranking

Captures lived experiences, perceptions, and priorities.

Spatial Analysis (GIS & RS)

The Objective Environmental Data

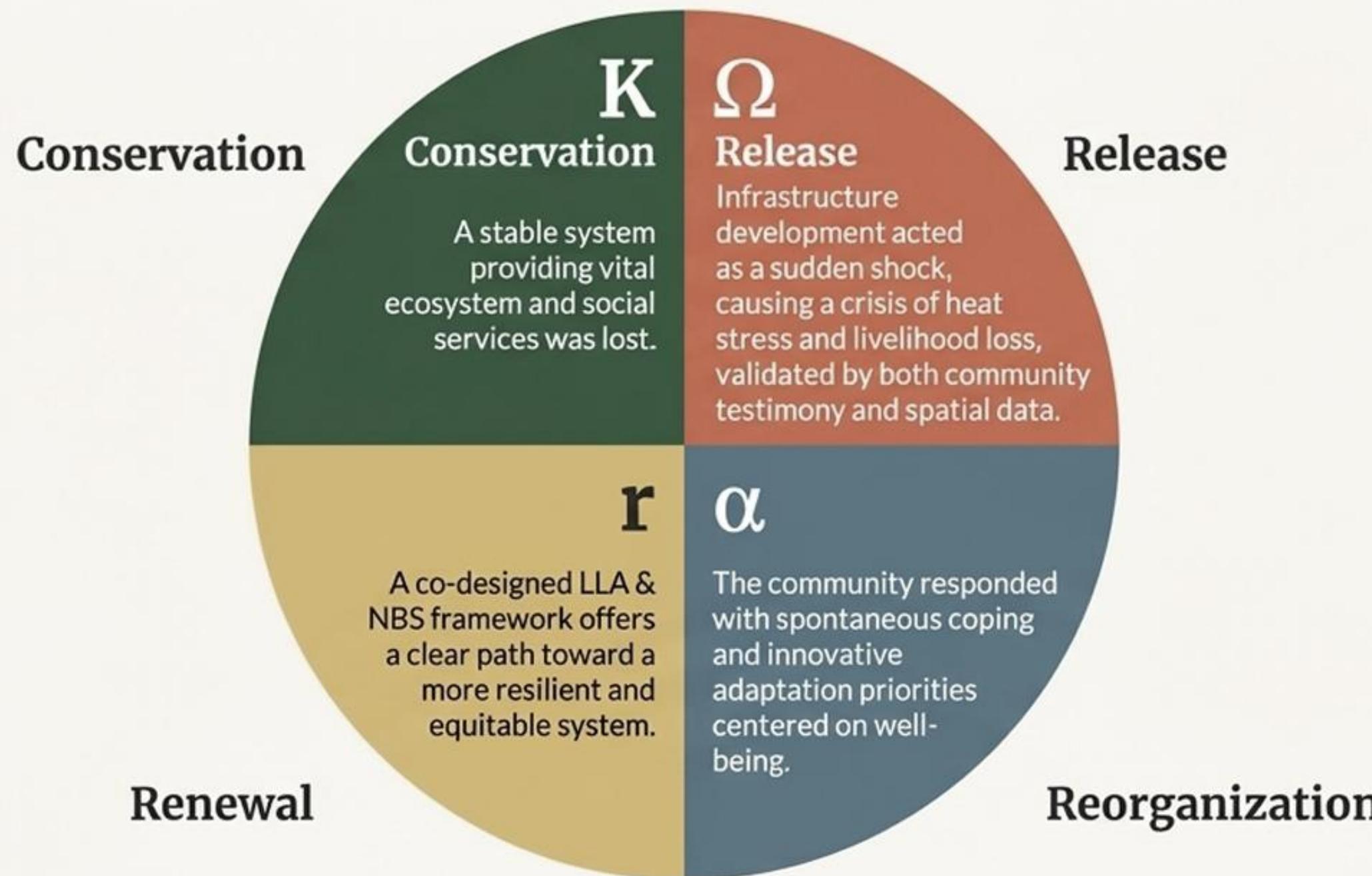
Land Surface Temperature (LST), Vegetation Index (NDVI)

Annual Precipitation, Air Quality (Aerosol Optical Depth)

Quantifies and validates environmental change over time.

The Journey of a Social-Ecological System

The Panarchy Theory (4 Phases)



Panarchy cycle → our lens to understand change



Panarchy theory helps us see social-ecological systems not as static, but as constantly adapting through cycles.

Our research asks: How does a community move from the shock of Release (Ω) to the innovation of Reorganization(α)?

PRA toolbox

We employed a suite of Participatory Rural Appraisal (PRA) tools to understand the crisis from the community's perspective. This approach captured lived experiences, mapped vulnerabilities, and identified local priorities for action.



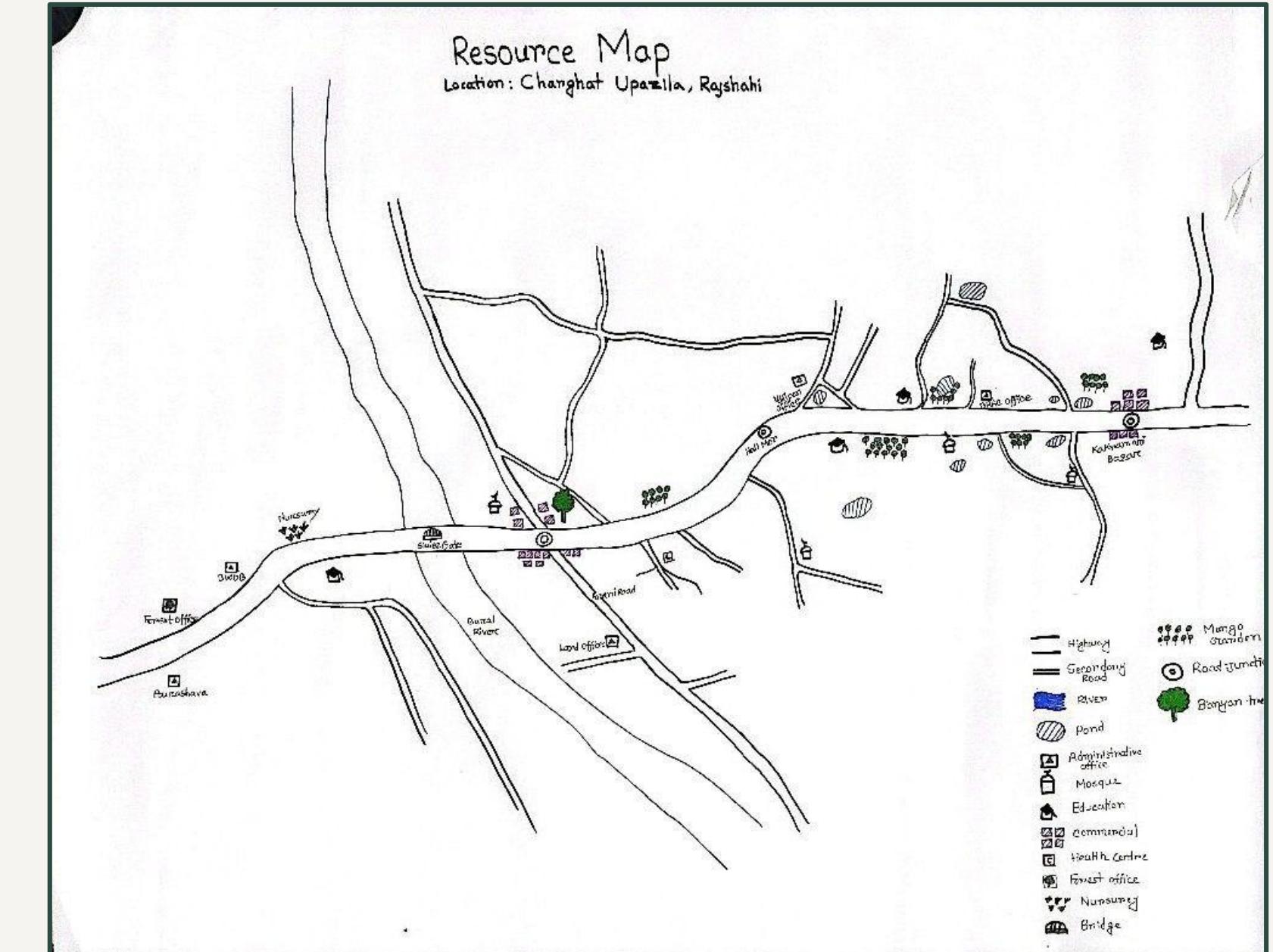
Spatial Tools (Resource & Service Maps):

To visualize **where** deforestation hit hardest.



Temporal Tools (Seasonal Diagram):

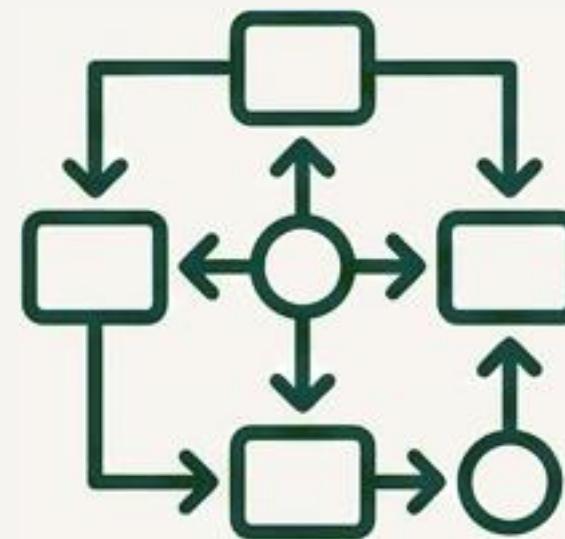
To understand **when** the community is most stressed.



Source: Primary data

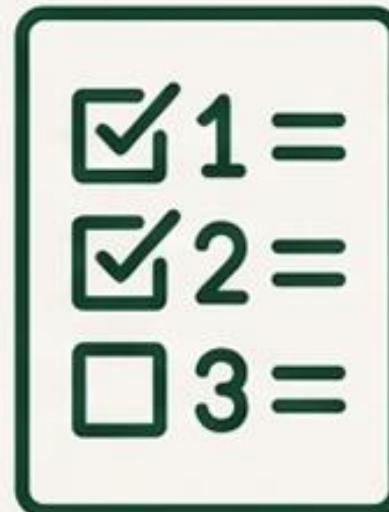
PRA toolbox

We used a suite of participatory tools to map the community's reality from the inside out.



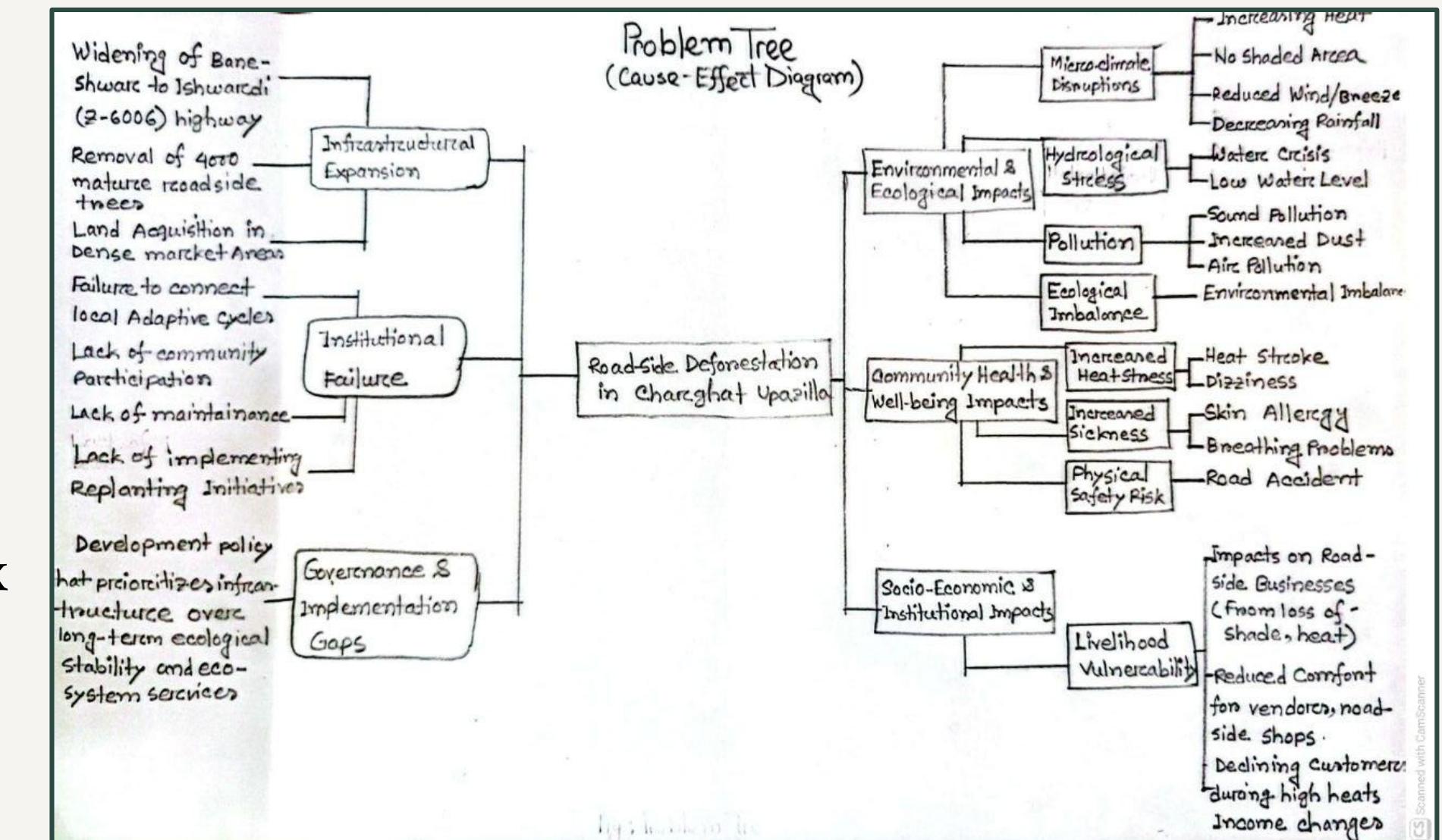
Relational Tools (Problem Tree):

To diagnose the **causes** the crisis happened for and **effects** of the crisis.



Prioritization Tools (Matrix & Pairwise Ranking):

To decide **how** to best move forward with solutions.



Source: Primary data

PRA toolbox

We used a suite of participatory tools to map the community's reality from the inside out.



Interviewing tools:
Focus Group
Discussions (FGD),
Key Informant
Interviews (KII)
& Seminars



Source: Primary data

RESULTS

Community's experience



Source: The Business Standard (2023)

The Conservation Phase (K): A Stable Social-Ecological System

For decades, the roadside trees along the Z-6006 highway in Charghat were more than green infrastructure: they were a lifeline. They provided:

Ecological Capital



Microclimate regulation & heat mitigation.



Biodiversity corridors & soil stability.



Air purification & carbon storage.

Socio-Economic Capital

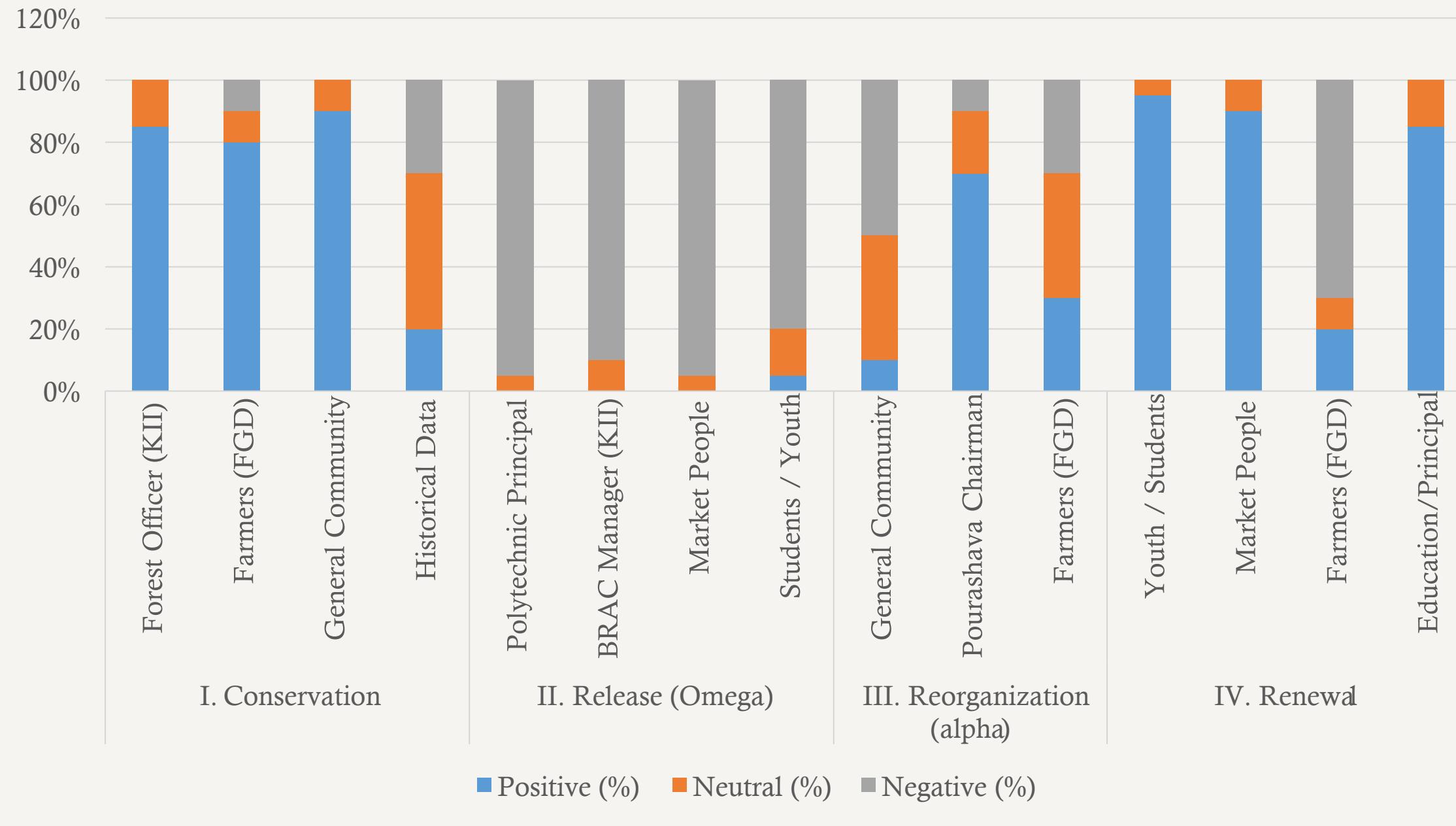


Shade for markets, schools, and social gatherings.



Livelihood support for vendors and local communities through non-timber products.

Sentiment Analysis: The Release Phase (Ω)

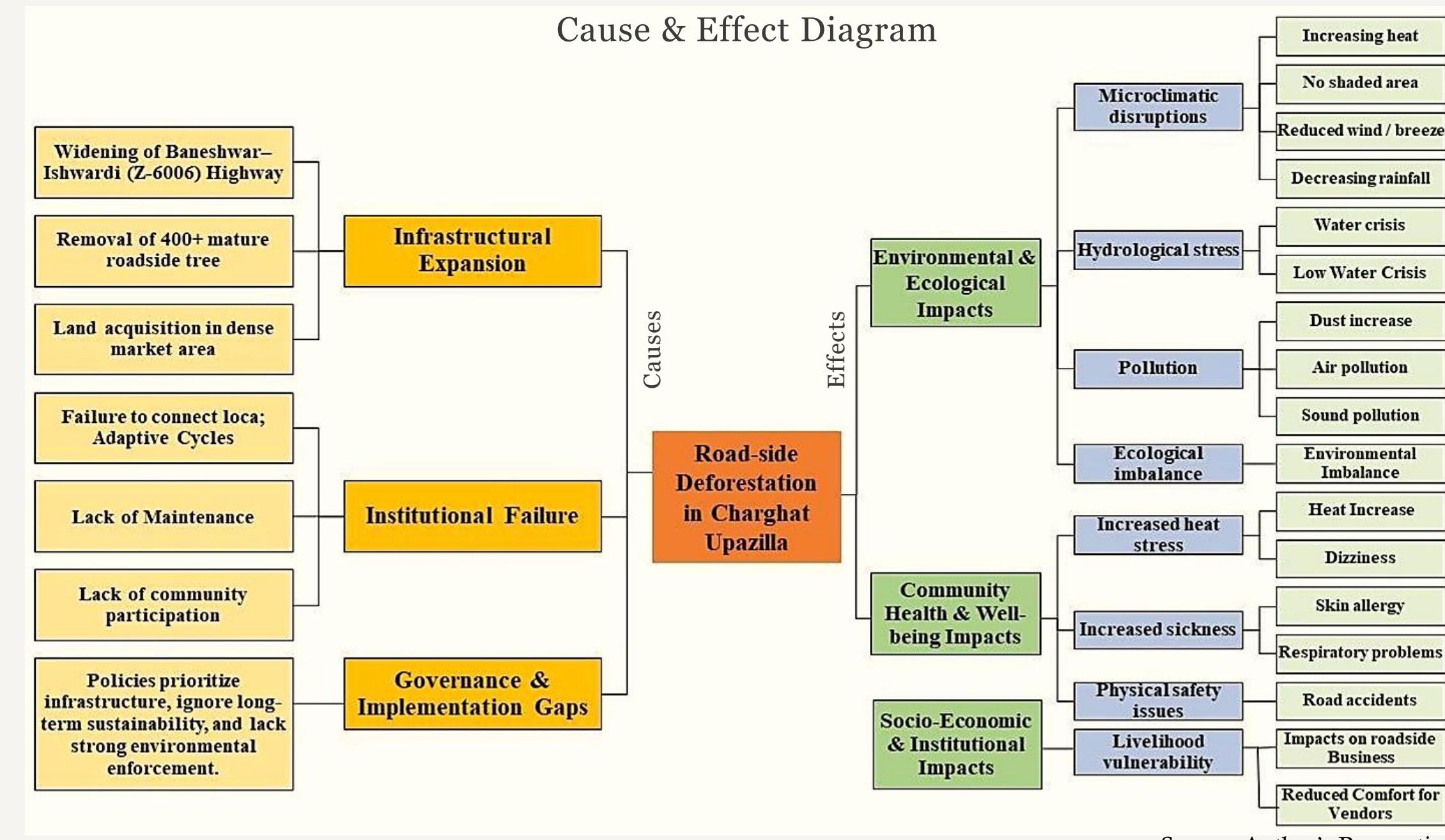


Source: Author's Preparation

The Sentiment Analysis chart quantitatively maps the community's emotional trajectory through the Panarchy cycle, revealing a dramatic shift from the stable **Conservation phase** (80-90% positive sentiment) to the acute distress of the **Release phase**, where negative sentiment among market vendors and educators peaks at 95% due to livelihood and health shocks. It further validates the adaptive capacity emerging in the **Reorganization and Renewal phases**.

Community narratives revealed a cascade of interconnected failures

- **Institutional Failure:** The process was driven by top-down infrastructure goals with a lack of community participation and long-term planning.
- **Environmental Crisis:** This directly caused microclimate disruption (increased heat, dust, no shade) and hydrological stress.
- **Socio-Economic Shock:** The environmental crisis translated into severe impacts on community health (respiratory illness) and livelihoods (reduced business, income decline).



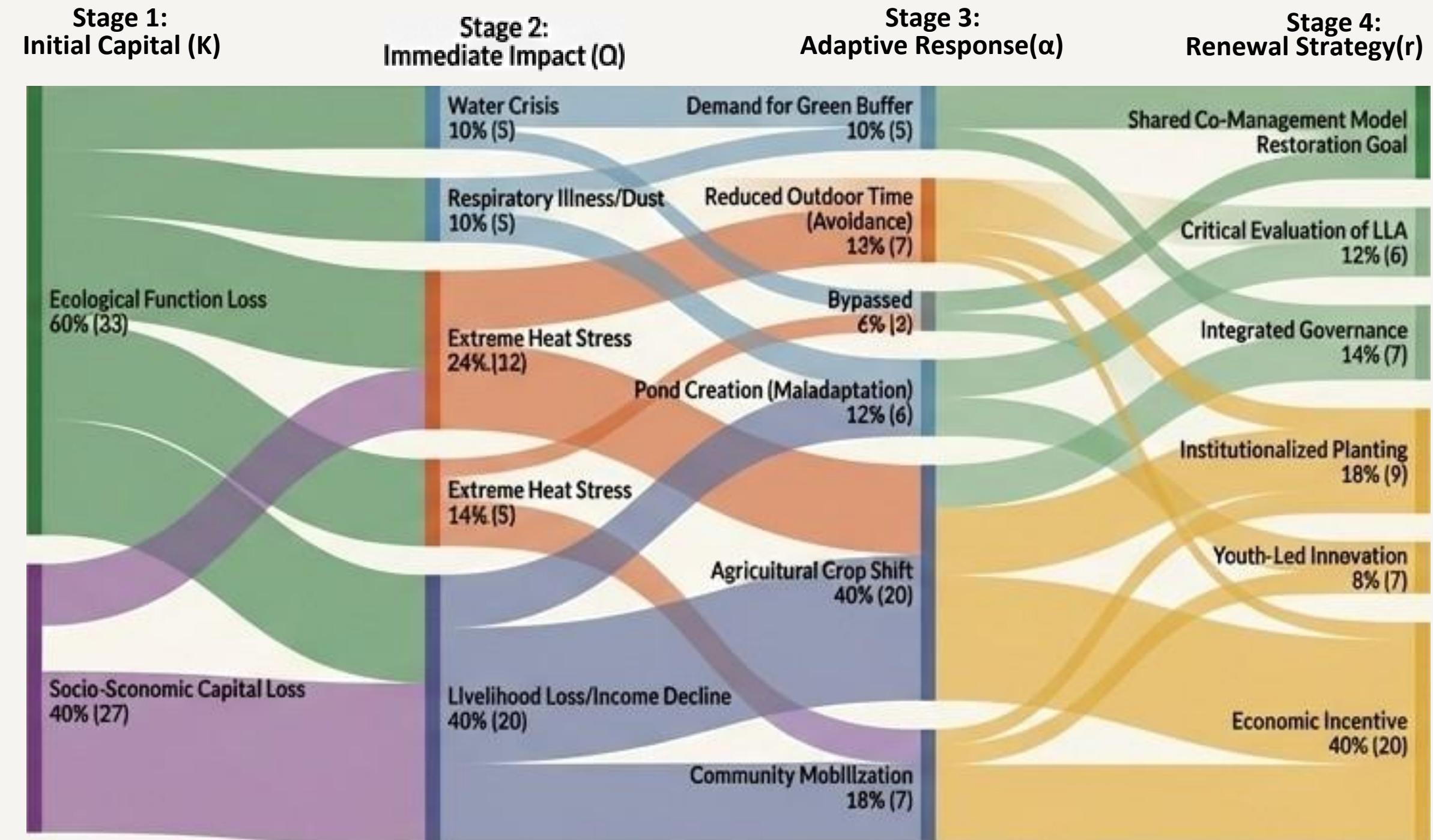
Source: Author's Preparation

The community didn't just lose trees; they lost a vital life-support system.

The Reorganization Phase (a): Community Responses to Crisis

The community's journey through the adaptive cycle shows how capital was lost and transformed into responses.

1. **Stage 1: Initial Capital (K):** The system began with stable Ecological (60%) and Socio-Economic(40%) capital.
2. **Stage 2: Immediate Impact (Ω):** Capital loss manifested primarily as Extreme Heat Stress and Livelihood Loss the two dominant pathways of the crisis.
3. **Stage 3: Adaptive Response (α):** The community reacted with coping strategies. Some were spontaneous (e.g., Reduced Outdoor Time), some maladaptive (e.g., Pond Creation), and some foundational (e.g., Community Mobilization).



Identifying Community Priorities

Through matrix ranking and thematic analysis, we quantified community priorities. The findings were clear:

- **Highest Priority:** Mitigating Livelihood Insecurity (rated 100% by farmers) and Heat & Health Stress (rated 85% by students) were the most urgent concerns across all affected groups.

Code ↓ \ Speaker →	Forest Officer	Pourashava_Chairman	Former_Pourashava_Chairman	BRAC_NGO_Manager	Polytechnic_Principal	Farmers_FGD1	Farmers_FGD2	Farmers_FGD3	Students_Youth_FGD1	Students_Youth_FGD2	Roadside_Market_People_FGD1	General_Community_FG_D1	General_Community_FG_D2
Dust_Pollution_Severity	3	6	5	4	4	8	7	9	5	4	10	6	5
Heat_Stress_and_Microclimate_Loss	2	4	3	5	6	7	6	8	9	8	4	7	6
Biodiversity_and_Wildlife_Loss	9	2	3	2	1	3	2	3	4	3	1	2	2
Livelihood_Insecurity	2	3	3	9	1	10	9	11	3	2	8	7	6
Illegal_Tree_Cutting	8	4	5	2	1	3	2	3	2	1	2	3	2
Road_Widening_and_Unplanned_Development	2	9	6	1	1	4	3	5	2	2	3	4	3
Loss_of_Ecosystem_Services	4	3	3	6	2	9	8	10	4	3	5	6	5
Reducing_Rainfall_and_Climate_Instability	3	2	2	4	3	6	5	6	8	7	2	5	4

Source: Author's Preparation

- **Divergent Views:** Institutional actors (Forest Officer) prioritized Biodiversity Loss (85%), while communities focused on immediate well-being. An effective solution must reconcile these perspectives.

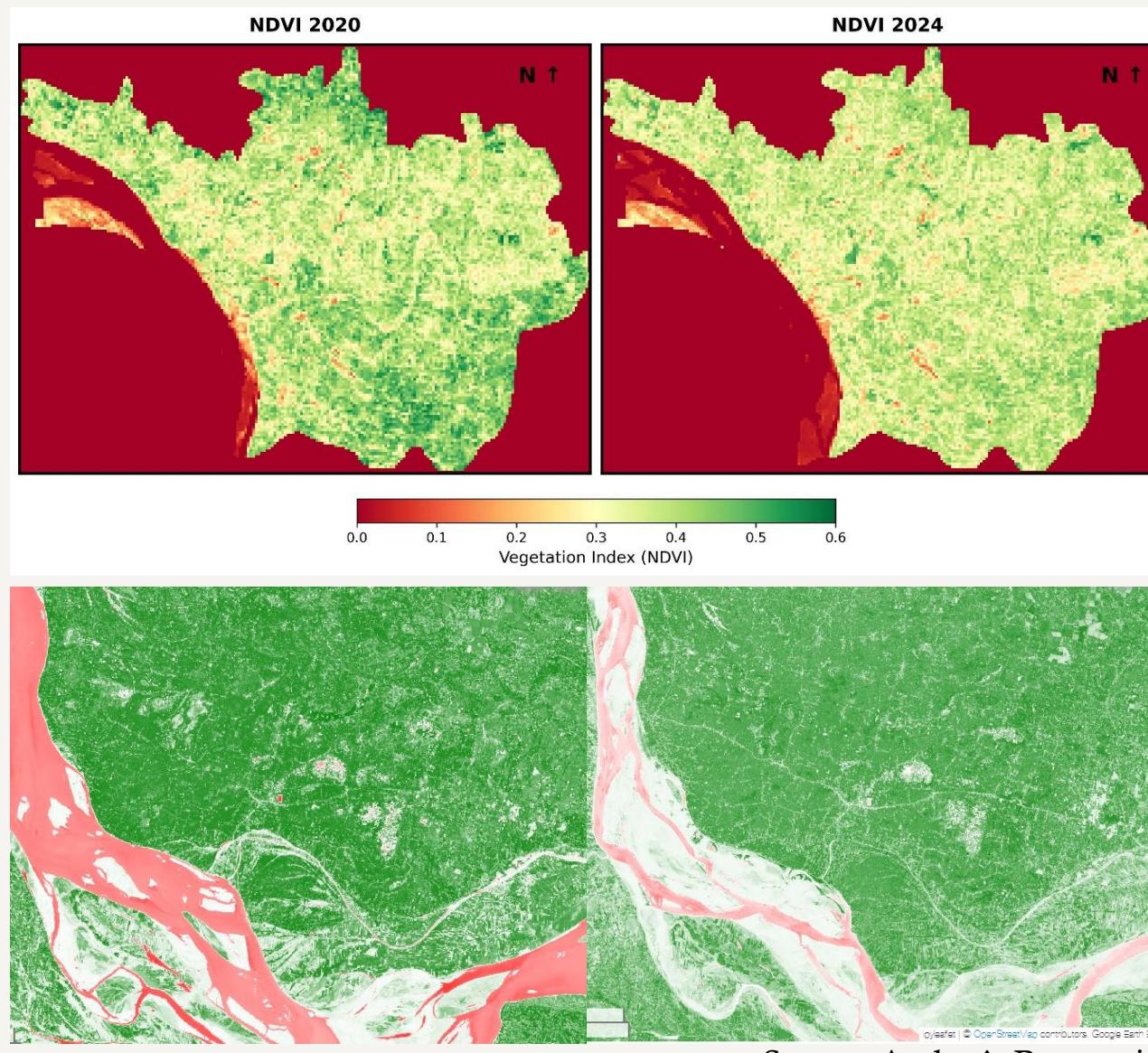
RESULTS

Spatial analysis

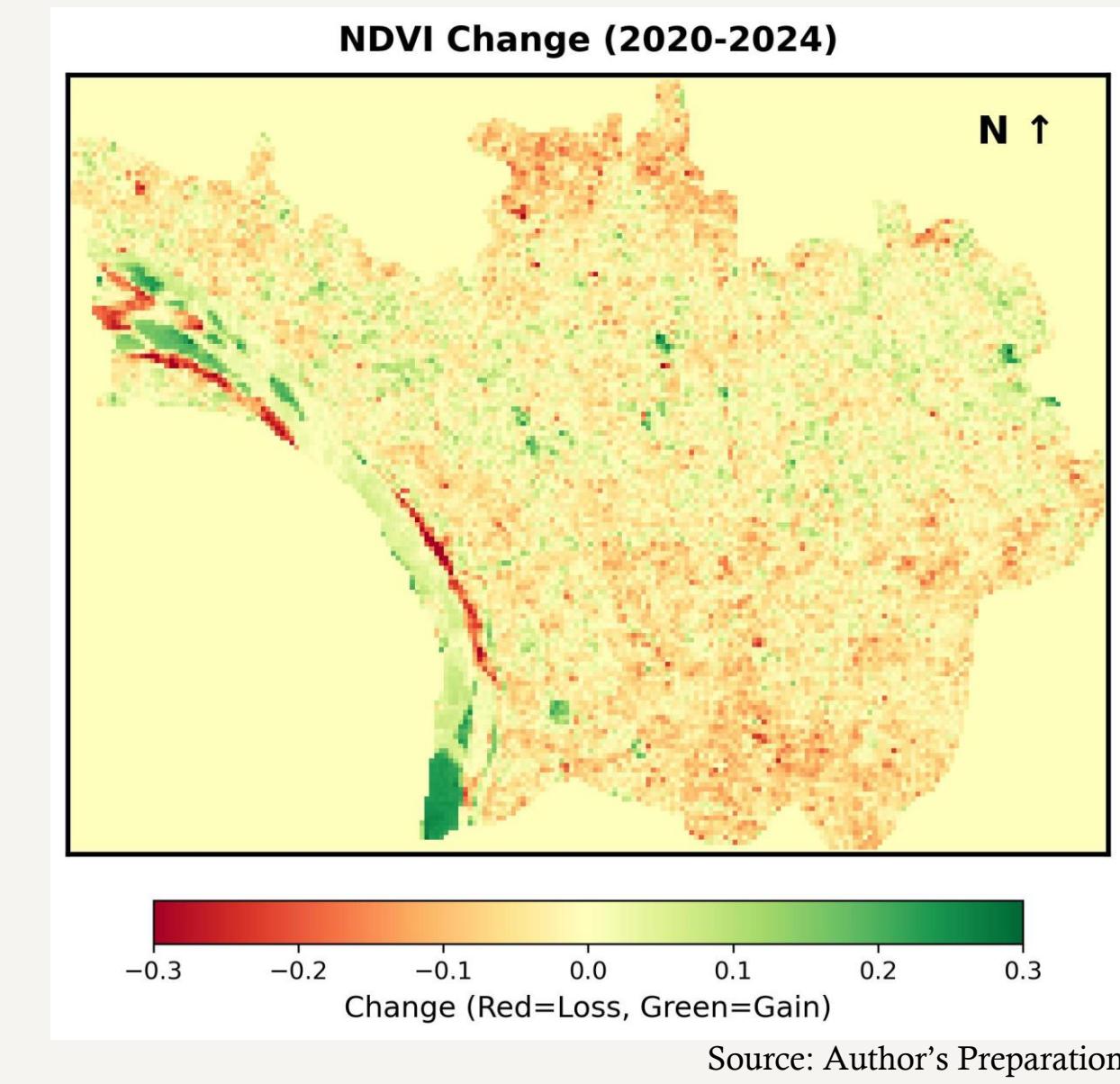
Satellite data confirmed the community's experience:

Remote sensing analysis provides objective proof of the environmental degradation.

NDVI (Normalized Difference Vegetation Index)



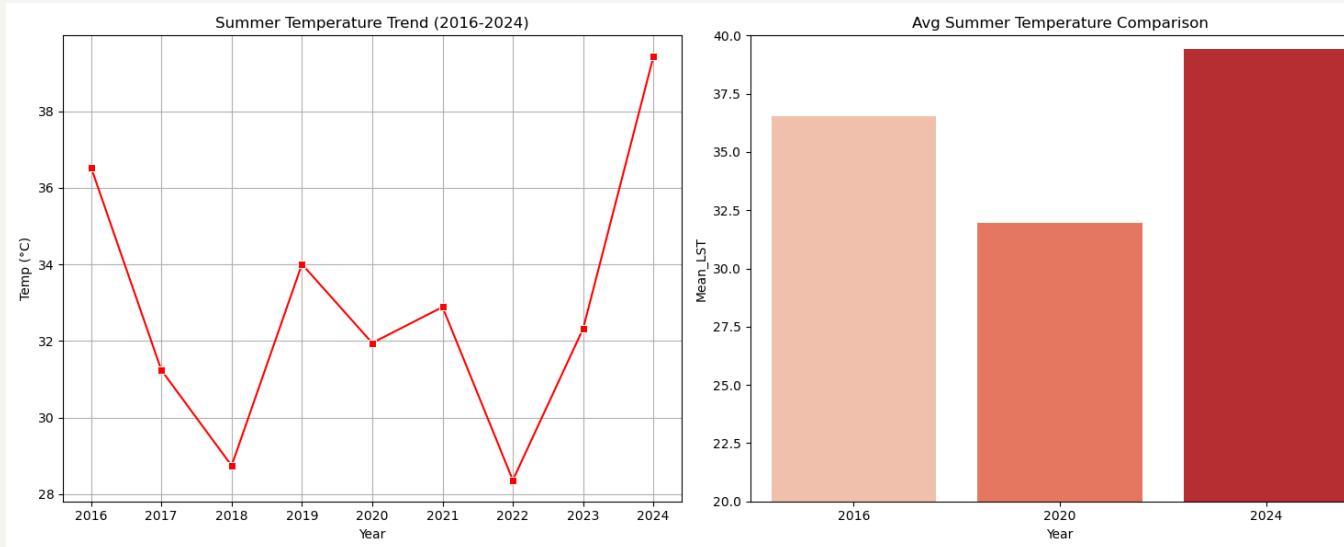
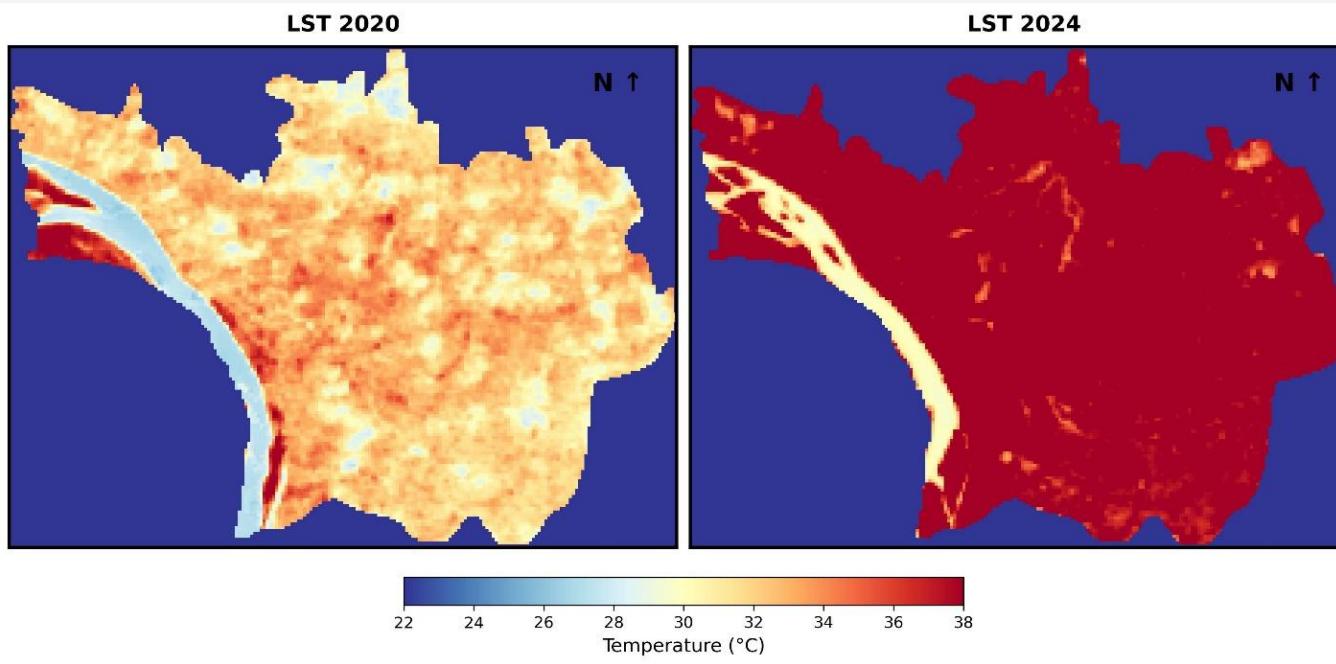
The 2024 map clearly shows the road network in yellow line where massive roadside deforestation was initiated in 2021-2023.



The change map clearly identifies significant vegetation loss (red areas) along the highway corridor, corroborating the scale of the tree removal.

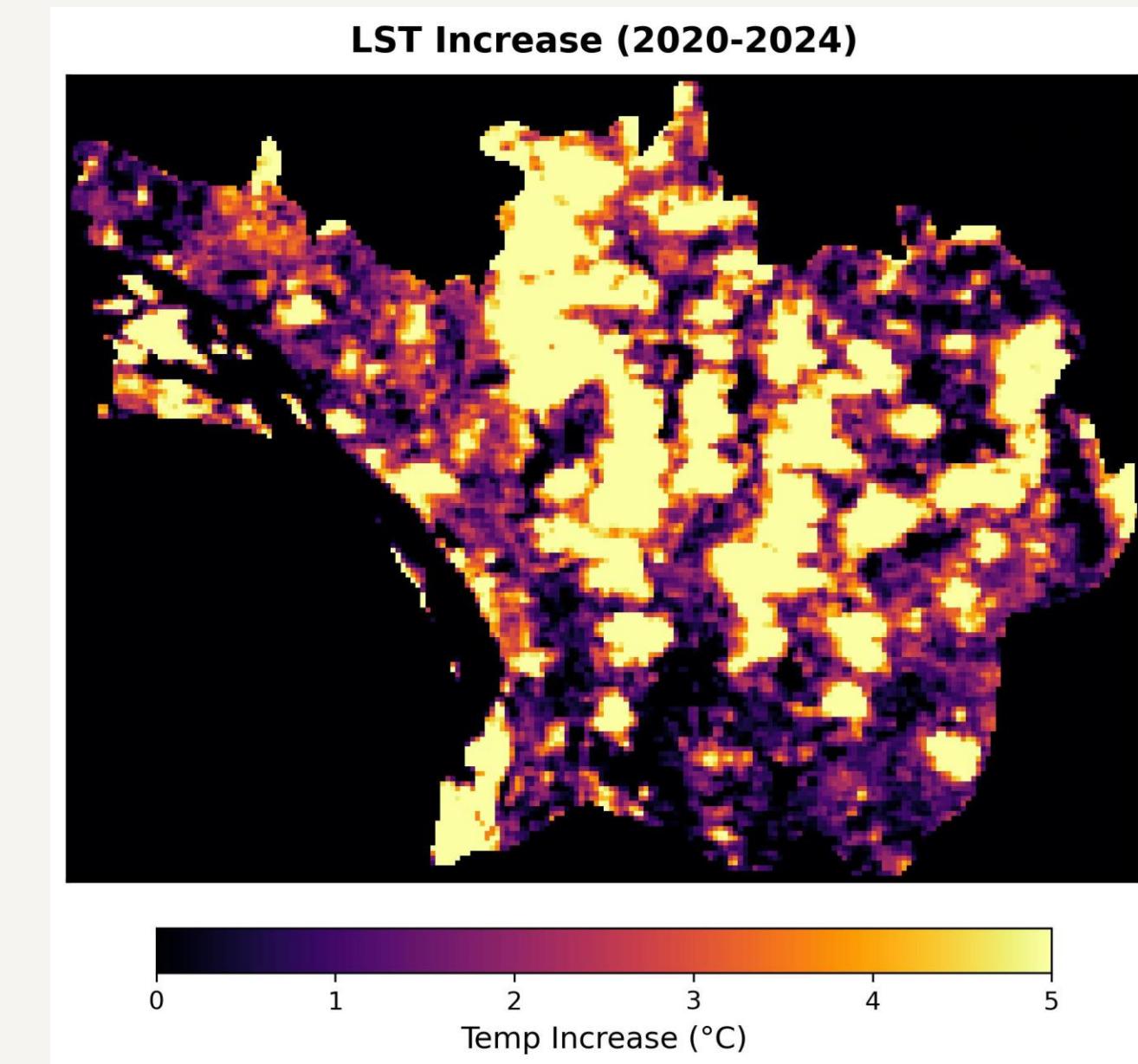
Temperature Change

LST (Land Surface Temperature)



Source: Author's Preparation

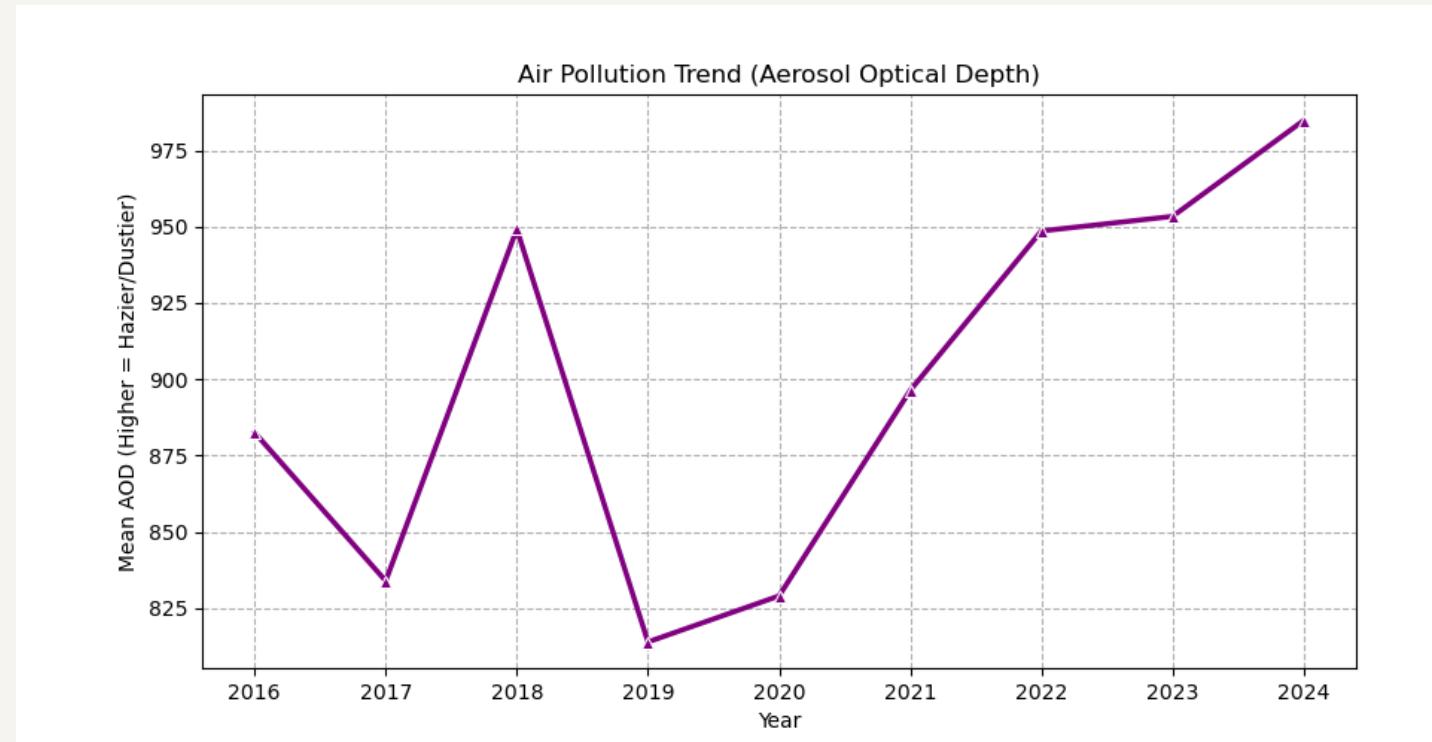
The 2024 map shows a dramatic increase in surface heat across the region, with some areas heating up by over 5°C since 2020.



Source: Author's Preparation

Temperature (average) reached 39°C in some areas, which is the highest in the last decade.

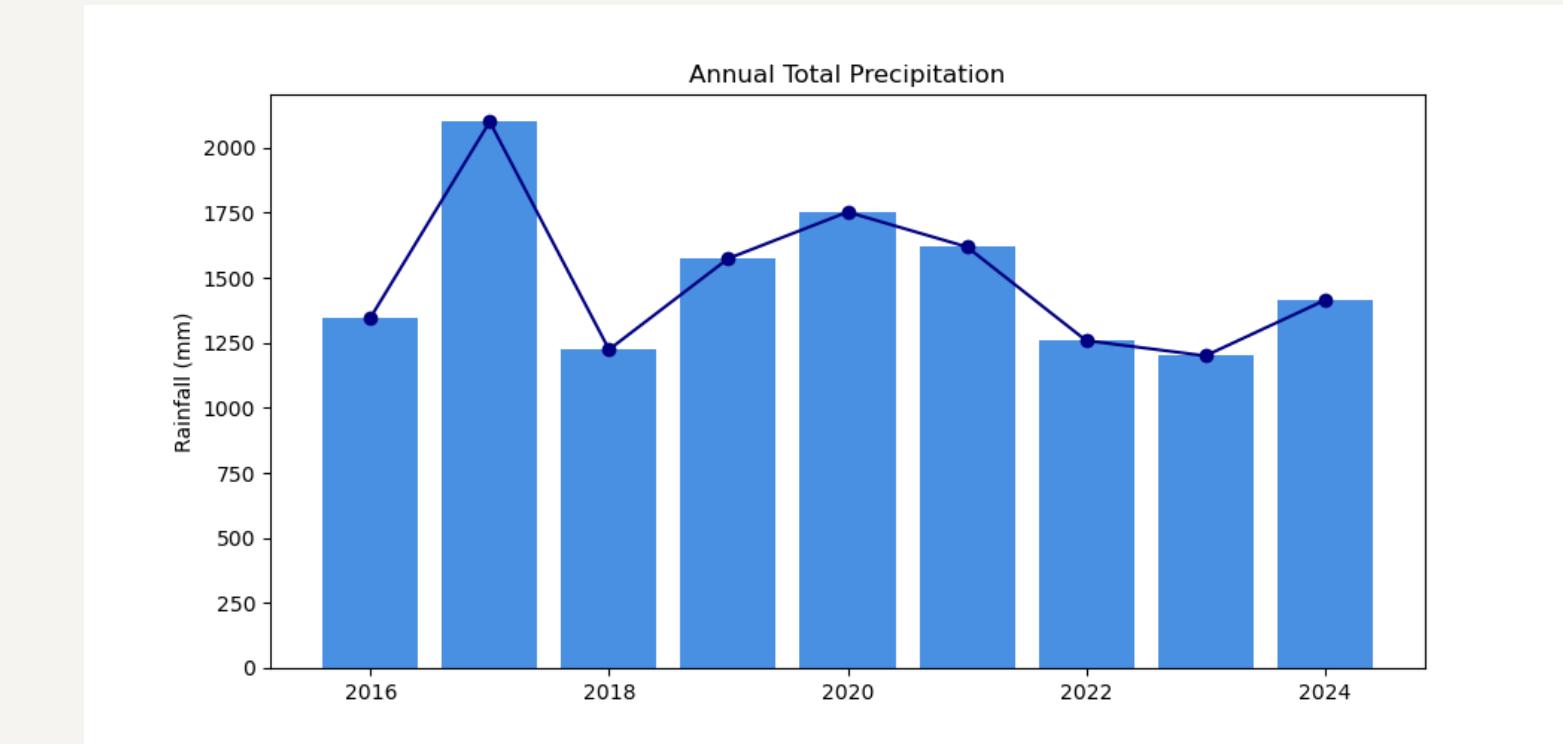
Air Pollution Analysis



Source: Author's Preparation

The air pollution (most accurately the Aerosol Optical Depth or AOD) was higher than any other time in the last decade.

Precipitation Trend Analysis



Source: Author's Preparation

The Annual Total Precipitation dropped in 2022 to 2023 and suddenly shows an increase which denotes instability in climate change.

POLICY INTEGRATION

Blueprint for Action

Community-Driven Solutions



FARMERS

- Farmers expressed that the loss of roadside trees increased heat stress on crops and working conditions, emphasizing the need to retain and restore tree cover for local temperature regulation.



ROADSIDE MARKET PEOPLE

- Roadside market vendors highlighted their vulnerability to extreme heat and stressed the importance of continuous shade and tree canopies to protect livelihoods and health.



STUDENT YOUTH GROUP

- Students and youth groups expressed curiosity and responsibility, rather than frustration alone. They emphasized regular school-based plantation activities as a way to build long-term environmental awareness and care.

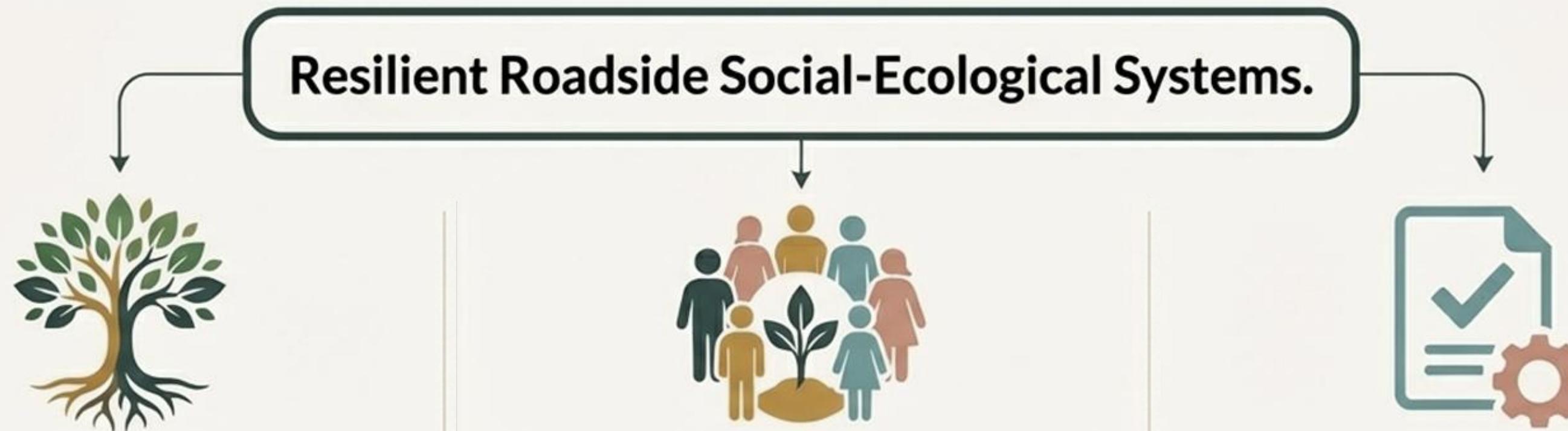


GENERAL COMMUNITY & BUSINESS OWNERS

- The general community and local business owners expressed concern over the lack of long-term maintenance. They suggested forming paid local volunteer groups to ensure tree maintenance, while also creating employment opportunities.

Together, these responses show that **adaptation is already happening at the community level**—what is needed is recognition, support, and continuity.

The Renewal Phase (r): A Framework for a Resilient Future



Ecological Restoration (NBS)

Policy: No Net Thermal Loss Policy

Action: Mandate that all road widening and infrastructure projects result in no **net increase in Land Surface Temperature (1ST)**.

Objectives:

- **Tree Retention & Canopy Equivalency:** Mandate the **preservation of mature trees** or replacement with equivalent roadside canopy to sustain local microclimate balance.
- **Thermal Auditing:** Implement thermal audits to verify that restoration measures effectively reduce asphalt-induced heat island effects.

Community Co-Management (LLA)

Policy: Community-Based Governance & Monitoring

Action: Establish formal stewardship agreements between local authorities and community groups to ensure long-term care of green corridors.

Objectives:

- **Local Volunteer Team:** Create a paid local volunteer corps to monitor and care for planted trees, providing green jobs for the unemployed.
- **Carbon Neutral Baby Program:** Pilot an initiative where households plant and maintain trees to offset a newborn's lifetime carbon footprint, ensuring long-term care through family ties.

Supportive Policy & Incentives

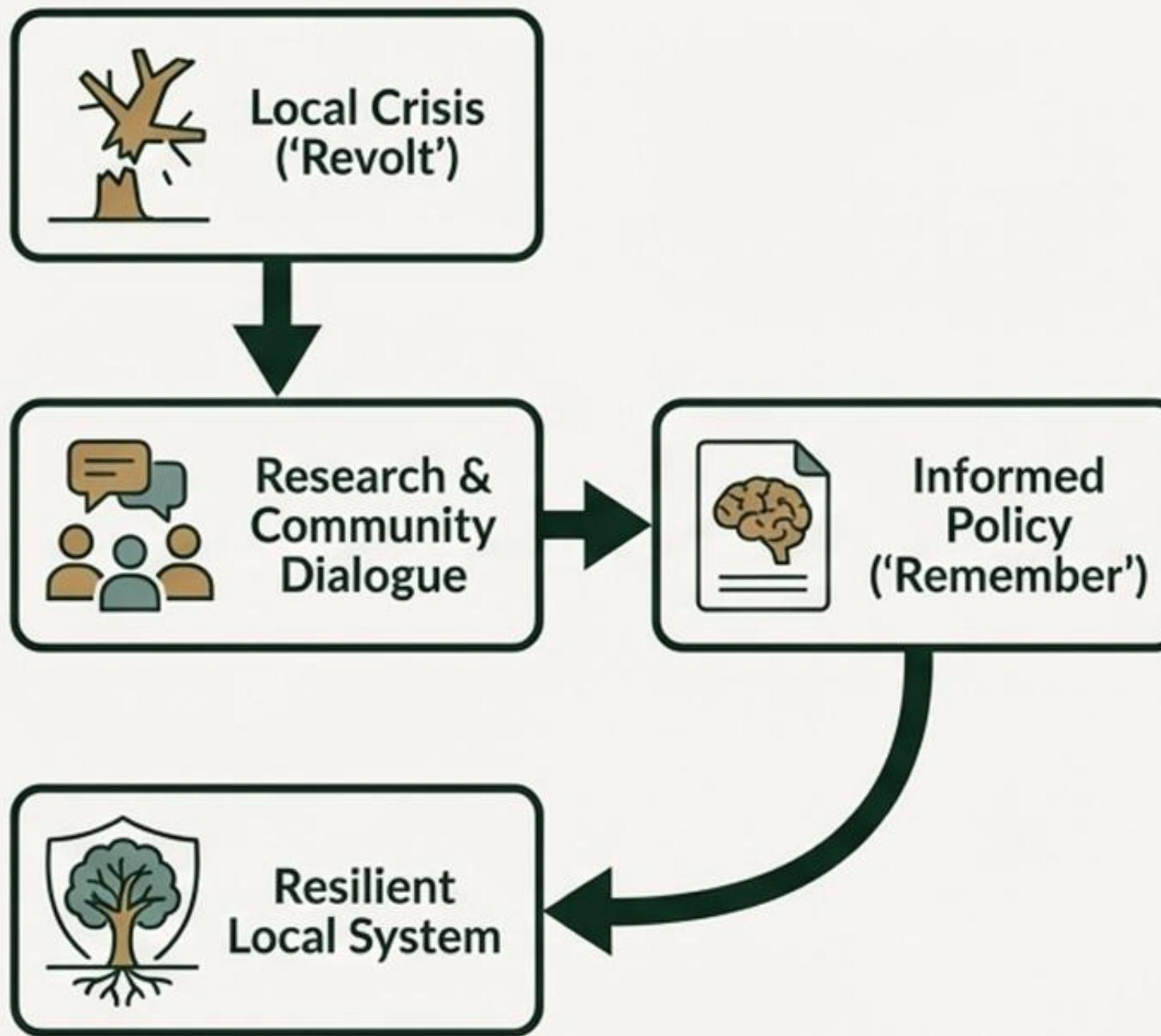
Policy: Climate-Resilient Livelihood & Infrastructure Protection

Action: Designate roadside economic zones as priority heat-protection areas and link greening efforts to business incentives.

Objectives:

- **Invest in Shading Infrastructure:** Provide continuous tree canopies and climate-responsive shading for vital economic hubs to protect vendor livelihoods.
- **Integrate Resilient Livelihood Strategies:** Link greening efforts with financial or business incentives for roadside vendors, positioning them as primary stewards.

Connecting local crisis with higher-level governance to build lasting resilience



This research provides a replicable model for transforming infrastructure crises into opportunities for sustainable development.

- **For Local Government:** Use PRA tools to assess socio-ecological impacts *before* development begins.
- **For National Agencies:** Mandate the integration of Nature-Based Solutions in all infrastructure tenders. The cost of not doing so is far greater.
- **For NGOs & Civil Society:** Facilitate the dialogue between communities and government to ensure local voices shape policy.

The key is creating **feedback loops** where local learning ("revolt") informs institutional memory ("remember").

Advancing knowledge and providing a practical model for change.

Key Finding: Roadside deforestation in Charchhat triggered a severe socio-ecological crisis but also revealed the community's powerful adaptive capacity.



Methodological Novelty



Theoretical Novelty

Developed a robust mixed-method framework that **triangulates local PRA insights with quantitative GIS/RS data**, creating a powerful evidence base for planning.

Provided a rare, empirical application of **Panarchy theory** to understand infrastructure-driven deforestation, demonstrating its utility in analyzing crisis and renewal.

The result is a **tested, community-driven framework for resilient environmental management**.

CONCLUSION

This study establishes that the widening of the Z-6006 highway, while serving as an economic artery, has simultaneously opened an ecological wound, trapping the Charghat community in a "Release" phase defined by searing heat and socioeconomic fragility. However, the data reveal we stand at a critical bifurcation point: **Either we accept permanent degradation and escalating heat stress, or we activate a Panarchy-guided renewal phase, transforming this linear heat corridor into a resilient linear forest.**

Ultimately, true infrastructure development must be redefined—not merely by the kilometers of asphalt laid, but by the canopy of shade preserved, ensuring that our roads connect our markets without severing the ecological lifelines that sustain our people.

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THANK YOU
Q & A?