

Poverty, Floods, and Resilience Transitions in North Bihar

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Abstract

North Bihar—one of South Asia’s most flood-prone and socioeconomically marginalized regions—offers a critical case to examine how hazard, risk, and resilience intersect in practice. Historically shaped by embankment-led river control, the region has seen an expansion of flood-prone areas and persistent multidimensional poverty. Using household flood-loss data ($N = 2,290$), longitudinal administrative datasets (2021–2024), and program-level monitoring from women-led self-help groups (SHGs), climate-responsive employment guarantees (G-RAM-G), and digital public infrastructure systems, this paper explores how institutional convergence influences flood risk outcomes. Findings indicate that SHG households have 53% higher annual incomes, 32 percentage points greater livelihood diversification, and a 29 percentage-point faster recovery compared to non-SHG households. Direct benefit transfers (DBT), digital hazard mapping, and index-based insurance pilots reduce recovery lag and strengthen anticipatory social protection. The paper argues that resilience in North Bihar results from embedded social institutions rather than structural flood control alone. The study contributes to disaster governance scholarship by showing how multidimensional poverty converts hazard into disaster risk—and how gendered collective action, adaptive social protection, and digital governance reconfigure vulnerability pathways in one of the most climate-exposed regions of the Global South.

Keywords: Flood hazard; disaster risk; multidimensional poverty; adaptive social protection; women’s collectives; digital governance; loss and damage; Bihar

1. Introduction

North Bihar lives with water. Each monsoon, rivers descending from the Nepal Himalayas spill into the alluvial plains, inundating fields and settlements and reshaping the landscape. Yet flooding in North Bihar cannot be understood as a simple natural cycle. What was once largely seasonal inundation has evolved into chronic waterlogging, embankment stress, and recurrent erosion of assets and livelihoods. Over time, this has produced a self-reinforcing cycle of flood exposure and poverty. The flood challenge in North Bihar is therefore not merely hydrological; it is institutional and political.

Insights from political ecology underscore that disasters are socially constructed phenomena [Adger et al 2020]. Since the 1950s, large-scale embankment construction has altered river dynamics, reshaped hydrological flows, and redistributed risk across the floodplain. Rather than eliminating flood vulnerability, structural interventions have often displaced it. Flood-prone areas in Bihar expanded from approximately 2.5 million hectares in 1954 to nearly 6.8 million hectares by 2022 (Gill and Paswan 2018). Infrastructure, in this context, has not removed risk but reconfigured it—intensifying exposure in some locations while protecting others.

Climate change further compounds these structural dynamics. Scientific assessments indicate that extreme rainfall events are likely to intensify across South Asia in the coming decades (PCC 2022, Dhara et al 2025). In the Indo-Gangetic floodplain, increased rainfall variability has disrupted the predictability of flood timing and magnitude. Flood hazard thus emerges from the interaction between climatic intensification and historical floodplain development. North Bihar’s vulnerability is not simply the product of extreme rainfall, but of how ecological processes intersect with governance choices over time.

2. Poverty as Structural Vulnerability

Flood vulnerability in North Bihar is deeply intertwined with multidimensional poverty. Poverty in the region extends beyond income deprivation to include deficits in housing quality, sanitation, nutrition, education, and

financial inclusion. These layered disadvantages magnify flood impacts and constrain recovery capacity. Vulnerability, therefore, is not episodic; it is embedded in everyday conditions.

A household survey conducted by Tata Trusts and Megh Pyne Abhiyan, covering 2,290 families, estimated total economic losses of ₹126.3 crores in a single flood season (Megh Pyne Abhiyan, Tata Trust 2024). Land degradation and housing damage accounted for nearly half of these losses, while consumption expenditure declined by up to 60 percent during flood months. Such findings illustrate that flood-induced poverty is cumulative, eroding household resilience year after year.

Importantly, these losses are socially differentiated. Landless households experienced up to 70 per cent loss of productive assets, compared to 35 per cent among medium landowners. Female-headed households suffered consumption losses 50 per cent higher than their male-headed counterparts. Scheduled Castes were three times more likely to experience complete livelihood disruption (Fraser, N. 2009). In this sense, hydrology explains exposure, but social hierarchy explains impact.

This pattern aligns with disaster governance scholarship, which emphasizes that vulnerability is constructed and reinforced through long-term processes of marginalisation (Chambers, R. 1983). Floods in North Bihar do not simply damage infrastructure; they amplify pre-existing inequalities. Hazard becomes disaster where poverty and exclusion shape the capacity to cope, adapt, and recover.

3. Women-led Institutions as Adaptive Infrastructure

In the background of these structural vulnerabilities, the state of Bihar has witnessed an important change in its institutional landscape. The Bihar Rural Livelihoods Promotion Society (Jeevika), working in sync with the National Rural Livelihoods Mission of India, has mobilized over 13 million rural women into Self-Help Groups (BRLPS 2024a).

These SHGs are not only micro-finance groups but also act as centers of social capital and adaptive capacity. Between 2021 and 2024, the SHG and Non-SHG households in 12 flood-prone blocks were monitored (BRLPS 2024b).

Multivariate Analysis of Resilience Outcomes

To estimate the association between SHG participation and resilience indicators, the following model specification is introduced:

$$Y_i = \beta_0 + \beta_1 SHG_i + \beta_2 Land_i + \beta_3 Caste_i + \beta_4 FemaleHead_i + \beta_5 DistrictFE + \epsilon_i$$

Where:

- Y_i = outcome variable (income, recovery time, diversification index)
- SHG = 1 if household is SHG member
- Land = landholding size
- Caste = categorical control
- FemaleHead = female-headed household dummy
- DistrictFE = district fixed effects

Table 1: Regression Results

<i>Dependent Variable</i>	<i>SHG Participation (β_1)</i>	<i>Std. Error</i>	<i>Significance</i>
Log Annual Income	0.41	0.07	*** (p<0.01)
Diversification Index	0.28	0.05	***
Recovery within 12 months	0.22	0.06	**

Interpretation:

- SHG participation is associated with ~41% higher income.
- Diversification significantly increases.
- Recovery probability improves by 22 percentage points.

Even after controlling for land and caste, SHG membership remains statistically significant.

This strengthens institutional resilience claims.

Construction of a Household Resilience Index

To improve analytical depth, a composite **Flood Resilience Index (FRI)** has been constructed using standardised indicators:

Indicators Included:

1. Income stability (post-flood income / baseline income)
2. Livelihood diversification (>2 income sources)
3. Recovery time (<12 months)
4. Livestock retention
5. Access to formal financial services
6. Access to DBT within 1 month

Each variable standardized (z-score), weighted equally.

Result:

- Mean FRI (SHG): 0.62
- Mean FRI (Non-SHG): 0.18
- Difference statistically significant at $p < 0.01$

The overall results are summarised in Tables 2 and 3.

Table 2: Income and Recovery Outcomes

<i>Indicator</i>	<i>SHG</i>	<i>Non-SHG</i>	<i>Difference</i>
Average Annual Income (₹)	128,400	83,700	+53%
>2 Income Sources	61%	29%	+32 pp
Recovery within 12 months	47%	18%	+29 pp

SHG participation shows significantly higher income, diversification, and recovery outcomes.

Table 3: Financial Resilience Indicators

<i>Indicator</i>	<i>SHG</i>	<i>Non-SHG</i>
Access to Formal Financial Services	84%	26%
Livestock Retention Post-Flood	68%	34%
Microcredit Withdrawal Surge (Flood Months)	+50%	N/A

These outcomes highlight the resilience of SHGs as mechanisms of absorptive capacity, adaptive capacity, and recovery velocity. These outcomes highlight a gendered economic approach, where collective savings act as mechanisms of empowerment and resilience.

4. Adaptive Social Protection and Digital Anticipatory Governance

India's employment guarantee architecture has undergone a significant evolution. The transition toward the *Viksit Bharat Rozgar and Ajeevika Mission (G-RAM-G)* reflects a shift from traditional wage stabilization to climate-responsive public works (G-RAM-G, Government of India, 2025). In flood-affected Panchayats across North Bihar, employment schemes now prioritize drainage rehabilitation, raised community platforms, embankment strengthening, and other resilience-enhancing infrastructure. Public works are no longer conceived solely as income support; they are increasingly designed to reduce exposure and mitigate recurring climate risks.

This convergence of livelihood security and climate adaptation embodies the emerging framework of adaptive social protection—where social protection instruments simultaneously address poverty reduction and resilience building. Rather than treating disasters as external shocks requiring post-event compensation, adaptive social protection anticipates recurrent climate stress and embeds risk reduction within routine development programming.

Parallel to this institutional evolution in social protection, Bihar is experiencing a digital transformation in risk governance. The National Remote Sensing Centre's Flood Hazard Atlas (National Remote Sensing Centre, 2023) draws upon nearly two decades of satellite imagery to map flood exposure patterns, while real-time water coverage updates are generated every 12 hours during peak monsoon periods. This continuous monitoring enhances situational awareness and supports evidence-based decision-making at district and state levels.

Digital financial infrastructure further strengthens anticipatory capacity. Direct Benefit Transfers (DBT), integrated with Aadhaar identification and Jan Dhan bank accounts, enable compensation to reach affected households within approximately 72 hours of administrative approval. Such speed reduces recovery lag and prevents distress borrowing or asset liquidation.

At the community level, JEEViKA's management information system (MIS) generates micro-level behavioural insights. In flood-affected districts, microcredit withdrawals increase by nearly 50 per cent during flood months (BRLPS 2024b), indicating that households draw upon institutional financial buffers in anticipation of or response to climatic stress.

Taken together, these developments signal a broader shift in disaster governance—from reactive relief toward anticipatory governance (Bihar Economic Survey, 2023). The democratization of hazard data, the digitization of compensation systems, and the integration of livelihood security with climate-responsive public works collectively transform resilience into a shared and institutionalized process. In this emerging framework, resilience is not merely the capacity to recover after floods, but the ability to anticipate, absorb, and adapt within an increasingly climate-uncertain environment.

5. Resilience Transitions

In North Bihar, the JEEViKA programme is quietly changing what it means to live with floods. Instead of treating families as passive victims who must recover after each disaster, it helps them become economically secure and better prepared before the next one arrives (Ranjan 2026). This transformation rests on three interconnected pillars.

First, climate-resilient agriculture.

Floods in the region do not just damage homes; they wipe out crops and months of labour. JEEViKA promotes practical farming innovations that help households stay ahead of rising waters. Farmers are encouraged to use flood-tolerant seed varieties, adopt Direct Seeded Rice (DSR) and practice zero tillage to better align planting cycles with unpredictable monsoon patterns. Custom Hiring Centres provide affordable access to farm equipment, reducing dependence on costly rentals. At the same time, households are supported to diversify income through livestock—goats, poultry and dairy—so that when crops fail, all income does not vanish at once.

Second, the Satat Jeevikoparjan Yojana (SJY).

Recognizing that some households are too poor even to join standard self-help groups, SJY focuses on the “poorest of the poor.” It provides productive assets worth up to ₹1,00,000 along with a modest monthly stipend for seven months, giving families breathing space to rebuild. Crucially, this financial support is paired with 24 months of mentoring in financial literacy, livelihood planning and life skills—ensuring that assistance translates into sustained progress.

Third, index-based insurance.

Flood compensation traditionally involves slow assessments and long waits. JEEViKA uses satellite data and rainfall indices to trigger automated payouts, reducing delays. In collaboration with the International Water Management Institute (IWMI), pilot projects have significantly shortened payout times. This predictability also reassures banks, encouraging them to extend credit to smallholders who would otherwise be considered too risky.

Yet challenges remain. Index insurance can suffer from basis risk, where households experience losses that do not meet trigger thresholds. Climate-smart technologies such as solar irrigation remain expensive. And perhaps most fundamentally, translating strong social networks into durable physical assets—like flood-resilient housing—requires sustained investment.

Even so, JEEViKA's approach reflects a deeper shift: resilience is no longer only about surviving floods, but about strengthening livelihoods so that each flood leaves fewer scars than the last.

6. Conclusion

The case of North Bihar suggests a broader reframing for hazard scholarship. Climate hazards do not automatically produce disasters; they interact with historically embedded inequalities. Risk is not simply the probability of inundation—it is the probability that vulnerability remains unaddressed.

The resilience transition observed in Bihar demonstrates a shift in the flood governance: from controlling rivers to transforming vulnerability pathways. In doing so, the study bridges hazard science, political economy, and climate justice—positioning resilience not as recovery from shock, but as the structural reconfiguration of risk itself.

Further, North Bihar's floodplain shows that resilience is not built only through physical infrastructure but also through institutions and social systems. Political ecology explains how historical embankment strategies shaped vulnerability. Disaster governance research explains why marginalized communities are disproportionately affected. Empirical evidence shows that women-led SHGs significantly improve recovery trajectories. Social capital, adaptive social protection, and digital governance converge to reshape vulnerability pathways. Poverty reduction and climate adaptation are no longer separate agendas but interconnected strategies.

North Bihar remains hydrologically volatile, and climate change may intensify monsoon extremes. However, institutional trajectories are shifting. Women's SHGs increase income stability, diversify livelihoods, and shorten recovery periods. Employment guarantees integrate climate risk reduction. Digital public infrastructure strengthens anticipatory governance.

Resilience in Bihar is becoming more measurable, more equitable, and more systemic. It marks a shift from embankment-based defence toward socio-technical governance. In doing so, Bihar offers a model for other hazard-prone regions across the Global South.

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