Climate Change, Tribal Livelihoods and Adaptive Capacity in Jangalmahal, West Bengal: A Comparative Policy and Secondary-Data Case Study

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Abstract*—Climate change interacts with livelihood insecurity through ecological change, resource access, labour markets, public infrastructure, and the capacity of institutions to support adaptation. These relationships are especially important in Jangalmahal, a forest-fringe and predominantly rural region of southwestern West Bengal where many households combine rain-fed agriculture, wage labour, forest-based products, livestock, and migration. This article develops a comparative policy and secondary-data framework for examining how climate-related livelihood risks and adaptive capacity intersect across Jhargram, Purulia, Bankura, and Paschim Medinipur. It synthesises published research on tribal livelihood vulnerability and forest dependence with official material on climate vulnerability, the Forest Rights Act (FRA), and the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). The review identifies an established empirical foundation: prior household research in Paschim Medinipur has compared vulnerability among Santal, Munda, Bhumij, and Lodha communities, while another study has examined forest-dependent households' perceptions of climate and forest change in Jangalmahal. Consequently, the principal contribution proposed here is not a claim that the region is unstudied, but a shift from describing vulnerability toward assessing the policy pathways through which adaptive capacity might be supported, constrained, or unequally distributed. The article uses the sustainable livelihoods framework, vulnerability theory, and institutional analysis to organise evidence across five dimensions: livelihood assets, climate exposure, access to natural resources, public employment and infrastructure, and institutional recognition and participation. Official FRA figures demonstrate that claims, titles, and pending or rejected applications differ across the four districts, but these administrative measures cannot by themselves establish whether rights are secure or whether climate resilience has improved. Similarly, MGNREGA expenditure and employment indicators can describe implementation but cannot be interpreted as adaptation outcomes without examining asset quality, durability, distribution, and local hazard relevance. The paper proposes a reproducible comparative protocol and a policy matrix linking evidence to testable propositions. It concludes that climate adaptation in Jangalmahal should be evaluated as a multi-institutional process connecting livelihood diversification, secure resource access, locally relevant public works, and meaningful participation. Quantitative conclusions about present-day household adaptive capacity remain contingent on extraction and harmonisation of current district- and block-level datasets.

***Index Terms*—Climate Change, Tribal Livelihoods, Adaptive Capacity, Jangalmahal, West Bengal, Forest Rights Act, MGNREGA, Sustainable Livelihoods, Climate Justice, Policy Implementation**

I. Introduction

Climate change is not experienced only as a change in mean temperature or precipitation. Its consequences are mediated through the resources on which people depend, the distribution of assets and opportunities, and the institutions through which households obtain support before, during, and after climatic stress. In rural settings, climatic hazards may affect crop production, water availability, forest

products, wage labour, health, and mobility simultaneously. A household's ability to respond therefore depends not only on the severity of a hazard but also on its assets, access to services, social networks, entitlements, and capacity to influence decisions. This relational understanding of vulnerability is central to contemporary climate adaptation research (Adger, 2006; Intergovernmental Panel on Climate Change [IPCC], 2022).

Jangalmahal in southwestern West Bengal provides a relevant setting for examining these relationships. The term is commonly used for a group of forest-fringe and historically marginalised areas associated with Jhargram, Purulia, Bankura, and Paschim Medinipur. The region is internally diverse: settlement patterns, forest cover, irrigation, market access, employment opportunities, administrative capacity, and tribal population shares vary between and within districts. Many households draw on mixed livelihood portfolios rather than a single source of income. Rain-fed cultivation, casual labour, collection or processing of non-timber forest products (NTFPs), livestock, public employment programmes, small trade, and seasonal migration may coexist within a household's annual livelihood strategy. The relative importance of these activities can change with rainfall, prices, access to forests, household labour, and public support.

Climate risk in such settings should not be reduced to a simple claim that one climatic variable directly determines poverty. Rainfall variability, heat stress, dry spells, and intense rainfall may create livelihood pressures, but the resulting harm depends on land quality, irrigation, savings, health, gendered divisions of labour, access to markets, forest governance, and the availability of social protection. Conversely, some households may use diversified income, community networks, public works, or resource rights to reduce exposure and recover more quickly. The analytical challenge is to explain why adaptive capacity differs across households and places, and how policy can improve it without undermining ecological sustainability or local agency.

The study is also relevant to international debates on climate justice and just adaptation. Indigenous and tribal communities are frequently described as highly dependent on natural resources, but this description can obscure the institutional and political conditions shaping resource access. Forests may provide food, fuel, fodder, medicinal plants, seasonal income, and cultural value. Yet resource use is mediated by legal recognition, conservation practices, market structures, and local governance. Adaptation policies that promote diversification without recognising these relationships may shift costs onto households or encourage maladaptive strategies.

Existing research in Jangalmahal has already examined important parts of this problem. Das and Basu (2022) used primary data from 200 tribal households in Paschim Medinipur to compare livelihood vulnerability among Santal, Munda, Bhumij, and Lodha communities. Their study reported differences in vulnerability and identified family size, poverty, agricultural income, and distance to markets as relevant determinants. Payra and Jana (2024) investigated household perceptions of climate and forest change in Jangalmahal. Studies of forest dependence and livelihood transitions further demonstrate that forest products and institutions are important to local livelihood systems. These contributions mean that a new article should not present the region as an empirical blank or reproduce a vulnerability index without a distinct purpose.

This article instead asks how the evidence on livelihood vulnerability can be connected systematically to the design and implementation of public policy. It focuses on the relationship among three policy domains: (a) climate adaptation and disaster-risk planning; (b) forest rights and community resource governance under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; and (c) employment, water conservation, and rural asset creation under MGNREGA. These domains have different legal mandates and administrative systems, but they can affect overlapping dimensions of adaptive capacity. Secure resource rights may influence livelihood options; employment guarantees may support consumption smoothing and finance locally useful assets; and climate plans may guide risk-sensitive

investments. Whether these mechanisms work together in Jangalmahal is an empirical question, not an assumption.

The article has four objectives. First, it synthesises the evidence on climate-related livelihood vulnerability and adaptive capacity in Jangalmahal. Second, it develops a comparative framework for analysing district differences without treating district averages as direct measures of household experience. Third, it examines how FRA, MGNREGA, and climate-adaptation planning can be assessed as potentially complementary policy mechanisms. Fourth, it specifies a transparent secondary-data protocol and identifies the evidence required before making claims about programme effectiveness.

The paper contributes in three ways. Conceptually, it treats adaptive capacity as a product of livelihood assets and institutional access rather than as a static household attribute. Methodologically, it separates descriptive administrative indicators, peer-reviewed empirical findings, and untested propositions. For policy, it proposes that adaptation evaluation should assess not only programme coverage or spending but also the relevance, durability, equity, and ecological consequences of interventions. The paper does not claim to estimate new district-level causal effects. Its empirical conclusions are limited to verified published findings and official administrative information; proposed comparisons requiring data extraction are explicitly identified as future analytical steps.

II. Study Context: Jangalmahal and Tribal Livelihood Systems

2.1 Defining the study region

Jangalmahal is a socio-geographic and administrative-historical term rather than a single uniform ecological unit. For a reproducible study, the article defines the core comparative area as Jhargram, Purulia, Bankura, and Paschim Medinipur districts, consistent with official reporting that identifies these districts as the Jangalmahal region for FRA implementation. The boundary must nevertheless be specified in every table and map because definitions of Jangalmahal vary across publications and administrative contexts. A district-level comparison is feasible with public administrative data, but district averages may conceal substantial variation between blocks, villages, and social groups.

The region includes forest-fringe settlements, agricultural landscapes, dry deciduous vegetation, and rural market centres. Rain-fed agriculture and seasonal labour are important components of many livelihood portfolios, while access to irrigation, roads, health services, schools, financial services, and non-farm employment is uneven. These features should be treated as hypotheses to be verified against official statistics rather than as uniform characteristics of every community.

2.2 Livelihood diversity and forest dependence

A sustainable livelihood perspective recognises that households combine assets and activities in ways shaped by institutions and vulnerability contexts (Chambers & Conway, 1992; Scoones, 1998). In Jangalmahal, forest products can contribute to food, fuel, fodder, medicine, household use, and cash income. Their importance may vary by season, species availability, collection rules, market access, gender, age, and labour availability. Forest dependence should therefore not be measured only as the proportion of cash income derived from forests. Subsistence value, reduced expenditure, cultural significance, and ecological services may also matter.

At the same time, dependence on natural resources can create risk when access is uncertain or ecological productivity changes. A reduction in the availability or quality of a product may affect collection time, household consumption, and sale income. If alternative employment is limited, households may increase labour migration, intensify extraction, borrow, reduce consumption, or rely on public transfers. These responses can be protective in the short term but costly over time. The paper treats such responses as pathways to investigate, not as established outcomes for all Jangalmahal households.

2.3 Climate stress and exposure

The climatic dimensions relevant to the study include long-term temperature trends, rainfall variability, dry spells, heavy-rainfall events, drought conditions, and potential changes in the timing of seasonal activities. The analysis should use quality-controlled observations or gridded products with a stated temporal period and spatial resolution. Regional climate projections can contextualise future risks, but projections should not be substituted for observed local trends. A credible assessment must distinguish observed weather variability, statistically estimated climate trends, and household perceptions.

Climate exposure also interacts with non-climatic pressures. Land fragmentation, low savings, poor transport, unstable prices, resource-access restrictions, and limited public services can turn a moderate climatic shock into a severe livelihood crisis. The study therefore adopts a multi-dimensional understanding of vulnerability, consistent with climate-risk frameworks that consider hazard, exposure, vulnerability, and adaptive capacity (IPCC, 2022).

III. Literature Review and Theoretical Framework

3.1 From livelihood vulnerability to adaptive capacity

Vulnerability is a relational concept. Adger (2006) emphasises the social dimensions of vulnerability and the importance of institutions, collective action, and access to resources. The IPCC (2022) frames climate risk through interactions among hazards, exposure, and vulnerability. These perspectives caution against treating exposure as destiny: two households facing similar climatic conditions may experience different outcomes because their assets, entitlements, health, savings, and options differ.

Adaptive capacity refers to the ability of systems, institutions, or people to adjust to potential damage, take advantage of opportunities, or respond to consequences. In livelihood research, it may include knowledge, assets, social networks, institutional access, income diversity, and the ability to mobilise resources. Adaptive capacity should not be inferred from a single indicator such as income, education, or programme participation. Indicators can be useful, but their meaning depends on context, measurement choices, and the scale of analysis.

The sustainable livelihoods framework provides a useful organising device. It connects vulnerability context, livelihood assets, structures and processes, livelihood strategies, and livelihood outcomes (Chambers & Conway, 1992; Scoones, 1998). Its five commonly used asset categories—human, social, natural, physical, and financial capital—allow the analyst to consider both material resources and institutional relationships. However, assets are not simply additive. Land or forest access may have limited livelihood value without water, labour, roads, market access, and enforceable rights. Social networks may provide support but can also be strained by repeated shocks. Financial capital may enable adaptation while debt can deepen vulnerability.

3.2 Tribal livelihoods, inequality, and forest access

Research on tribal livelihood vulnerability in Paschim Medinipur offers a direct empirical foundation. Das and Basu (2022) compared Santal, Munda, Bhumij, and Lodha communities using a livelihood vulnerability index and beta regression. Their reported results indicate that vulnerability differed across the groups studied, with the Lodha sample exhibiting the highest index in that study. Family size, poverty, agricultural income, and distance to markets were identified as relevant determinants. These findings are important but should be interpreted within the study's sample, year, geography, indicators, and model; they should not be generalised automatically to every tribal community or to current conditions.

Forest-based livelihoods are shaped by more than ecological supply. Property rights, collective institutions, local rules, market power, and distribution of benefits influence who can use resources and who captures value. Ostrom's (1990) institutional analysis demonstrates that common-pool resource governance depends

on rules, monitoring, participation, and conflict-resolution arrangements. For Jangalmahal, this implies that a policy review should examine whether rights are recognised in practice, whether community institutions participate meaningfully, and whether rules are compatible with sustainable livelihood use.

The Forest Rights Act, 2006 recognises individual and community forest rights for eligible forest-dwelling Scheduled Tribes and other traditional forest dwellers. Its potential relevance to adaptive capacity includes security of livelihood access, community forest governance, and the ability to make decisions about resources. However, the existence of a legal framework does not establish effective implementation. Claims may be rejected or pending; titles may not resolve all access constraints; and formal recognition may not ensure equitable benefit distribution or climate resilience. The paper therefore treats FRA administrative data as an indicator of institutional process rather than a direct outcome measure.

3.3 Public employment and livelihood resilience

MGNREGA creates a statutory framework for rural wage employment and supports works that may include water conservation, land development, and other rural assets. Its livelihood-security role can be analysed through at least two pathways. The first is an income and consumption-smoothing pathway: paid employment may help households meet needs when agricultural work is scarce. The second is an asset pathway: durable works may reduce water stress, improve land productivity, or support local resource management. These pathways are distinct and should be measured separately.

Programme employment days, households demanding work, households receiving work, wage payments, expenditure, and completed assets are useful implementation indicators. They do not alone establish resilience. For example, a high number of person-days may provide income support without creating an asset that reduces climate risk. Conversely, a water-conservation asset may have adaptation value that depends on its location, maintenance, design, and hydrological context. An evidence-based evaluation must connect programme records to local hazards and asset outcomes rather than assuming that all public works are climate-adaptive.

3.4 Climate policy and adaptation governance

Adaptation governance requires coordination across sectors because climate risks do not align neatly with departmental boundaries. Agriculture, forests, rural development, water resources, public health, roads, and social protection may all affect adaptive capacity. A state climate-action plan can articulate risks and priorities, but its practical influence depends on budgets, departmental responsibilities, local planning, technical support, monitoring, and public participation. The distinction between policy design and policy implementation is central to this study.

Climate adaptation also raises distributional questions. A programme may improve average outcomes while leaving the most vulnerable households behind. Benefits may differ by gender, landholding, tribal identity, disability, age, remoteness, and access to administrative documentation. Participation should therefore be assessed not only as attendance at meetings but as the ability to influence decisions, challenge exclusion, and receive information in accessible forms.

3.5 A policy-integration perspective

The article combines the sustainable livelihoods framework with climate-risk analysis and institutional policy assessment. Livelihood assets describe the resources available to households; climate-risk analysis describes the pressures to which those resources are exposed; and institutional analysis explains how rules and programmes affect access to resources and options. The combination is intended to avoid three common analytical errors: attributing every livelihood difficulty to climate change, treating programme presence as proof of programme effectiveness, and assuming that adaptive capacity can be measured independently of rights and power.

The proposed causal logic is that climate-related stress affects livelihood assets and activities, while institutions influence both exposure reduction and recovery options. Public employment may stabilise income and produce useful assets; forest rights may influence resource access and collective management; and climate planning may help prioritise high-risk locations. These effects are conditional. Poorly located assets, exclusionary decision-making, delayed wages, insecure resource access, or environmentally inappropriate interventions may limit benefits or create maladaptation.

IV. Research Gap, Questions, and Propositions

4.1 Research gap

The reviewed evidence demonstrates that Jangalmahal is not an unstudied region. Existing studies have measured tribal livelihood vulnerability, examined climate perceptions, and documented forest dependence. The more specific gap addressed here is the limited integration, within one comparative framework, of (a) evidence on livelihood vulnerability, (b) the administrative reach and limitations of forest-rights implementation, (c) employment and asset-creation mechanisms, and (d) climate-adaptation planning. The gap should be treated as a provisional synthesis rather than a definitive claim about all published research; a full Scopus and Web of Science search is required before journal submission.

A second gap is evidentiary. District-level data can describe administrative performance and broad socio-economic conditions, but they do not automatically reveal the adaptation outcomes experienced by tribal households. A policy analysis can make this scale mismatch explicit and specify the additional evidence needed to test whether public interventions improve resilience.

4.2 Research questions

RQ1. What livelihood and institutional dimensions of climate vulnerability are established by existing research on tribal communities in Jangalmahal?

RQ2. How do the design and implementation indicators of FRA and MGNREGA differ across Jhargram, Purulia, Bankura, and Paschim Medinipur?

RQ3. Through what plausible mechanisms could forest-rights recognition, public employment, and climate-adaptation planning strengthen or constrain adaptive capacity?

RQ4. What data and evaluation design are needed to determine whether these mechanisms produce equitable and durable adaptation outcomes?

4.3 Analytical propositions

P1. Households with more diversified livelihood options and better access to markets, infrastructure, and public services are likely to have more options for responding to climate-related stress, although diversification quality and stability matter as much as the number of activities.

P2. Forest-rights recognition may support adaptive capacity where it translates into secure, equitable, and ecologically sustainable access; administrative title counts alone are insufficient to test this proposition.

P3. MGNREGA may support resilience through income stabilisation and locally relevant asset creation, but these two pathways require separate indicators and should not be conflated.

P4. Policy integration is more likely to support adaptation when local planning connects climate-risk evidence, livelihood priorities, resource rights, asset maintenance, and meaningful community participation.

These propositions guide evidence organisation; they are not findings established by the current secondary review.

V. Methodology

5.1 Research design

The proposed design is a comparative policy and secondary-data case study. It combines a structured review of peer-reviewed studies, documentary analysis of policy instruments, and descriptive comparison of public administrative indicators for four districts. It is appropriate where the research objective is to understand how policy mechanisms relate to a documented vulnerability context and where new household-level data are not available. The design does not support causal attribution unless additional outcome data and a credible identification strategy are added.

The unit of analysis varies by evidence type and must be kept explicit. Published household studies have their own sample units and study boundaries. FRA records are administrative counts at district level. MGNREGA indicators may be reported by financial year, district, block, or work category. Climate observations may be gridded or station-based. These datasets should not be combined into a single index until their spatial boundaries, time periods, definitions, and missingness have been assessed.

5.2 Geographic and temporal scope

The comparative area comprises Jhargram, Purulia, Bankura, and Paschim Medinipur. The final paper should specify a common analytical period based on the overlap of reliable data sources. FRA administrative figures reported by the Government of India in August 2025 refer to information supplied by the West Bengal government as of 4 September 2023. Those figures should be labelled by their reporting date and not described as current 2026 status. MGNREGA records should be extracted for a clearly stated sequence of financial years. Climate data should use a period long enough to support trend analysis, subject to availability and quality.

5.3 Evidence sources and inclusion criteria

Peer-reviewed literature should be identified through Scopus, Web of Science, Crossref, Google Scholar, and publisher databases using combinations of terms such as Jangalmahal, tribal livelihood, indigenous adaptation, climate vulnerability, forest dependence, MGNREGA, Forest Rights Act, adaptive capacity, West Bengal, and climate resilience. Inclusion criteria should cover empirical or theoretical relevance to tribal or forest-dependent livelihoods, climate vulnerability, resource governance, rural employment, or adaptation policy. The search record should include database, date, query, filters, number of records, duplicates removed, and reasons for exclusion. Because the present draft is based on an initial targeted search rather than a completed systematic review, it does not claim PRISMA compliance.

Official sources should include the Ministry of Tribal Affairs, the Ministry of Rural Development and MGNREGA portal, Census of India, the Department of Science and Technology's climate-vulnerability assessment, and relevant West Bengal climate-action documents. Climate observations should be sourced from the India Meteorological Department or an explicitly documented open gridded dataset. Secondary sources should be checked for publication details, reference accuracy, geographical coverage, and whether they report observed measurements or perceptions.

5.4 Variables and operationalisation

The study organises indicators into five domains. First, climate exposure: rainfall variability, dry-spell frequency, temperature extremes, drought or heavy-rainfall occurrence, and exposure to climate-sensitive livelihood activities. Second, livelihood sensitivity: dependence on rain-fed cultivation, forest-based products, casual labour, landholding constraints, and livelihood concentration. Third, adaptive assets: education, health access, irrigation, transport, financial access, livelihood diversity, and relevant social networks where data are available. Fourth, institutional access: FRA claims and titles, community rights,

MGNREGA demand and employment, wage-payment timeliness, and participation in local planning. Fifth, outcomes: crop loss, income stability, food security, asset functionality, recovery time, or changes in livelihood strategies, where credible outcome data exist.

Not all indicators are available at the same scale. The final analysis should present an indicator dictionary with definitions, units, years, source, spatial resolution, direction of expected relationship, and known limitations. Missing data should remain missing rather than being coded as zero. If a composite index is later constructed, the normalisation method, weights, aggregation rule, sensitivity tests, and theoretical rationale must be reported. An index should not be produced simply because the variables are available.

5.5 Comparative policy analysis

Each policy instrument will be assessed against a common set of questions: What vulnerability pathway does it address? What legal or administrative entitlement does it create? Which institutions are responsible? What indicators can verify implementation? What outcome evidence exists? What equity or ecological risks remain? This creates a structured comparison without assuming that FRA and MGNREGA have identical objectives.

For FRA, the analysis will distinguish individual and community claims, titles distributed, claims rejected, pending claims, and the area recognised where reported. Administrative figures will be treated as process indicators. For MGNREGA, the analysis should distinguish work demand, employment provided, person-days, wage payments, expenditure, work completion, and asset types. Adaptation relevance should be assessed by asset purpose, location, technical design, maintenance, and the hazard addressed. Climate plans should be coded for explicit attention to tribal communities, forest-dependent livelihoods, drought and heat risk, local participation, interdepartmental coordination, and measurable targets.

5.6 Analysis strategy

The analysis proceeds in four stages. Stage 1 is evidence mapping: summarise study locations, populations, methods, periods, and findings from the peer-reviewed literature. Stage 2 is descriptive comparison: harmonise public indicators across the four districts and display them in tables, with clear dates and denominators. Stage 3 is policy-mechanism analysis: compare how FRA, MGNREGA, and climate planning address the five analytical domains. Stage 4 is triangulation: identify where published research, administrative records, and policy documents converge, diverge, or cannot be compared.

If climate trends are estimated, the final analysis should specify the data product, missing-data handling, temporal aggregation, trend estimator, statistical significance procedure, and treatment of autocorrelation. If MGNREGA and FRA indicators are compared with vulnerability measures, correlations should not be interpreted causally. If a future extension uses household-level outcomes, the model must account for sampling, clustering, confounders, and the limits of cross-sectional data.

5.7 Reliability, validity, and bias

Documentary evidence may reflect reporting incentives, administrative definitions, or incomplete records. Published studies may have different sampling frames and indicator constructions. Climate data may not resolve village-level microclimates. These limitations require triangulation and cautious language. The study should distinguish an official programme record from independent verification, and perceived climate change from observed climate trends. A source-quality table should record authority, date, spatial scale, completeness, and relevance.

5.8 Ethics and transparency

Because this design uses published and public secondary information, it does not involve new human-subject recruitment. Nevertheless, ethical reporting remains important. Community identities should

not be essentialised, and sensitive social differences should be described respectfully. If the project later incorporates interviews or household data, the researcher should obtain institutional ethics approval where required, informed consent, appropriate language support, data minimisation, secure storage, and safeguards against disclosure of identifiable or politically sensitive information. The final article should include a data-availability statement and disclose any funding or conflicts of interest.

VI. Evidence Review and Results Framework

This section separates findings already reported by sources from analyses that remain to be completed. Because the current project has not yet extracted and harmonised the full district-level climate, MGNREGA, census, and policy datasets, it would be misleading to present new district rankings, climate trends, or programme-effect estimates. The following results are evidence-backed observations and a structured framework for the final comparative analysis.

6.1 Published evidence on livelihood vulnerability

Das and Basu (2022) provide direct evidence that livelihood vulnerability differed among the Santal, Munda, Bhumij, and Lodha households included in their Paschim Medinipur study. The authors reported a livelihood vulnerability index of 0.318 for the Lodha sample, the highest among the groups compared in that study, and identified family size, poverty, agricultural income, and distance to market as determinants in their model. This result supports a multi-dimensional approach to adaptive capacity: economic resources, household characteristics, agricultural dependence, and spatial access may interact. It does not establish current vulnerability levels across all four Jangalmahal districts.

Payra and Jana (2024) reported that surveyed households perceived increasing average temperatures, more hot days, and less predictable rainfall, alongside negative perceived impacts on several forest resources. These findings establish the relevance of climate perceptions to the region's forest-dependent livelihoods. However, perception data cannot independently confirm long-term climate trends or attribute observed ecological changes to climate change alone. A stronger synthesis would compare these perceptions with station or gridded climate records and ecological observations.

6.2 Forest Rights Act: administrative evidence

A Government of India press release dated 21 August 2025 reported West Bengal government figures, last reported as of 4 September 2023, for FRA implementation in Jhargram, Purulia, Bankura, and Paschim Medinipur. The published district totals were as follows.

Table 1. Forest Rights Act administrative figures reported for Jangalmahal districts

District	Claims received	Titles distributed	Forest area titled (ha)	Claims rejected	Claims pending
Jhargram	20,917	9,464	997.84	11,453	0
Purulia	39,766	8,060	1,639.58	31,701	5
Bankura	37,559	12,104	5,843.37	24,809	646
Paschim Medinipur	29,890	5,233	500.74	24,511	146

Note. *Figures are reproduced from the Ministry of Tribal Affairs / Press Information Bureau release of 21 August 2025, based on state-reported data dated 4 September 2023. "Claims received" and "titles distributed" are totals of individual and community claims/titles as reported in the source. The figures are administrative counts, not estimates of climate resilience. Source: Ministry of Tribal Affairs (2025).*

The table shows that reported administrative totals vary across districts. Bankura had the largest reported area of forest land for which titles were distributed among these four districts, while Jhargram had the highest total number of titles distributed. Purulia had a particularly high number of rejected claims in the reported record. These descriptive comparisons require careful interpretation because district population, eligible claimants, land area, application history, claim types, and verification processes may differ. Counts should be supplemented by denominators and disaggregation before conclusions about relative performance or fairness are drawn.

The policy implication is not that more titles automatically create greater adaptive capacity. Rather, FRA implementation provides one measurable institutional dimension that may shape resource security. To assess adaptation effects, future analysis would need evidence on how recognised rights affect access, forest management, household income, resource availability, collective decision-making, and response to climatic stress.

6.3 MGNREGA: indicators needed for comparative assessment

The Government of India's open-data catalogue provides an entry point for MGNREGA administrative data. The programme's statutory livelihood-security purpose and its rural asset-creation functions make it relevant to the analysis. However, the present draft does not report district totals for person-days, household employment, wage delays, or asset completion because those data have not been extracted and validated for a common period.

Table 2. MGNREGA evidence required to assess adaptation pathways

Indicator	Analytical meaning	Adaptation interpretation	Caution
Households demanding work / receiving work	Access to employment entitlement	Whether vulnerable households can obtain support	Administrative access is not the same as adequate work
Person-days and days per household	Employment intensity	Potential income smoothing during lean periods	Must be compared with demand and household needs
Wage-payment timing	Reliability of support	Timely income may improve shock response	Aggregate payment data may hide household-level delays
Water conservation and land-development works	Type and purpose of assets	Potential to reduce water stress or improve productive capacity	Asset quality, location, maintenance, and ecological impact matter
Completed assets and functionality	Implementation and durability	Whether benefits persist beyond construction	Completion records do not guarantee functionality
Participation and distribution	Who benefits and who is excluded	Equity of adaptation support	Requires social-group and gender disaggregation where lawful and available

The table is an analytical specification, not a report of observed district outcomes. For journal submission, the authors should extract the same financial years for all four districts, document any data gaps, and avoid interpreting spending as a proxy for adaptation success.

6.4 Climate and socio-economic evidence

The national climate-vulnerability assessment developed under India's Department of Science and Technology offers a framework for comparing exposure, sensitivity, and adaptive-capacity dimensions. Such assessments can identify broad structural vulnerabilities, but their spatial resolution and indicators may not represent intra-district differences or the experience of particular tribal groups. District comparisons should therefore be used as context rather than as substitutes for local evidence.

A robust climate analysis should compile rainfall and temperature series for a defined baseline period and test for trends and variability. It should examine the timing of rainfall, dry spells, heat extremes, and any available drought indicators rather than relying only on annual averages. If climate data are available only at a coarse grid, the paper should state that limitation and avoid village-level claims. The climate record should then be interpreted alongside livelihood and policy indicators, not merged mechanically into a single score.

6.5 Comparative policy matrix

Table 3. Comparative policy mechanisms and evidence requirements

Policy domain	Potential mechanism	Observable indicators	Possible constraint	Evidence needed
FRA	Greater security and recognition of individual/community forest rights	Claims, titles, area recognised, community rights, implementation records	Pending/rejected claims; weak awareness or implementation; unequal benefit distribution	Disaggregated administrative data plus evidence on actual access and outcomes
MGNREGA employment	Income support during lean or disrupted livelihood periods	Demand, employment provided, person-days, wage timeliness	Insufficient days, delayed payments, uneven access	District/block time series and household-level access where available
MGNREGA assets	Water, soil, land and other rural assets may reduce risk	Work type, location, completion, functionality, maintenance	Assets poorly located or not maintained; weak climate-risk alignment	Geospatial asset records and technical/outcome assessment
State climate planning	Mainstreaming climate risks into sectoral planning	Targets, budgets, responsible departments, local plans	Policy commitments not translated into local action	Plan documents, budgets, implementation reports and local records
Local governance and participation	Community knowledge informs prioritisation and monitoring	Meeting records, participation, grievance resolution, inclusion	Tokenistic participation or exclusion	Qualitative documentation and disaggregated participation data

Note. *This matrix identifies plausible mechanisms and required evidence. It does not conclude that the mechanisms have been effective in Jangalmahal.*

VII. Discussion

7.1 Why adaptive capacity must be analysed institutionally

The available literature suggests that adaptive capacity in Jangalmahal cannot be understood through a single economic indicator. The Paschim Medinipur vulnerability study links vulnerability to poverty, family size, agricultural income, and market distance, while forest-livelihood research emphasises the importance of natural resources and livelihood diversification. Together, these strands point toward an interaction among household assets, spatial access, and institutional arrangements. This interpretation is consistent with the sustainable livelihoods framework, in which livelihood strategies are shaped by both assets and the structures and processes governing access to them.

A household may possess substantial knowledge of local ecological conditions yet lack financial resources to alter cropping practices. Another may have access to public employment but lack secure access to forest resources. A third may have land but inadequate irrigation or market access. These examples illustrate why adaptive capacity is relational and multidimensional. They are conceptual examples, not claims about the prevalence of particular household types in the region.

7.2 FRA and the difference between legal recognition and effective resilience

FRA is relevant to climate adaptation because forest rights can shape resource access, livelihoods, and collective stewardship. Yet administrative progress should not be confused with substantive outcomes. The official data show differences across districts in claims received, titles distributed, rejected claims, and titled area. The next analytical step is to understand those differences in relation to eligible populations, land area, claim categories, procedural history, and community governance.

A rights-based approach also raises a normative question: adaptation should not be designed only to protect ecosystems or reduce aggregate risk; it should also recognise legitimate claims, participation, and distributional fairness. If a conservation or restoration intervention restricts livelihood access without providing alternatives or meaningful participation, it may reduce one environmental pressure while increasing household vulnerability. Conversely, secure and accountable community governance may help align livelihood needs and sustainable resource management. The direction and magnitude of these effects must be established empirically.

7.3 MGNREGA as social protection and adaptation infrastructure

MGNREGA should be assessed through its separate income-support and asset-creation functions. Employment may provide an important source of cash when farm work is scarce, but its stabilising value depends on whether work is available when needed, whether wages arrive on time, and whether the number of days is sufficient to matter for household budgets. For households experiencing climate-related shocks, delays or administrative barriers may reduce the usefulness of the entitlement.

Asset creation creates a second pathway. Water harvesting, soil conservation, land development, and other works may help reduce climate sensitivity if they are designed around local ecological conditions and maintained. A policy analysis should ask whether works target locally important risks, whether assets remain functional, and whether their benefits reach households with limited land or labour. These questions require data beyond expenditure and completion totals.

7.4 Policy coherence and institutional coordination

Climate risks cross administrative boundaries, while public programmes often operate through separate departments, reporting systems, and budget lines. This creates a risk that one programme's assets, another programme's resource rights, and a climate plan's priorities are evaluated independently even when they affect the same households and landscapes. A comparative framework can help identify opportunities for coordination: climate-risk information can inform local asset planning; FRA-related institutions can contribute to forest and livelihood planning; and employment programmes can support locally prioritised, technically appropriate works.

Policy coherence should not mean imposing a single uniform intervention across four districts. Districts and blocks may differ in rainfall patterns, forest access, irrigation, labour markets, and administrative capacity. The goal should be a common evidence framework with locally differentiated priorities. Participatory planning can help ensure that the choice of assets and livelihood support reflects local knowledge and distributional concerns.

7.5 Climate justice and heterogeneous vulnerability

A climate-justice lens draws attention to unequal exposure, unequal capacity to respond, and unequal influence over adaptation decisions. Tribal identity alone does not define vulnerability; social groups are internally diverse, and outcomes may vary by gender, age, landholding, disability, household composition, and location. The analytical task is to identify how these dimensions intersect with resource access and programme delivery rather than to assume that every tribal household has the same needs.

The existing evidence on differences among tribal communities reinforces this point. However, the index reported in one study should not be used as a permanent ranking of communities. Vulnerability changes with economic conditions, access to public services, migration, forest policy, climate variability, and the timing of observations. A policy system should therefore use disaggregated, periodically updated indicators and combine them with local deliberation.

7.6 Avoiding maladaptation

Adaptation interventions can create unintended consequences. Infrastructure may shift water availability between users, encourage unsustainable extraction, or fail under future climate conditions. Livelihood diversification may increase income while exposing workers to unsafe heat or precarious labour. Forest-based enterprise support may raise market returns but increase pressure on particular species if extraction is not sustainable. Resilience should therefore be assessed in terms of who benefits, for how long, at what ecological cost, and whether interventions preserve future options.

For Jangalmahal, a maladaptation screen should be included in programme appraisal. Relevant questions include whether an asset is suitable for projected as well as historical conditions; whether it increases the burden of unpaid work; whether it excludes households without land; whether it weakens customary or legal rights; and whether maintenance responsibilities are realistic. Such screening would strengthen the link between climate policy and social protection.

7.7 Implications for international research

Although Jangalmahal has a specific ecological and institutional context, the analytical lessons are relevant to other forest-fringe and rural regions. The combination of livelihood assets, resource rights, public employment, and climate planning is applicable wherever communities depend on climate-sensitive natural resources while relying on multiple public institutions for support. The case illustrates a general methodological point: climate adaptation cannot be evaluated adequately from hazard maps or programme expenditure alone. It requires tracing how institutions alter the options available to people exposed to risk.

The international relevance of the article will be strongest if the final analysis offers transparent indicators and clearly bounded conclusions. A region-specific study becomes internationally useful not by claiming universal representativeness, but by showing how a carefully specified case can test broader ideas about institutional adaptation, rights, and livelihood resilience.

VIII. Policy Recommendations

8.1 Build an integrated district adaptation evidence system

District administrations should be encouraged to align climate-risk information with livelihood and programme data through a shared monitoring framework. Such a system should not simply merge datasets; it should document definitions, spatial resolution, time periods, and missing information. Climate indicators, FRA implementation, MGNREGA work types, water availability, agricultural conditions, and relevant socio-economic indicators should be reviewed together during local planning.

8.2 Strengthen rights-based forest governance

FRA monitoring should move beyond headline totals to examine claim processing, reasons for rejection, access to information, community rights, grievance mechanisms, and the practical consequences of recognition. Where data permit, reporting should distinguish individual and community rights and provide denominators. Any proposed link between rights recognition and adaptation should be evaluated through evidence on livelihood access, ecological conditions, and community participation.

8.3 Make rural employment assets climate-relevant and durable

MGNREGA planning should connect local hazard analysis to the selection and design of works. Water and soil conservation projects should be technically appropriate to local conditions, benefit distribution should be assessed, and completed assets should be inspected for functionality after construction. Employment access, wage timeliness, asset quality, and longer-term outcomes should be monitored as separate dimensions.

8.4 Prioritise differentiated and inclusive planning

Local adaptation planning should avoid treating tribal communities as homogeneous. Participatory processes should consider differences in land access, forest dependence, gendered work, age, disability, migration, and access to public services. Information should be accessible in relevant languages and formats, and participation should include a mechanism for recording how community priorities influence final decisions.

8.5 Monitor adaptation outcomes, not only activities

A minimum monitoring framework should distinguish inputs, activities, outputs, and outcomes. Budget spent is an input; a completed pond or water-harvesting structure is an output; reliable water access, reduced livelihood disruption, or improved recovery after a dry spell may be outcomes. Outcome indicators should be selected according to programme objectives and measured over time. Where feasible, independent evaluation should compare beneficiaries and non-beneficiaries while accounting for selection effects and contextual differences.

8.6 Invest in data quality and community accountability

Public dashboards and administrative reports should disclose reporting dates, definitions, denominators, and revisions. Community-level social audits and grievance channels can help identify gaps that aggregate data conceal. Researchers should collaborate with local institutions to interpret results and communicate uncertainty rather than treating administrative data as a complete representation of lived experience.

IX. Limitations and Future Research

This manuscript has several limitations. First, the current evidence review is a targeted synthesis, not a completed systematic review of all Scopus and Web of Science records. The literature gap and novelty claim must be reassessed after a reproducible database search. Second, the draft does not include a newly extracted, harmonised dataset for rainfall, temperature, MGNREGA, Census indicators, or district policy budgets. It therefore does not report new statistical trends, rankings, correlations, or causal effects. Third, official administrative figures may contain reporting delays, inconsistent definitions, and differences in implementation capacity. Fourth, district-level statistics cannot be assumed to represent the experience of every tribal community or household.

Fifth, published studies may differ in sampling methods, time periods, geographic boundaries, and definitions of vulnerability. Their findings cannot be pooled quantitatively without checking comparability. Sixth, climate exposure and livelihood outcomes are affected by multiple factors, including markets, infrastructure, governance, health, and migration; a descriptive policy study cannot isolate the causal effect of climate change. Seventh, public administrative data may not reveal intra-household inequalities, the quality of participation, or the practical security of resource rights.

Future research should first complete a systematic review and build a documented data inventory. A second stage should extract comparable district- and block-level climate and programme indicators for a defined period. A third stage could add geospatial analysis of rainfall, drought, land cover, and public assets. A fourth stage should conduct carefully sampled household research or qualitative interviews to test how programme access and resource rights influence adaptation decisions. A mixed-methods design would be particularly valuable because administrative indicators can identify patterns while community evidence explains the mechanisms behind them.

If the authors wish to make causal claims about MGNREGA or FRA, the research design must go beyond cross-sectional comparisons. Possible approaches include longitudinal analysis, matched comparisons, policy-timing designs where assumptions are defensible, or carefully constructed qualitative process tracing. Each method requires sufficient observations and a clear account of confounding, selection, and measurement error.

X. Conclusion

Climate change, tribal livelihoods, and adaptive capacity in Jangalmahal should be understood as a connected social-ecological and institutional problem. Existing research already demonstrates that livelihood vulnerability differs among tribal communities and that forest-dependent households perceive climate-related pressures on local environments. The next contribution is to connect this evidence more systematically to the policies that shape access to employment, forests, rural assets, and adaptation planning.

The comparative policy framework developed here places FRA, MGNREGA, and climate-action planning within a shared analytical structure while recognising that they serve different purposes. FRA may affect the security and governance of forest resources; MGNREGA may provide employment and support locally useful assets; and climate planning may help align investments with anticipated risks. None of these mechanisms should be assumed to improve adaptive capacity simply because a policy exists or an administrative target is recorded. Their contribution depends on access, quality, equity, ecological suitability, and sustained implementation.

The official FRA figures reported for the four districts illustrate why administrative evidence needs careful interpretation. Claims, titles, and titled areas vary, but the counts alone cannot establish the security of rights or the effect of recognition on climate resilience. Likewise, MGNREGA implementation data can reveal

employment and asset activity, but adaptation outcomes require evidence on wage reliability, asset functionality, hazard relevance, and household experience.

The paper's central conclusion is therefore methodological and policy-oriented: a credible assessment of tribal adaptive capacity must combine climate information, livelihood analysis, rights-based institutional evidence, and evaluation of public programmes. For international scholarship, the value of Jangalmahal lies not in presenting it as a uniform or exceptional case, but in demonstrating how climate adaptation can be studied through the interactions between environmental stress, livelihood assets, and institutions. The next empirical stage should test the propositions set out here with harmonised public datasets and, where possible, community-level evidence. Until that work is completed, conclusions about the relative adaptive capacity of districts or the effectiveness of specific interventions should remain provisional..

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