Weaving Resilience: Adaptive Livelihood Strategies and Workforce Realities in East Garo Hills' Informal Economy

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Abstract: This research aims to investigate how households in the East Garo Hills of Meghalaya cope with the challenges posed by the Indian economy, the environment, and the institutions operating within India's 90% informal employment landscape. Using a mixed-methods strategy that included key-informant interviews, focus groups, and household surveys (N = 250), the study identified livelihood diversification as the most significant predictor of household resilience (β = +6.20, p < 0.001). Access to markets and credit increases one's ability to adapt, whereas being digitally illiterate and having an unstable workforce in financial institutions reduces one's ability to remain sustainable in the long term. While cultural traditions, particularly those led by women, such as weaving and forest-based businesses, are essential for preserving identity, they also require modernisation through customer-centric design and digital marketing. The model of resilience presented in the paper is contextualised through the integration of the Sustainable Livelihoods and Adaptive Resilience frameworks. The policy recommendations place strong emphasis on providing income assistance through portfolios, developing digital skills, building co-operatives, and integrating markets sustainably. These recommendations align with Sustainable Development Goals 1, 8, and 13, as well as India's Northeast Vision 2040.

1. Introduction

1.1. Background and Context

In many parts of the Global South, informal economic systems remain the bedrock of livelihood for millions of households. In India, for example, informal employment accounts for nearly 90% of total jobs, often lacking contractual protections, social security, or stable wages (Table 1). The informal sector's expansion is especially pronounced in rural and remote areas, where formal opportunities are scarce and structural constraints restrict upward mobility [14]. In Northeast India, the informal non-farm sector holds a particularly important role, absorbing labour displaced from agriculture and providing survival pathways for marginalised communities. East Garo Hills in Meghalaya, a hilly, tribal-dominated district in Northeast India, epitomises

the challenges and opportunities of informal economies. The region is characterised by limited infrastructure, challenging terrain, low market penetration, and strong cultural embeddedness in traditional livelihood systems such as weaving, jhum (shifting) cultivation, agroforestry, artisanal crafts, and local trades [21]. Over recent decades, external pressures such as environmental change, shifting market demands, migration, and the gradual penetration of digital connectivity have pushed many households to adapt by diversifying income sources, combining informal wage labour with home-based crafts, or engaging in seasonal migration to urban centres [6]. At the same time, the region's workforce dynamics are under pressure: skill mismatches, limited access to credit, weak market linkages, and retention challenges in sectors such as microfinance, local co-operatives, and rural banking create friction in translating resilience into sustainable growth. In the regional context of Assam and nearby states, initiatives in digital financial inclusion, skill development missions, and rural connectivity aim to bridge these gaps. Still, their effectiveness in peripheral districts such as East Garo Hills remains underexplored. Thus, understanding how households in East Garo Hills weave resilience, adapt, recombine assets, negotiate constraints, and how the informal workforce evolves through patterns of transition (including partial formalisation, gig-type links, and return migration) is highly relevant to theory and policy (Table 1).

Table 1: Selected statistics on informality in India and Northeast India

Indicator	Value / Estimate	Source / Note
Share of workforce in informal employment (India)	~ 90 %	Raveendran and Vanek [21]; "Informal Workers in India"
Share of non-agricultural employment in India)	> 80 %	ILO [14]; Indian Express, explained pieces
Decline in rural non-farm employment in Assam (2010–2016)	Negative growth in service enterprises	Urban Unorganised Sector, Northeast India, 2023 (Assam's RNFEs)
Employment elasticity of urban non-farm informal enterprises in Assam	Modest growth	Growth of Urban Non-Farm Informal Enterprises, Assam (ResearchGate)

These data demonstrate both the dominance of informality and its structural fragility, particularly in less developed regions.

1.2. Research Problem and Statement of Purpose

Despite the ubiquity of informal livelihoods in East Garo Hills, existing studies provide only fragmentary glimpses: either descriptive accounts of crafts or anthropological snapshots of tribal households. The deeper dynamics—how households reconfigure livelihood portfolios under shocks (ecological, market, policy), how workforce transitions (toward digital gig links or formal contractual ties) occur, and how household-level resilience can be fostered into sustainable pathways—have not been comprehensively studied. The problem is acute: in the absence of nuanced insight, policymakers and development actors may impose generic interventions (e.g., blanket microcredit schemes, remote training modules) that fail to resonate with the terrain, culture, resource constraints, and market access realities of East Garo Hills.

There is thus a pressing need to articulate a research framework that captures both the adaptive strategies and the workforce transitions of informal livelihoods in this region, and to design context-sensitive strategies to strengthen household resilience, resource sustainability, and market integration. Hence, the purpose of this research is to examine how households in East Garo Hills deploy adaptive livelihood strategies in response to shocks and constraints, to map the realities and pathways of workforce transitions in the informal economy, and to propose actionable, locally grounded strategies for weaving resilience.

1.3. Research Objectives

Drawing from the above context, this study proposes the following objectives:

- To document and classify the livelihood portfolios and adaptive strategies adopted by households in East Garo Hills under economic, ecological, and institutional shocks.
- To analyse the patterns, constraints, and determinants of workforce transitions—from purely informal modes toward hybrid or semi-formal engagements (e.g., microcontract work, digital gig linkages) in the region.
- To assess the enabling and disabling factors (e.g., access to credit, market reach, skill gaps, infrastructure, cultural capital) that influence the success and sustainability of adaptive strategies.
- To develop context-sensitive policy and programmatic strategies to enhance resilience, resource sustainability, and inclusive livelihood pathways for households in East Garo Hills.

1.4. Research Hypotheses

To guide empirical investigation, the following hypotheses are posited:

- **H1**: Households with more diversified livelihood portfolios (i.e., combining agriculture, crafts, wage labour, remittances) exhibit greater resilience—measured via income stability, asset retention, and ability to absorb shocks—than households reliant on a single activity.
- **H2**: Workforce transition toward semi-formal or hybrid modes (e.g., contractual linkages, digital platform work) is positively associated with greater market access, digital literacy, and social networks, but is constrained by initial capital, terrain remoteness, and infrastructure deficits.
- **H3**: Access to credit, training, and institutional support (e.g., co-operatives, local NGOs) moderates the relationship between adaptive strategy and livelihood outcomes—households with greater access to such support will achieve significantly better outcomes under similar constraints.

These hypotheses aim to test the interplay of diversification, transition, and enabling factors in shaping resilience.

1.5. Significance of the Study

This research offers multiple contributions:

- **Academic**: It fills a gap by connecting adaptive livelihood theory, workforce transition frameworks, and resilience in a peripheral tribal-hilly context, thus pushing the literature beyond major urban or agrarian settings.
- **Policy and Practice**: It will yield strategic insights (e.g., on financial product design, micro-training, market linkages, digital inclusion) tailored for East Garo Hills, with potential replicability in other hilly tribal districts in Northeast India.
- **Community Empowerment**: By highlighting the lived strategies of resilience, the study can help local communities and civil society actors co-develop programs that respect cultural logics and local realities.
- **Regional Development**: Understanding how informal economies can transition sustainably supports broader goals of inclusive growth in Meghalaya and the Northeast, bridging the divide between marginalised districts and formal growth corridors.

1.6. Scope and Limitations

The scope of this study is geographically limited to the East Garo Hills district of Meghalaya, a predominantly rural and tribal region characterised by diverse livelihood systems. Sectorally, the research focuses on the informal economy, encompassing crafts, small trades, wage labour, and emerging platform-linked work, while excluding large formal enterprises. To capture temporal and seasonal variations in income and employment, primary data collection is designed to occur across two agricultural and climatic cycles, pre- and post-monsoon. The study's population comprises households engaged in informal livelihood activities, with a total sample of 250 respondents selected from both village and semi-urban clusters, ensuring balanced representation of economic and spatial diversity. However, the study faces certain limitations inherent to field-based socioeconomic research. It may not capture every micro-sector or quantify long-term structural shifts due to time and resource constraints. Data accuracy could be affected by self-reported income and recall bias, and emerging forms of digital gig work may remain underrepresented, limiting statistical robustness. Additionally, geographical barriers and poor connectivity might exclude some remote hamlets, leading to selection bias. Therefore, generalisations beyond East Garo Hills should be made cautiously, while acknowledging the region's unique cultural and ecological context.

2. Literature Review

The literature on informality, livelihoods, and resilience spans several disciplinary traditions, anthropology, labour economics, development studies, and political ecology, and provides conceptual tools and empirical findings that inform the present inquiry. This review synthesises theoretical approaches to informality, the livelihoods/resilience literature, region-specific empirical work relevant to Northeast India (particularly Garo Hills), and scholarship on resource dependency, market access, and culture. It concludes by identifying the precise research gap this study addresses.

2.1. The Informal Economy: Theoretical Perspectives and Global Context

Early conceptualisations of the informal economy emphasised urban survival strategies and non-regulated income opportunities, with Hart's [13] formative work showing how "informal income opportunities" constituted a vital urban

livelihood domain [13]. Over time, the literature broadened to treat informality as a structural feature of developing labour markets rather than a residual or ephemeral phenomenon [14]. Contemporary statistical estimates indicate that informal employment constitutes most of the global employment in low- and middle-income countries—roughly six in ten workers worldwide are informally employed—and India's labour market remains particularly informal [21]. Crises such as the COVID-19 pandemic exposed the fragility and centrality of informality, revealing how lockdowns disproportionately affected informal workers and accelerated debates on social protection and formalisation pathways [5]; [26]. Scholarly debates continue to nuance formalisation as one of multiple policy options—some argue for worker-centred protections that recognise informal realities. In contrast, others emphasise gradual pathways to formal employment and enterprise registration (Table 2).

Table 2: Selected indicators on informality and regional context

Indicator	Value / Estimate	Source
Global share of workers in informal employment	~61%	ILO [14]
Share of workers in informal employment (India)	~90%	Raveendran and Vanek [21]
Forest cover (% of state area, Meghalaya)	~76%	MegLIFE and MBDA [16]

(Values are drawn from comparative global reports and national/state surveys to situate the research context.)

2.2. Livelihood Strategies and Household Resilience in Rural Economies

The sustainable livelihoods and livelihood-diversification literatures conceptualise household strategies as portfolios of activities and assets, natural, human, social, physical, and financial capital that households combine to manage risk and pursue wellbeing [24]; [9]; [4]. Empirical work demonstrates that diversification often enhances short-term resilience (income smoothing, shock absorption) but does not automatically translate into long-term sustainability without enabling public goods (market access, infrastructure, credit) [9]; [24]. Recent resilience studies in India emphasise behavioural and institutional pathways, such as remittances, seasonal migration, SHG membership, and community-level resource management as critical mechanisms by which households survive shocks and rebuild assets. Yet, the efficacy of these mechanisms is mediated by gendered labour allocation, market volatility, and environmental change.

2.3. Employment Dynamics in Informal Sectors: Focus on Northeast India

Studies focused on Northeast India highlight region-specific features: high forest dependence, the prevalence of shifting (jhum) cultivation, and limited industrialisation, which have combined with weak infrastructure to shape distinctive rural non-farm dynamics. Research from the Garo Hills and neighbouring districts documents multi-activity household portfolios—combining agriculture, artisanal crafts (weaving), petty trade, and seasonal migration—and points to constraints in scaling market linkages and value addition. Regional planning documents and NEC compilations show that rural non-farm employment growth in several Northeastern states has been uneven, reflecting structural barriers to RNFE. Importantly, recent state and donor interventions (e.g., MegLIFE) illustrate policy efforts to marry forest ecosystem management with livelihood enhancement—an important recent programmatic development to monitor.

2.4. Role of Resource Dependency and Market Access in Livelihood Sustainability

Resource dependency, especially on forest products, jhum systems, and common-property resources, creates dualities: ecological services and cultural identity on one hand, and vulnerability to resource degradation and market failure on the other [18]. The Sustainable Livelihoods Framework underscores that natural capital can be both an asset and a liability under unsustainable extraction regimes [24]. Empirically, households with better market access (roads, weekly markets, digital platforms) are more likely to translate craft and agro productions into stable cash incomes; conversely, market isolation constrains price discovery and scale. For the Northeast, several regional reports highlight weak market linkages, limited processing capacity, and inadequate logistics as binding constraints to livelihood upgrading (NEDFi and NSDC skill stock reports). Thus, market integration and value-chain interventions are central to livelihood sustainability.

2.5. Cultural Practices and Their Influence on Informal Work and Resilience

Cultural practice shapes both the composition of livelihoods and the institutional logics that govern resource use. In Garo communities, weaving, indigenous food systems, and customary forest governance are intertwined with identity and reciprocity norms; these cultural systems can foster collective action (co-operatives, SHGs) but can also limit rapid, market-driven change when it undermines traditional social capital [15]. Gendered divisions of labour, notably women's centrality in home-based crafts and unpaid care, have important implications for policy design: interventions must negotiate cultural rhythms and seasonal obligations to be effective [14].

2.6. Identified Research Gap

The reviewed literature offers strong conceptual tools but leaves a critical empirical and policy gap at the intersection of adaptive household strategies, workforce transition pathways (including nascent digital/gig linkages), and context-specific resource dependency in the Garo Hills. Existing studies are either: (a) descriptive/localised ethnographies of cultural livelihoods, (b) macro statistical treatments of informality, or (c) program reports of isolated interventions. What is largely absent is a mixed-methods, household-level analysis that explicitly links (i) the portfolio composition and adaptive tactics of households, (ii) measurable resilience outcomes (income stability, asset retention, shock recovery), and (iii) the role of enabling factors such as digital platforms, skills provisioning and market integration in a hilly, tribal district like East Garo Hills. Moreover, little is known about how financial-sector workforce dynamics (retention of frontline staff in rural microfinance/co-operative institutions) interact with local access to credit and thereby affect livelihood transitions. This gap justifies a focused study that integrates livelihoods theory, workforce transition frameworks, and local political ecology to produce actionable, place-sensitive pathways for resilience.

3. Research Methodology

3.1. Research Design

The study adopts a convergent mixed methods design with concurrent quantitative and qualitative strands, integrated at the interpretation stage, so that numerical patterns (e.g., diversification, income stability, determinants of workforce transition) are triangulated with lived narratives and institutional perspectives [8]. The quantitative strand emphasises household-level survey measurement and statistical modelling; the qualitative strand uses semi-structured interviews, focus group discussions (FGDs) and key-informant interviews to explain mechanisms and contextual nuance.

3.2. Study Area: East Garo Hills, Meghalaya

East Garo Hills is a predominantly rural, tribal district with challenging terrain and dispersed settlements; according to the 2011 District Census Handbook, the district contained approximately 58,328 households and a largely rural population [3]. These demographic realities shape access to markets, credit, and service delivery—key variables in the study's conceptual framework.

3.3. Sampling Universe and Frame

The sampling universe comprises all households in East Garo Hills engaged in one or more informal livelihood activities (agriculture, weaving/handicrafts, petty trade, casual wage labour, seasonal migration-linked work, small processing). The primary sampling frame will be village and ward lists from the District Census Handbook and updated local administrative rolls maintained by block offices.

3.4. Sampling Method and Technique

A multi-stage, stratified cluster sampling strategy will be implemented. Stage 1: stratification by block and by predominant livelihood zone (e.g., forest-edge weaving clusters; agro-pastoral villages; market-proximate hamlets). Stage 2: random selection of villages within strata (probability proportional to size). Stage 3: within selected villages, systematic random sampling of households from the enumerated household lists. Purposeful selection will be used for qualitative respondents (local leaders, microfinance officers, co-operative heads, NGO field staff) to ensure institutional and supply-side perspectives.

3.5. Sample Size and Characteristics (N = 250)

Sample size decisions used the Cochran [7] formula as a baseline [7]. For a conservative proportion estimate (p = 0.5), at 95% confidence (Z = 1.96) and margin of error e = 0.06, Cochran [7] infinite-population estimate is calculated as follows:

- Compute Z^2: $1.96 \times 1.96 = 3.8416$.
- Compute numerator: $3.8416 \times p(1-p) = 3.8416 \times 0.25 = 0.9604$.
- Compute e^2: $0.06 \times 0.06 = 0.0036$.
- $n_0 = 0.9604 \div 0.0036 = 266.777\ldots \approx 267$ [7].

Applying the finite population correction with an estimated household frame N ≈ 58,328 yields n ≈ 266.78/(1 + 265.78/58,328) ≈ 265.6 ≈ 266. Given field constraints, a final survey sample of N = 250 is adopted: this approximates the statistically derived requirement while balancing logistical realities and the complementary explanatory power of qualitative methods. The

household sample will be profiled by livelihood composition, gender of household head, and remittance/migration status to permit subgroup analysis.

3.6. Data Collection Methods (Quantitative and Qualitative)

Quantitative data: structured household questionnaire collecting demographic data, detailed livelihood portfolios, incomes (seasonal), shocks and coping responses, access to credit/markets, digital access and skills, and workforce transition indicators. An asset inventory will be recorded for wealth ranking. Qualitative data: semi-structured interviews (household life histories), FGDs (men, women, youth), and key-informant interviews with microfinance/micro-enterprise officers, co-operative managers, and local market actors to unpack institutional barriers (e.g., frontline staff retention in rural financial bodies) and demand-side constraints. Secondary sources (District Statistical Handbooks, program reports) will be compiled for triangulation.

3.7. Data Analysis Techniques (Statistical Tools and Qualitative Approaches)

Quantitative analysis will begin with descriptive statistics and cross-tabulations; inferential techniques will include chi-square tests, t-tests, and multivariate regressions—OLS for continuous outcomes (income) and logistic regression for binary transitions (e.g., adoption of semi-formal contractual work) [2]. A household asset index will be constructed using principal components analysis (PCA) following Filmer and Pritchett's method to proxy long-run welfare [11]. Software: Stata/R/SPSS. Qualitative data will be analysed via thematic analysis, supported by CAQDAS (e.g., NVivo) where appropriate; emergent themes will be linked to quantitative findings in the integrative interpretation phase [8].

3.8. Ethical Considerations

The study will secure institutional ethical clearance and local permissions. Informed consent (written or recorded verbal, as culturally appropriate) will be obtained; anonymity and confidentiality will be guaranteed; respondents will have the right to withdraw. Translation and culturally sensitive framing will be used for Garo-language respondents. Data will be stored securely and de-identified before analysis. Compensation for respondents' time will be in accordance with local ethical norms.

4. Results and Analysis

4.1. Demographic and Socioeconomic Profile of Respondents

The sample (N = 250) is largely working age and rural. Table 3 summarises key demographic characteristics. The profile indicates a predominance of households in prime working ages (25–44) and a substantial share in which women serve as household heads or primary income managers (42%). Educational attainment clusters at the secondary level, but a meaningful minority (16%) report no formal schooling—an important fact when interpreting employability and digital-skill indicators.

Table 3: Demographic profile of surveyed households (N = 250)

Characteristic	Count	% of sample
Gender of household head		
Male	145	58.0%
Female	105	42.0%
Age group (household head)		
< 25 years	30	12.0%
25–44 years	120	48.0%
45–64 years	80	32.0%
65+ years	20	8.0%
Highest level of education in the household (head)		
No formal schooling	40	16.0%
Primary	70	28.0%
Secondary	95	38.0%
Post-secondary	45	18.0%
Average household size		4.8 members

4.2. Employment Dynamics in the Informal Sector

Employment in the sample reflects multi-sectoral informality rather than dominance by a single activity (Table 4). Agriculture (including jhum and other smallholder cultivation) remains the most common primary activity (34% of households), followed by weaving and handicrafts (22%), casual wage labour (18%), petty trade/small shops (14%), and remittance/seasonal migration linkages (12%).

Table 4: Primary livelihood activity (N = 250)

Activity	Count	%
Agriculture (jhum/other)	85	34.0%
Weaving and crafts	55	22.0%
Casual wage labour	45	18.0%
Petty trade/shop	35	14.0%
Remittance / seasonal migration	30	12.0%

Notably, 64% of households (n = 160) engage in two or more income sources (diversified portfolio), with an average of 2.3 livelihood activities per household—an initial indicator of household adaptive behaviour. Seasonal patterns are pronounced: agriculture incomes peak pre-harvest, while handicraft and petty trade incomes cluster around festival and market days.

4.3. Adaptive Livelihood Strategies Employed by Households

Quantitatively, diversification is the dominant coping/adaptation strategy: 64% of households combine farm and non-farm work or blend home-based crafts with casual labour and small trade. Migration (permanent or seasonal) is present in 28% of households as a supplementary strategy, and about 48% (n = 120) report dependence on forest products (fuelwood, minor timber, NTFPs) for subsistence or sale. Informal credit from local moneylenders or rotating savings is widespread; formal banking remains uneven. A comparative test of resilience outcomes shows markedly better outcomes for diversified households. Using a composite 'resilience score' (0–100) that integrates income stability, asset retention, and shock-recovery indicators, diversified households (n = 160) average 62.5 (SD = 12.4), whereas single-activity households (n = 90) average 51.3 (SD = 14.1). A Welch t-test yields $t \approx 6.29$ ($p < 0.001$), indicating that diversification is strongly associated with higher measured resilience—supporting the first hypothesised relationship.

4.4. Role of Resource Dependency and Market Access

Nearly half the sample (48.0%) relies on forest products for household subsistence or small-scale sale. However, forest dependency displays a double-edged pattern: households that combine sustainable forest extraction with value-addition (e.g., processed NTFPs, co-operative marketing) show higher resilience scores than those that sell raw produce to intermediaries. Market proximity matters: 38% of households (n = 95) are within 5 km of a weekly market or town; these households report higher average cash incomes and are more likely to participate in semi-formal contractual linkages. Distance to market is a statistically significant negative predictor of workforce transition (see regression results below), illustrating that physical market access remains a core constraint to livelihood upgrading.

4.5. Impact of Cultural Practices on Livelihood Resilience

Qualitative fieldwork shows that the cultural embeddedness of activities—especially weaving—both supports resilience and imposes constraints. Women's home-based weaving is a stable source of income that preserves cultural identity and secures intra-household income flows. Still, its market logic is constrained by low product differentiation, weak packaging, and the absence of customer-centric marketing. Focus groups emphasised pride in traditional motifs but also frustration with intermediaries who capture margins. Collectivist practices (informal co-operatives, SHGs) emerged as critical enabling institutions, particularly when linked to micro-credit or joint marketing initiatives.

4.6. Emerging Workforce Transitions and Employability Skills

Transitions to semi-formal or hybrid work arrangements are emergent but limited: 10% of households (n = 25) report some form of semi-formal contractual engagement (for example, regular piece-rate work for a local co-operative or NGO), while direct digital platform participation is nascent (6.0%, n = 15). Digital literacy deficits are acute—72% of households report no meaningful digital skills—limiting the pace of digital gig adoption and constraining upward mobility in the regional labour market. Key-informant interviews with microfinance and co-operative staff highlighted high turnover of frontline employees

in rural branches, which undermines credit continuity and client trust—an institutional bottleneck with direct implications for workforce resilience and financial access.

4.7. Quantitative Data Analysis Results

Multivariate regression was conducted to test the three core hypotheses. The first Ordinary Least Squares (OLS) model estimates the influence of key explanatory variables on the Household Resilience Index (0–100 scale). The second model, a logistic regression, predicts the probability that a household will adopt semi-formal/hybrid work arrangements (Table 5).

Table 5: Determinants of household resilience and workforce transition

Explanatory Variable	OLS β (Std. Error)	t-Value	Sig. (p)	Logistic OR (95% CI)	Wald χ^2
Diversification Index (No. of livelihood activities)	+6.20 (1.50)	4.13	0.000 ***	—	—
Market Access Index (0–10 scale)	+3.10 (1.10)	2.82	0.005 **	1.90 (1.20 – 3.00)	7.90
Formal Credit Access (1 = Yes)	+4.80 (1.90)	2.53	0.012 *	1.70 (1.00 – 2.80)	3.90
Digital Literacy (1 = Yes)	+2.50 (1.70)	1.47	0.141 n.s.	2.80 (1.60 – 4.90)	11.30
Distance to Nearest Market (per km)	–	—	—	0.85 (0.75 – 0.97)	5.90
Household Initial Capital (> ₹10 000 = 1)	—	—	—	1.70 (1.00 – 2.80)	3.90
Constant / Intercept	38.70 (4.80)	8.06	0.000 ***	—	—
Model Fit Statistics	R² = 0.34	—	—	Pseudo R² (Nagelkerke) = 0.29	—

*Notes: N = 250; Dependent variables = (1) Household Resilience Index (OLS) and (2) Semi-Formal Workforce Adoption (Logit). Significance codes: *** p < 0.001; ** p < 0.01; * p < 0.05; n.s. = not significant. Source: Author's field survey (2024–25).*

Multivariate analysis clarifies observed associations. An OLS model with resilience score as the dependent variable yields the following (selected coefficients):

- **Diversification index (number of livelihood activities)**: β = +6.2 (SE = 1.5), p < 0.001.
- **Market access index (0–10)**: β = +3.1 (SE = 1.1), p = 0.005.
- **Access to formal credit (binary)**: β = +4.8 (SE = 1.9), p = 0.012.
- **Digital literacy (binary)**: β = +2.5 (SE = 1.7), p = 0.14 (not significant).
- Model R² ≈ 0.34.

These results indicate that diversification and market access have robust, independent relationships with resilience outcomes. Digital literacy shows a positive but statistically weak association in this sample—likely because the digital economy in East Garo Hills is still limited. A logistic regression predicting adoption of semi-formal/hybrid work (n adopters = 25) indicates:

- **Digital literacy**: OR = 2.8 (95% CI: 1.6–4.9), p < 0.001.
- **Market access (per unit increase)**: OR = 1.9 (95% CI: 1.2–3.0), p = 0.005.
- **Initial capital (binary)**: OR = 1.7 (95% CI: 1.0–2.8), p = 0.048.
- **Distance to market (per km)**: OR = 0.85 (95% CI: 0.75–0.97), p = 0.015.

Thus, while semi-formal work is still numerically limited, its occurrence is significantly shaped by digital capability, proximate markets, and available capital—confirming the second hypothesis about enabling and constraining factors.

4.7.1. Interpretation

- The positive, statistically significant coefficients for Diversification Index, Market Access, and Formal Credit Access confirm their strong influence on household resilience, thereby validating H1 and H3.
- Logistic results show that Digital Literacy (OR = 2.8) and Market Access (OR = 1.9) substantially increase the likelihood of participation in a semi-formal/hybrid workforce, while Distance to Market reduces it—supporting H2.
- The moderate R² (0.34) and Nagelkerke R² (0.29) indicate satisfactory model explanatory power for socioeconomic field data.

Together, these results statistically substantiate that diversification, access, and enabling institutions are the pillars of resilience and workforce transition in East Garo Hills' informal economy. Finally, interaction tests indicate that access to credit

strengthens (moderates) the positive effect of diversification on resilience: households that diversify and have formal credit access score on average 5–7 points higher on the resilience index than equally diversified households lacking credit (interaction $\beta \approx +3.9$, p = 0.03), supporting the third hypothesis.

4.8. Qualitative Insights and Thematic Analysis

Thematic analysis of FGDs and interviews generated four cross-cutting themes that explain the statistical patterns:

- **Portfolio pragmatism**: households purposefully balance subsistence and cash activities to smooth seasonal risk.
- **Institutional fragility**: frequent staff turnover in rural microfinance and irregular co-operative functioning weakens credit reliability and continuity of business training.
- **Market capture by intermediaries**: lack of direct market channels forces producers to accept low margins, especially for raw forest produce and unbranded crafts.
- **Cultural negotiation**: communities value tradition, which can be leveraged for niche marketing (e.g., cultural branding) but requires customer-centric product development and packaging skills.

Together, quantitative and qualitative findings point to a coherent story: resilience in East Garo Hills is built through diversification, market connections and institutional support; workforce transitions toward semi-formal and digital modes are contingent on market proximity, capital, and critical skill upgrades; and local cultural assets provide an entry point for value-added livelihood strategies if complemented by targeted capacity building and stable financial services. In Summary, the evidence supports the study's hypotheses: diversification enhances resilience (H1); workforce transition is enabled by market access and digital skills, while constrained by remoteness and capital (H2); and institutional supports, such as credit, moderate the link between strategy and outcome (H3). The following section draws on these empirical findings to offer policy-oriented recommendations for weaving locally rooted resilience into sustainable development pathways.

5. Discussion

5.1. Interpretation of Key Findings in Relation to Objectives and Hypotheses

The findings from the East Garo Hills district reveal that diversification of livelihood portfolios is the most consistent determinant of household resilience. This empirically validates H1, demonstrating that households engaging in multiple economic activities—combining agriculture, handicrafts, petty trade, and wage labour—have greater resilience to income volatility and environmental shocks. This finding resonates with global evidence from Sub-Saharan Africa and Southeast Asia, where diversified rural economies exhibit stronger adaptive capacities [9]; [24]. The East Garo Hills context underscores diversification as both a necessity and a deliberate risk management strategy, shaped by seasonality, terrain, and market constraints. Similarly, H2—that workforce transition toward semi-formal or hybrid modes is influenced by market access and digital literacy—finds partial but robust support. The logistic regression results demonstrate that proximity to markets, initial capital, and digital capability significantly predict workforce transitions.

This suggests that informal economies are not static; they evolve along a continuum of hybridity, often blurring the traditional boundaries between informal and formal work. However, digital literacy remains low, and infrastructure deficits inhibit transformative digital engagement, highlighting a key area for policy action [14]; [19]. The moderation effect identified in H3, where access to credit amplifies the benefits of diversification, underscores the crucial role of financial institutions and credit-delivery mechanisms. The findings align with recent Indian policy discourses that emphasise an inclusive financial architecture through microfinance, SHGs, and digital banking [23]. Yet, as qualitative data revealed, persistent staff turnover and weak outreach among rural microfinance branches constrain continuity, undermining both household trust and resilience outcomes. Overall, the results reaffirm that adaptive capacity in informal rural economies depends on an interplay of factors—economic diversification, institutional access, market connectivity, and skill upgrading—rather than any single intervention.

5.2. Addressing the Research Gap and Research Questions

The research gap identified in Section 2 highlighted the absence of integrated, empirical analyses linking household-level adaptation, workforce transitions, and resilience within peripheral tribal economies such as East Garo Hills. This study bridges that gap through a mixed-methods framework that situates quantitative livelihood data within qualitative accounts of institutional fragility and cultural embeddedness. The first research question: How do households in East Garo Hills adapt their livelihood strategies to economic, ecological, and market pressures? is answered by evidence of multidimensional diversification and pragmatic adaptation. What are the emerging workforce transition patterns, and which factors enable or constrain them? is addressed through the identification of hybrid livelihood trajectories that combine traditional crafts with semi-formal contracts and micro-entrepreneurial ventures. The third question is: Which institutional and cultural factors

influence household resilience? is illuminated by findings that access to credit, co-operative membership, and gendered cultural norms significantly shape adaptive outcomes. This multi-layered evidence thus responds directly to the research gap by integrating economic, institutional, and cultural variables into a holistic framework of resilience.

5.3. Critical Issues in Informal Employment and Livelihood Sustainability

Several structural challenges emerge as critical issues for the sustainability of livelihoods in East Garo Hills:

- **Institutional Fragility and Financial Retention:** The instability of microfinance and co-operative staffing weakens long-term client relationship-building. This mirrors national concerns over employee retention and service delivery in rural financial sectors, where short-term contracts and high turnover compromise institutional memory and outreach [22]. Without a stable institutional presence, even well-designed credit schemes risk exclusion of remote households.
- **Skill Gaps and Digital Exclusion:** Only a small fraction of respondents reported meaningful digital literacy. The absence of structured training limits both employability and market integration. Similar findings in rural Assam and Nagaland confirm that skill mismatches remain a persistent obstacle to labour mobility [20]. Addressing these gaps is essential for aligning workforce development with India's ongoing digital transformation agenda [17].
- **Market Intermediation and Customer-Centric Constraints:** Producers remain dependent on intermediaries, reflecting asymmetries in information and market power. Lack of branding, product differentiation, and customer-oriented design constrains income potential. Lessons from Kerala's co-operative crafts model and Bangladesh's rural garment clusters indicate that customer-centric marketing, combined with co-operative aggregation, can elevate local producers into higher-value chains [1].
- **Resource Dependency and Environmental Risks:** Overdependence on forest resources without adequate regeneration measures threatens both ecological and livelihood sustainability. This aligns with regional studies warning of jhum intensification and forest degradation in Marchang [15]. Integrating sustainable forestry with value-chain development remains a pressing challenge for balanced development in hill economies.

Collectively, these critical issues underscore the fragility and potential of the informal economy—where resilience coexists with vulnerability and targeted interventions can yield transformative outcomes.

5.4. Linking Empirical Findings to Theoretical Frameworks

The empirical results converge with and extend established theoretical frameworks. The Sustainable Livelihoods Framework (SLF) finds strong validation here: the five capitals—natural, human, social, physical, and financial—are all visible determinants of resilience in Chambers and Conway [4]. Diversification involves the mobilisation of multiple capital forms, while institutional access (credit, co-operatives) strengthens linkages between financial and social capital. At the same time, Labour Market Segmentation Theory helps explain persistent informality: workforce transition is constrained by limited capital, low digital literacy, and structural barriers in rural labour markets [10]. East Garo Hills exemplifies the 'secondary segment' of informality—low entry thresholds, minimal regulation, but weak upward mobility. Furthermore, the Adaptive Resilience Perspective resonates strongly. Households are not passive recipients of change but active agents of adaptation—reconfiguring work portfolios, engaging in migration, and experimenting with hybrid livelihoods [12]. This human agency, embedded within cultural and ecological systems, underscores that resilience is both an economic and socio-cultural construct. By integrating these frameworks, this study advances a contextualised resilience model specific to hilly tribal economies, bridging the gap between macro theories of informality and the micro realities of adaptation [25]; [24].

5.5. Implications for Policy, Practice, and Sustainable Development

The findings carry significant implications for policy and practice across four domains—livelihood policy, skill development, institutional strengthening, and sustainable regional development:

- **Livelihood Policy and Program Design:** Policymakers should prioritise portfolio-based interventions that support diversified income streams rather than single-sector dependence. Integrating crafts, agro-processing, and eco-tourism into livelihood missions can enhance resilience. Market infrastructure—roads, local markets, digital payment platforms—should be strategically expanded to connect isolated producers.
- **Skill Development and Employability:** A localised Skill Gap Analysis should be undertaken for East Garo Hills to align training curricula with actual market demand. Skill-building initiatives must be embedded within cultural and gender realities—training women weavers in customer-centric design, packaging, and digital marketing. This aligns with the Ministry of Skill Development's "Skill India 2.0" strategy, emphasising digital inclusion and regional customisation.

- **Institutional Strengthening and Workforce Retention:** The study's findings on microfinance staff turnover highlight the need for stronger employee retention policies in rural financial institutions. Introducing performance-linked incentives, localised recruitment, and rotational field postings can stabilise service continuity. Strengthened co-operatives and SHGs, coupled with consistent extension support, can bridge the trust deficit in rural credit ecosystems.
- **Sustainable Resource Governance:** Integrating livelihood programs with environmental safeguards is imperative. Introducing forest-based enterprise models, promoting certified NTFP products, and involving local communities in co-management can balance ecological integrity with economic gain. The Meghalaya State Rural Livelihoods Mission (MSRLM) could pilot such integrated resilience clusters.

At the macro level, these strategies directly contribute to Sustainable Development Goals (SDGs)—notably SDG 1 (No Poverty), SDG 8 (Decent Work), and SDG 13 (Climate Action). By institutionalising adaptive capacities and cultural capital, East Garo Hills can become a model of inclusive, sustainable rural transformation in Northeast India. In conclusion, the analysis underscores that resilience in East Garo Hills' informal economy emerges not from external interventions alone but from the synergy of household ingenuity, institutional stability, and context-aware policy design.

The informal sector—often dismissed as peripheral—proves to be an arena of creativity, adaptation, and evolving workforce realities. Embedding these insights into policy and practice can reimagine the informal economy as a driver of regional resilience and sustainable development rather than a symbol of marginality.

6. Recommendations and Solutions

6.1. Innovative and Practically Applicable Strategies for Livelihood Resilience

Promote portfolio-based livelihood support rather than single-sector subsidies. Small, conditional "resilience grants" (seed capital ₹10–20k) linked to technical assistance can help households combine farm, craft, and micro-enterprise activities—an approach that amplifies the proven benefits of diversification [9]. Strengthen SHG-federation linkages and incentivise producer co-operatives to reduce dependence on predatory intermediaries; co-operatives should receive performance grants for quality control, packaging, and bookkeeping. Finally, pilot a "shock-response" fund at the block level to provide rapid liquidity for households after climate or market shocks, reducing distress sales of assets [14].

6.2. Enhancing Market Access and Resource Sustainability

Establish local market hubs and digital market windows: periodic rural-roots markets and permanent community centres can eliminate intermediaries and enable direct sales; complement these with low-bandwidth digital storefronts and group e-commerce onboarding supported by community agents. Integrating value-addition for NTFPs and weaving through micro-processing units and design clusters—linking MegLIFE's forest restoration goals with marketable, certified NTFP products can align sustainability with income [18]. Invest in last-mile logistics (pooled transport and, where relevant, cold storage) to lower transaction costs and improve price realisation for remote producers.

6.3. Capacity Building and Skill Development for Workforce Empowerment

Launch region-customised skill bundles combining product design, customer-centric marketing, digital literacy, and simple bookkeeping—delivered through village learning hubs and mobile trainers. The curriculum should be co-designed with local artisans to preserve traditional motifs while aligning with market trends. Strengthen rural financial outreach by addressing employee retention in microfinance/branch networks through localised hiring, career pathways, and modest retention incentives—thereby stabilising credit relationships that amplify diversification benefits [22]. Offer targeted apprenticeships linking youth to semi-formal value-chain roles to smooth workforce transitions.

6.4. Strengthening Cultural Assets Towards Sustainable Economic Practices

Adopt heritage branding and participatory certification for Garo weaving and forest-based products—using community trademarks to secure higher margins and cultural recognition. Facilitate women-led design incubators that combine traditional knowledge with consumer insights and ethical storytelling for niche markets. Encourage community co-management of forest resources with market agreements that reward sustainable extraction and reinvest a share of proceeds into community resilience projects [16].

7. Conclusion

7.1. Summary of Major Findings

This study demonstrates that household diversification is the central axis of resilience in East Garo Hills: households combining agriculture, weaving, petty trade, and wage labour attain higher income stability and recover more quickly from shocks than single-activity households. Market access and formal credit further strengthen these gains, while digital literacy and proximate markets significantly increase the likelihood of households adopting semi-formal or hybrid work arrangements. Institutional fragility—most visibly expressed as high frontline staff turnover in rural financial providers—undermines credit continuity and constrains sustained livelihood upgrading. Finally, local cultural assets (notably weaving and forest-based knowledge) offer tangible pathways to value addition and niche marketing, if product design, packaging, and customer-centric marketing are strengthened.

7.2. Research Contributions and Theoretical Advancements

The research contributes empirically and theoretically in three ways. Empirically, it supplies a mixed-methods, household-level account of adaptive strategies and workforce transitions in a hilly tribal district—an under-researched context in informality studies. Theoretically, the findings synthesise the Sustainable Livelihoods Framework with labour market segmentation and adaptive-resilience perspectives, advancing a contextualised model in which capitals (natural, social, human, physical, and financial) interact with market and institutional factors to produce resilience. This integrated framing clarifies why diversification alone is insufficient without stable institutions and market integration.

7.3. Limitations and Areas for Future Research

Limitations include the cross-sectional design, potential recall and self-reporting biases, and the inevitable selection constraints imposed by remote hamlets excluded for logistical reasons. The relatively nascent incidence of digital gig participation limits statistical power for that sub-analysis. Future research should pursue longitudinal designs to track shocks and recovery over time, experimental or quasi-experimental evaluations of targeted interventions (e.g., resilience grants, market hubs), and in-depth value-chain studies that map margins and capture points of market capture by intermediaries. Investigating institutional reforms that reduce employee attrition in rural financial delivery (thus improving credit continuity) also merits focused inquiry.

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