

Tribal resilience in changing ecologies: A socio-ecological study from Purulia District, West Bengal, India

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Abstract

This paper offers a fresh perspective on the socio-ecological niche and resilience of tribal communities in the Purulia district of West Bengal, India. It explores how tribes such as the Santhals, the Kharia Sabars, and the Birhors etc. one of the most primitive tribal groups, maintain harmony between their society, culture, and ecological surroundings. Grounded in the principles of social ecology, the study investigates both qualitatively and quantitatively the dynamics of socio-ecological transformation and resilience within these communities. The study constructs a correlation matrix using a socio-ecological framework consisting of five designated categories: ecology, social structure, culture, economy, and polity. The correlation among these categories generated fifteen interrelationships, such as ecology and social structure, ecology and culture, ecology and economy, social structure and culture, etc. To quantitatively assess resilience, the study identified twenty indicators and conducted fieldwork across 600 tribal households within five community development blocks of Purulia. The collected primary data were analysed using Z-score standardization and Principal Component Analysis (PCA) to evaluate the state of socio-ecological resilience among the tribes. Additionally, observational and biographical field studies were carried out to complement the quantitative findings. The PCA results showed a strong positive loading for the cultural component, which is closely aligned with the cultural resilience observed in the qualitative analysis, most notably among the Kharia Sabars.

Keywords: Correlation matrix, cultural resilience, social models, Santhal, Kharia Sabar, Birhor, Principal Component Analysis

Introduction

Tribal communities represent some of the most pristine and resilient societies on Earth. Found across diverse ecological settings, these communities have developed unique cultural practices, governance systems, and survival strategies. However, rapid ecological exploitation and related processes have disrupted their traditional ways of life, leading to displacement, loss of identity, and socio-economic exclusion. A central concern today

is how to better understand the current state of tribal societies and the foundations of their resilience. Traditionally, the study of tribal communities has been approached through disciplines such as anthropology, which emphasizes cultural and kinship structures; sociology, which examines social interactions and institutions; environmental determinism, which views nature as the primary force shaping human societies; cultural ecology,

which focuses on adaptation; and theoretical lenses like structural-functionalism; Marxist ecology, materialism, and reductionism, which tend to emphasize economic structures, technological modes of production, and profit maximization. While each of these frameworks provides important insights, the present study adopts social ecology as a more integrative lens to investigate tribal resilience. The rationale for selecting social ecology lies in its comprehensive and relational approach, rooted in a socio-ecological framework synthesising ecosophic principles that emphasize ecological equilibrium and the interconnection of social and environmental spheres, as described by Guattari (1996), and geosophic perspectives reflecting the human sense of space, as articulated by Wright (1947). In a world of ever-changing biophysical, socio-economic, and cultural conditions, social ecology offers a deeper and more nuanced understanding of tribal communities. It acknowledges that tribal interaction with the environment is not solely driven by economic necessity, but is also shaped by cosmologies, rituals, and reciprocal relationships with nature. Furthermore, it illuminates the diversity and complexity of relations within and between tribal groups or the inter- and intra-tribal dynamics. The socio-ecological framework adopted in this study enables the construction of a correlation matrix that explores the relationship among five coexisting categories: ecology, social structure, culture, economy, and polity. Here last four categories are also referred broadly as social models in social ecology (Guha, 2008). This matrix serves as both a conceptual and methodological foundation for examining the quantitative and qualitative dimensions of socio-ecological resilience among three prominent tribal communities living in the

Purulia district of West Bengal- the Santhals, the Kharia Sabars, and one of India's most primitive tribes, the Birhors.

Social ecology

The concept of social ecology and its philosophical dimensions have been developed, enriched, and modified over time by several distinguished scholars and philosophers. Prominent among them are Radhakamal Mukherjee (1926, 1930, 1942), D. N. Majumder (1956), P. K. Bhowmik (1963), Murray Bookchin (1964), H. C. Brookfield (1969), Vidyarthi (1972), and Ramachandra Guha (2008). In more recent years, scholarly contributions focusing on tribal social ecology and resilience have been advanced by Sharma and Gangmei (2015), Raj and Mohan (2018), Long, Lake, and Goode (2020), Malhotra, Nandigama, and Bhattacharya (2021), Mukherjee and Malik (2021), Camacho (2023), Kumar and Singh (2023), Chakraborty and Rout (2024), and Kumar and Mohanasundari (2025), among others. However, most of the literature in this domain remains predominantly theoretical, offering conceptual and abstract frameworks for understanding human societies. Empirical studies are relatively scarce. Notable exceptions include Guha and Martinez-Alier (1997), who examined grassroots environmental movements in the global south; Carl Folke (2006), who empirically investigated socio-ecological systems and resilience; and Salomon and Quinlan (2019), who developed empirical frameworks for assessing tribal resilience in southern Mexico. In this context, the present study seeks to address the gap in empirical and mixed-method research by applying a socio-ecological framework to investigate

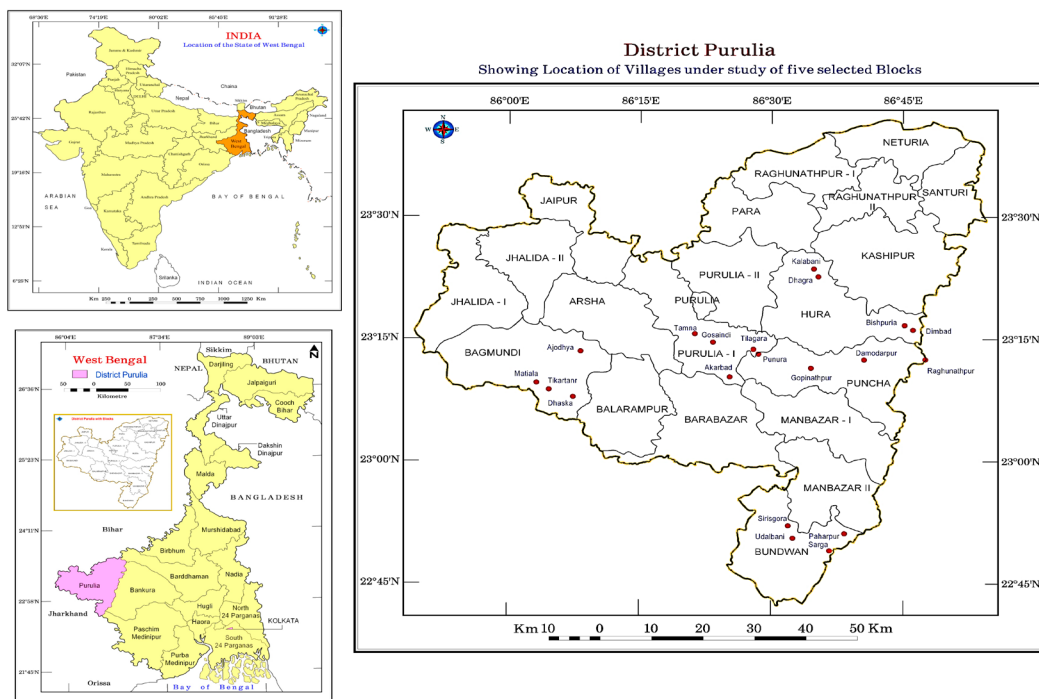


Fig. 1: Location map of five community development blocks of Purulia district

how tribal societies in the Purulia district of West Bengal, India, adapt and demonstrate resilience (Fig. 1). It explores the evolution of traditional cultural practices in response to rapid environmental and socio-economic changes.

Objectives

The present study was undertaken with the following objectives:

1. To apply a socio-ecological framework to examine the nature and extent of socio-ecological resilience among selected tribal communities in the Purulia district.
2. To employ qualitative and quantitative methods to assess and validate the state of tribal socio-ecological resilience in ecological degradation.

Methodology

Step 1: A correlation matrix consisting of a set of twenty-five interrelationships was designed and developed by using the key elements of the socio-ecological frameworks. These relationships were initially identified between independent ecology (E) and independent ecology (E), and subsequently between independent ecology (E) and the dependent components of the socio-ecological framework, referred to as social models, namely, social structure (S), culture (C), economy (Ec), and polity (P). Further, ten (10) of these interrelationships represent *direct correlations*, accounting for 40% of the total. An additional five (5) interrelationships (20%) were identified as *identity variables*, while the remaining ten (10) were classified as *Indirect Correlations*.

Step 2: Based on the combination of the *direct correlations* and *identity variables*, an *Upper Triangular Correlation Matrix* was constructed. This matrix served as the basis for quantifying tribal socio-ecological resilience. To ensure analytical clarity and avoid redundancy, the *indirect correlations* represented in the Lower Triangular Matrix were deliberately excluded from the analysis.

The Upper Triangular Correlation Matrix includes the following fifteen interrelationships:

A. Direct Correlations

1. Ecology-Social Structure (E-S)
2. Ecology-Culture (E-C)
3. Ecology-Economy (E-Ec)
4. Ecology-Polity (E-P)
5. Social Structure-Culture (S-C)
6. Social Structure-Economy (S-Ec)
7. Social Structure-Polity (S-P)
8. Culture-Economy (C-Ec)
9. Culture-Polity (C-P)
10. Economy-Polity (Ec-P)

B. Pure Correlations

1. Ecology-Ecology (E-E)
2. Social Structure-Social structure (S-S)
3. Culture-Culture (C-C)
4. Economy-Economy (Ec-Ec)
5. Polity-Polity (P-P)

Step 3: Twenty indicators have been selected for the study. Of these, the first four were exclusively used to examine the current ecological condition in the area under study. The remaining sixteen indicators have been selected to investigate the socio-ecological resilience of the tribal communities by using

correlations among the categories of the socio-ecological framework. (Fig. 2, Fig. 3 and Fig. 4)

Interrelationship-1: Ecology-Ecology (E-E):

1. E-E_1: Percentage of forest area to total area;
2. E-E_2: Percentage of the area under culturable waste to total area (including communal pasture lands or *gauchar* and groves);
3. E-E_3: Village(s) located in the foothill / hilltop;
4. E-E_4: Village(s) located relatively in plain land;

Interrelationship-2: Ecology with the social models:

Ecology-Social Structure (E-S):

5. E-S_1: Village(s) with compact settlement pattern;
6. E-S_2: Village(s) with scatter settlement pattern;
7. E-S_3: Village(s) with maximum multi-linguistic populations (besides mother tongue);
8. E-S_4: Percentage of households with more than three generations;
9. E-S_5: Percentage of tribal households situated in isolation based on their age-old Tradition, far away from non-tribal settlements;
10. E-S_6: Percentage of households situated within or close to non-tribal settlements;
11. E-S_7: Village(s) found still maintaining resource partitioning and inter-community territoriality; (It refers to the barter system, an age-old tradition of exchanging goods and services, without the use of money, practiced even today among some of the tribal communities

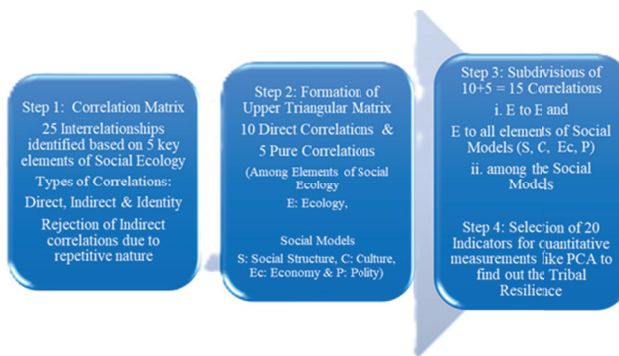


Fig. 2: Major components and steps used to form the correlation matrix

Elements	1.	2.	3.	4.	5.
1.	E-E	E-S	E-C	E-Ec	E-P
2.	S-E	S-S	S-C	S-Ec	S-P
3.	C-E	C-S	C-C	C-Ec	C-P
4.	Ec-E	Ec-S	Ec-C	Ec-Ec	Ec-P
5.	P-E	P-S	P-C	P-Ec	P-P

Fig. 3: Correlation matrix

Elements	1.	2.	3.	4.	5.
1.	E-E ↔ E-S ↔ E-C ↔ E-Ec ↔ E-P				
2.		S-S ↔ S-C ↔ S-Ec ↔ S-P			
3.			C-C ↔ C-Ec ↔ C-P		
4.				Ec-Ec ↔ Ec-P	
5.					P-P

Index

E: Ecology; S: Social Structure; C: Culture; Ec: Economy; P: Polity

Direct Correlations

Indirect Correlations

Identity Variables

↔
↔

 Reciprocal Correlations

Fig. 4: Upper triangular correlation matrix

like Birhors of Purulia. It indicates the sense of rigidity and practice of the tribal way of living and traditional culture, where they still do not have the notion of savings.)

12. E-S_8: Village(s) found authority maintained by the stratified functional socio-structural system;

Ecology-Culture (E-C):

13. E-C_1: Percentage of households practicing hunting;
14. E-C_2: Village(s) displaying cultural functions embedded in elements of nature;

Ecology-Economy (E-Ec):

15. E-Ec_1: Village(s) primarily based on minor forest products;
16. E-Ec_2: Percentage of households transformed from nomadic to permanent agriculture;
17. E-Ec_3: Percentage of area not available for cultivation to total area;

Ecology-Polity (E-P):

18. E-P_1: Percentage of respondents agreed that they are marginalized from their habitat (meaning thereby the said tribal people under consideration collectively acknowledge and experience being pushed to the fringes of society by losing access to their ancestral land and resources etc.);
19. E-P_2: Percentage of respondents agreeing that they must save the forest by uniting themselves;
20. E-P_3: Percentage of respondent believed that peace is the only way to sustain their habitat.

Step 4: Primary data were collected from 600 households across 20 tribal villages,

comprising 10 uni-ethnic and 10 multi-ethnic villages, situated within five C. D. Blocks of Purulia district, namely Purulia-I, Hura, Pancha, Baghmundi, and Bundwan. The break-up of the villages has been done with a specific objective. The villages have been divided to derive the sense of tribal cultural resilience in both uni-ethnic (ethnically homogenous) tribal villages, and the villages where tribal people are living with the non-tribal communities, exposed to acculturation, and often subject to detribalization. The selection of 600 households was determined based on the need to ensure both statistical reliability and adequate representation of intra-community and inter-community variations in tribal socio-ecological resilience. This sample size strikes a balance between depth and breadth, allowing for meaningful analysis while remaining logistically and financially feasible within the scope of the study. The five blocks were purposively selected to reflect variations in socio-economic development, as identified by government reports and policy documents from the *Paschimanchal Unnayan Parshad*. For instance, Purulia-I is relatively more economically developed, featuring better infrastructure and service access, whereas Bundwan is comparatively underdeveloped, with limited connectivity and persistent livelihood challenges. This development gradient allowed for a comparative analysis of resilience factors across differing socio-economic and ecological contexts. Within each block, villages were selected using purposive stratified sampling to ensure representation of both uni-ethnic and multi-ethnic settlement types. This distinction was crucial to capture the role of ethnic composition in shaping community dynamics, collective action, and resilience-building practices.

Step 5: A separate case study, grounded in geographical biography, was conducted to assess whether tribal communities such as the Kharia Sabar have adopted modern facilities and amenities introduced through tribal development plans and policies available in the district. To support this analysis, the author incorporated field-based photographs. The case study also involved interviews with village leaders (*Manjhis*) to assess their perceptions and insights regarding the effectiveness and reception of these policies.

Result and discussion

Socio-ecological significance of the tribal communities

Role of the natural environment

The physical environment plays a fundamental role in sustaining the life and livelihoods of tribal communities. These communities, in turn, maintain a close and symbiotic relationship with their surrounding ecology. Elements of tribal culture, such as rites and rituals, social organization, and governance systems, are deeply intertwined with ecological conditions. The tribal economy remains largely forest-based, and this ecological distinctiveness has historically isolated them from mainstream society, thereby helping to preserve their traditional lifestyles. This study explores the interrelationship between tribal communities and their natural environment, guided by the conceptual framework of the social ecology.

The tribal belts of Purulia are mostly characterized by dense forested uplands, which provide a natural habitat for tribes such as the Birhors (*bir* meaning 'forest', and *hor* meaning 'man'), who are recognized as a PVTG or Particularly Vulnerable Tribal Group in India. Their original sub-group,

the *Uthlu* Birhors, continues to inhabit cave shelters deep within the Ajodhya hills, preserving their traditional forest-dwelling lifestyle. In contrast, the *Jagghi* Birhors, another sub-group, have gradually settled in the foothill regions, such as Bhupatipalli of Matiala village in Bagmundi (Adhikary, 2008) (Mukherjee, 2020a) (Fig. 5).

A separate qualitative inquiry was conducted to understand how ecological barriers, such as elevation, slope, and forest cover, shaped the tribal settlement patterns. The relationship between topography and the pattern of settlements is unmistakable as evident in the Digital Elevation Model (DEM) of Purulia district (Fig. 6). In relatively elevated regions, especially in the Bundwan and Bagmundi blocks, dispersed settlement is more of a rule. As elevation increases, especially towards the Ajodhya Hilly region, scattered settlement pattern becomes more common due to difficult terrain and poor accessibility. In contrast, compact settlements of the tribes, especially of Santhals, are more visible in relatively flat and plain regions, reflecting greater infrastructural integration and easier land use. The scatter diagram in figure 7 bear testimony to this.

Tribal Society

Tribal communities often perceive themselves as descendants of the Earth, with a profound duty to protect their immediate physical environment, referred to as *Disum*. For instance, the Birhor identify themselves as *Horhopon ko*, meaning the sons of Man, and describe themselves as forest people. Traditionally, they reside in caves, hilltops, and sometimes alongside peasants, whom they call *Diku*. They refer to the external world beyond their ecological domain as *muluk*. The Santhals, another prominent tribal

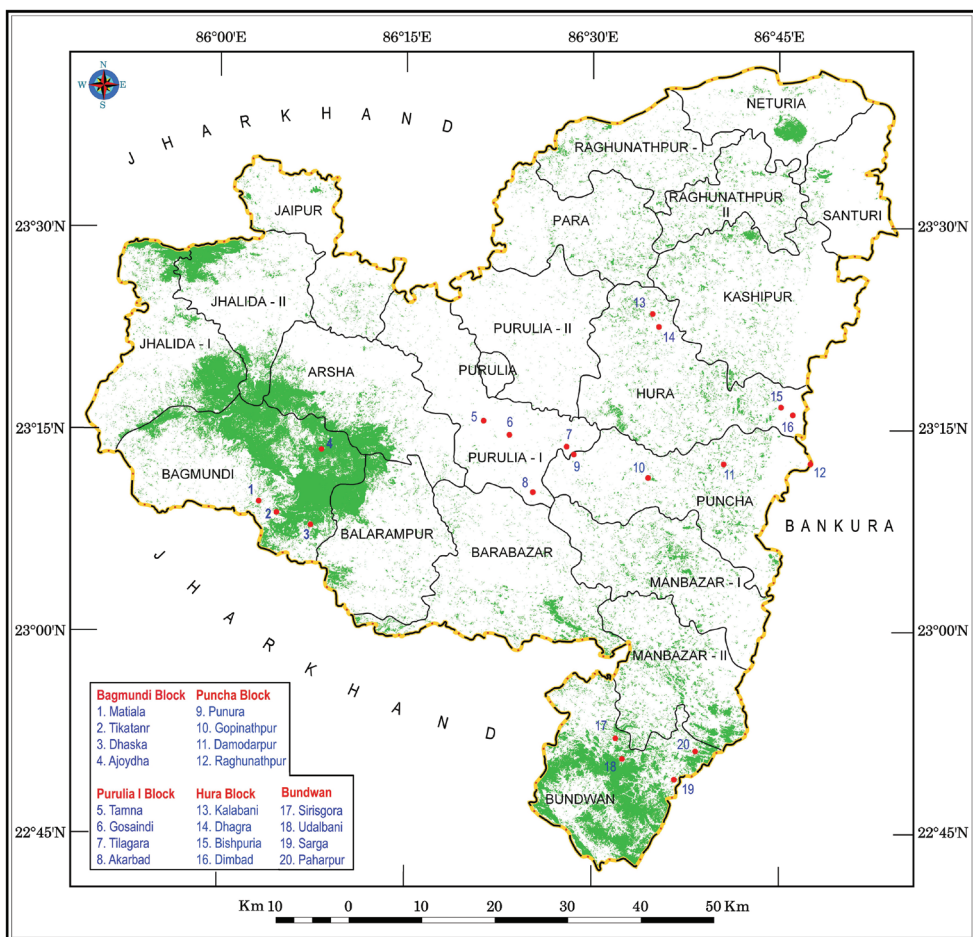


Fig. 5: Purulia district: Distribution of forest and the location of the selected villages

group, inhabit both uni-ethnic and multi-ethnic villages. Regardless of their current living conditions, they maintain a deep reverence for nature, which is reflected in the ritualistic worship of their deities. The Sun, locally known as *Sing bonga*, is their supreme deity. Before performing any cultural activity, they ritually honour natural elements such as soil, hills, rivers, and forests. Deities such as *Marang Buru* and *Basumata* (the earth goddess) are central to their cosmology.

Santhal religious practices revolve around sacred groves, the most significant being the *Jaher Than*, usually located to the west of their settlements or *tanda*. This sacred space symbolizes their intimate relationship with the forest. The social structure of the Santhal is organized around complex exogamous clans, known as Paris, each carrying a unique totemic identity connected to nature. For example, the *Kisku* clan is associated with the golden eagle, *Murmu* with the Nilgai,

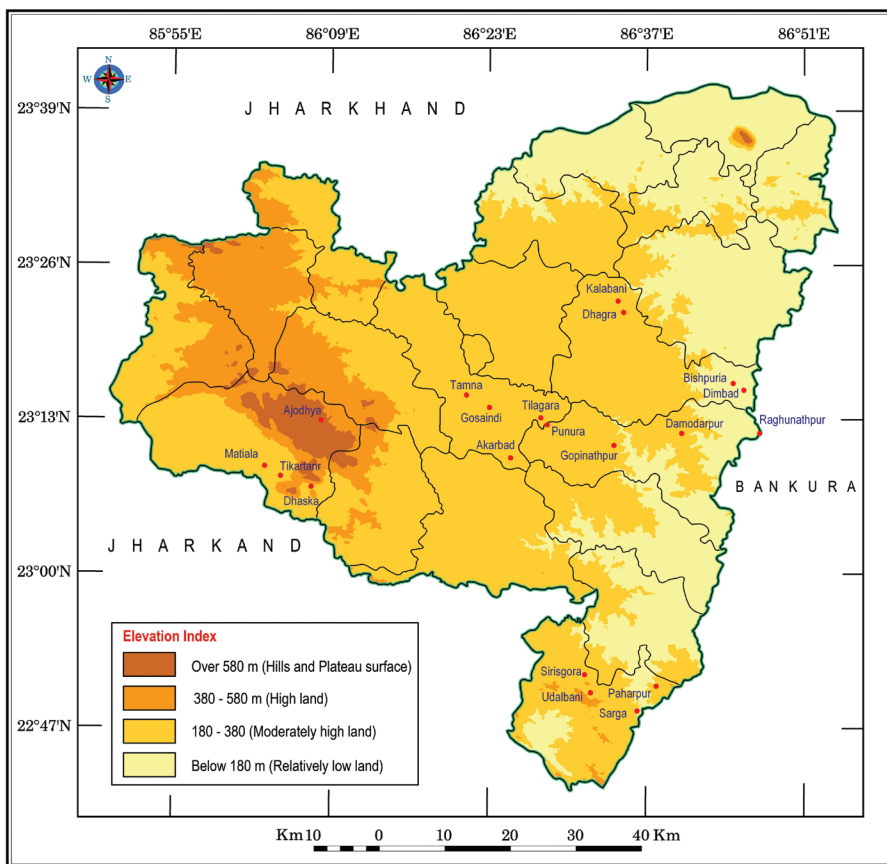


Fig. 6: Purulia: Digital elevation and the village locations

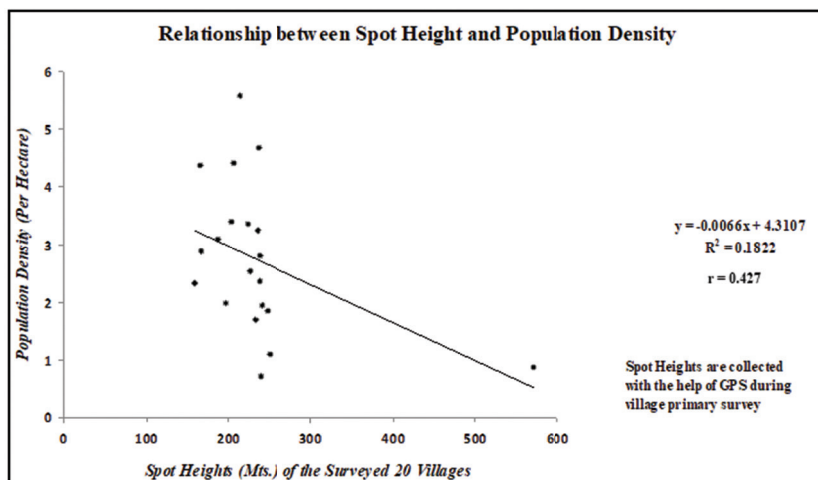


Fig. 7: Relationship between tribal population density and elevation

Hembrom clan with the betel-nut, and Tudu with the duck. This symbiotic relationship with nature becomes even more complex when viewed through the lens of agricultural adaptation. Among the twelve clans, the *Marandis* are believed to have adopted agriculture earlier than others, symbolized by their totemic marker, Merza grass, a weed commonly found in rice fields (Rao, 2005). Traditionally, tribal communities were hunters and gatherers. Activities like *sendra* (hunting) remain vital for tribes such as the Kharia Sabar and the Birhors.

The tribal economy and associated natural laws have evolved with an inherent focus on the conservation of both community and environment. To explore this, the study investigated inter-community territoriality and resource partitioning among selected tribal groups. Each village maintains a stratified governance structure, led by the *Manjhi* (village headman) and supported by elders and ritual specialists such as the *Paranik*, *Naeke*, and others. These leaders regulate resource use, offering guidance on how to sustainably utilize locally available materials. Such indigenous knowledge systems have fostered specialized expertise in production. For instance, the Santhals, settled predominantly in plains, focus on agriculture, while the Birhors, many of whom remain semi-nomadic, excel in forest-based subsistence activities. They craft strong ropes from a creeper locally called *Chihor-lata*, demonstrating their ecological mastery. Each tribal community has established territorial zones where they produce specific commodities, often not replicated in neighboring areas. Over time, however, no single community remained entirely self-sufficient, prompting the development of

inter-community and inter-ethnic exchange networks. This gave rise to barter systems, particularly in the foothills of the Ajodhya Hills, where Santhals and Birhors engaged in resource exchange without undermining their distinct territorial identities. These practices have not only preserved traditional tribal boundaries but have also contributed significantly to the sustainable management of natural resources in the region.

Integrated narrative: Quantitative and qualitative dimensions

In this segment, the current situation of the selected tribal communities has been assessed using a quantitative approach, specifically through the development of a correlation matrix based on key social and ecological categories of social ecology. The interrelationship between tribal societies and their surrounding environment was statistically examined using fifteen identified correlations (Fig. 3), analyzed through standardized Z-scores and Principal Component Analysis (PCA). The composite Z-scores were computed for five critical components: Ecology (E), Social Structure (S), Culture (C), Economy (Ec), and Polity (P) (Table 1). These standardized indices were analyzed through SPSS software, resulting in two principal components that together explain 72.84% of the total variance (Tables 2 and 3). Component 1, accounting for 48.04% of the total variance, emerges as the most significant in understanding the interrelationships in tribal social ecology. A strong negative loading of Ecology (-0.857) in Component 1 reflects widespread environmental degradation, particularly forest depletion, a fact corroborated by the India State Forest Report (2023) and Global Forest Watch, stating that a huge amount of forest

Table 1: Composite Z-Scores of the selected villages

Blocks	Villages	Composite Z-Scores				
		PC-E	PC-S	PC-C	PC-Ec	PC-P
Purulia-1	Gosaindi	1.57	-1.01	3.80	0.54	0.65
	Tilagara	-0.37	-0.12	1.75	2.17	0.15
	Tamna	-5.52	-1.06	10.56	3.27	0.50
	Akarbad	-4.39	-0.35	-7.03	-2.10	-7.78
Hura	Dimbad	0.23	0.24	7.12	-2.51	-2.41
	Dhagra	-0.96	4.98	8.55	1.69	-1.66
	Kalabani	2.29	4.68	0.35	1.36	0.91
	Bishpuria	-1.59	-0.17	9.14	2.48	-0.67
Puncha	Gopinathpur	4.98	2.31	-1.80	1.55	0.04
	Raghunathpur	3.99	1.76	0.61	1.23	1.42
	Punura	-3.64	-1.26	-0.54	0.24	-2.33
	Damodarpur	-5.69	3.88	-6.41	-0.15	-6.39
Bagmundi	Matiala	5.38	-4.35	0.80	-0.33	-1.61
	Dhaska	7.94	2.26	-5.00	-1.92	4.00
	Tikatanr	7.71	0.42	-2.52	0.37	3.85
	Ajodhya	7.63	-5.54	-11.23	-3.33	2.86
Bundwan	Paharpur	5.55	0.70	-6.98	-4.10	4.44
	Sarga	7.19	-1.44	-6.01	-1.85	3.79
	Udalbani	5.00	-3.09	1.18	0.33	-0.56
	Sirisgora	3.02	-2.85	3.68	1.06	0.82

Source: Field survey, 2023-2024

Table 2: Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% Variance	Cumulative %
1	2.402	48.037	48.037	2.402	48.037	48.037
2	1.240	24.807	72.844	1.240	24.807	72.844
3	0.906	18.125	90.968			
4	0.284	5.677	96.646			
5	0.168	3.354	100.000			

Extraction Method: Principal Component Analysis

has been lost in Purulia in the last few years. In contrast, positive loadings for culture (0.724) and economy (0.744) in the same component underscore that, despite ecological decline, tribal communities continue to preserve

core cultural practices and subsistence systems. Component 2 adds further nuance, showing positive associations for culture (0.539), economy (0.542), and polity (0.703), suggesting resilience not just in cultural

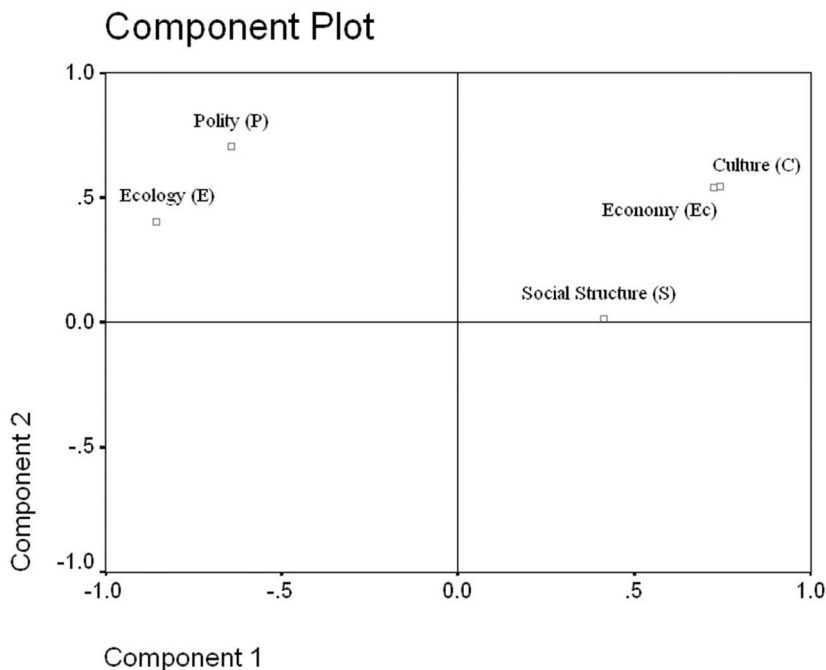


Fig. 8: Samples are plotted by using the first two principal components

forms but also in community governance and interdependence. The component plot (Fig. 8) further visualizes these relationships: culture and economy are clustered in the upper right quadrant, indicating their strong positive influence across both the components. Ecology and polity appear in the upper-left quadrant, showing ecological challenges counterbalanced by stable political structures. Meanwhile, social structure remains closer to the center, reflecting its relatively weaker explanatory power in the present resilience framework. It reinforces the finding that cultural continuity and decentralized governance remain strong in both uni-ethnic and multi-ethnic tribal villages. These statistical patterns are validated by qualitative ethnographic insights. For instance, a biographical case study on the Kharia Sabar community, a PVTG residing in

Akarbad village in the Purulia-I block, offers a poignant illustration of cultural resilience in practice. Fieldwork based on interviews, observation, and photography revealed that the Kharia Sabars actively resisted housing provisions under tribal development schemes because the designs included modern sanitary facilities—elements fundamentally misaligned with their cultural beliefs and lifestyle. The lavatory units were repurposed by the community as outdoor seating areas beneath village trees (Fig. 9), rather than being used for their intended purpose. This act of quiet resistance reflects a deep-seated cultural ethic: for the Kharia Sabars, traditional norms, spatial arrangements, and belief systems cannot be easily overridden by modern interventions, however well-intentioned. Their autonomous decision-making, rooted in community consensus and

Table 3: Component matrix

Elements of Social Ecology	Components	
	1	2
Ecology (E)	-0.857	0.402
Social Structure (S)	0.415	0.011
Culture (C)	0.724	0.539
Economy (Ec)	0.744	0.542
Polity (P)	-0.645	0.703

Extraction Method: Principal Component Analysis (PCA)



Fig. 9: Exhibition of cultural resilience: The housing scheme under the government plan is not accepted by the Kharia Sabars as it is against their cultural traditions

led by the village *Manjhi*, further strengthens the role of indigenous polity structures, as seen in the positive loading of polity (0.703) in component 2. Therefore, the high cultural loading in the PCA is not an abstract statistical artifact; it is directly embodied in the lived experiences of communities like the Kharia Sabars. Their selective adoption and rejection of state-provided amenities is a powerful expression of cultural resilience, reaffirming how identity, ecology, and tradition intersect to sustain tribal ways of life even amid structural ecological and developmental pressures. Thus, this integration of quantitative evidence with rich

qualitative fieldwork offers a holistic and grounded understanding of socio-ecological resilience. While the numbers quantify variance and correlation, the biographies of communities like the Kharia Sabars give that data depth, agency, and meaning, showing how tribal societies in Purulia negotiate modernity without losing their ecological and cultural anchorage.

Conclusions

This study on the tribal communities of the Purulia district reveals a profound capacity for cultural and ecological resilience amidst increasing ecological degradation and

socio-economic and cultural transformations. By integrating both qualitative and quantitative approaches across the five key dimensions of social ecology, the research provided a comprehensive portrait of how indigenous communities adapt while preserving their traditional ways of life.

The ecological dimension highlights the interdependence between tribal livelihoods and the natural environment. Despite the depletion of forest resources, the tribal worldview remains rooted in ecological stewardship and sacred relationships with nature. This enduring connection reflects a knowledge system developed through generations of lived experience and cultural transmission. In terms of social structure, traditional kinship networks and communal hierarchies remain strong across the studied communities, offering stability and cohesion. Although modern forces have introduced new dynamics, mutual aid, collective responsibility, and age-old hierarchies continue to underpin social interactions and reinforce resilience. The cultural resilience emerges as the most salient theme. The PCA findings underscore high positive loadings on cultural indicators, which are supported by field-level observations. For example, the Kharia Sabar community's rejection of government-provided housing due to cultural objections to toilet design illustrates the persistence of indigenous norms in shaping everyday decisions (Fig. 9). Oral traditions, festivals, totemic systems, and sacred groves function as cultural anchors that safeguard identity in the face of external pressures. Forest-based subsistence, barter systems (as with the Birhors), and handicrafts (notably by Kharia Sabars) still support household

economies. The categorization of groups like the Birhors as a particularly vulnerable tribal group underlines the continued need for targeted, culturally appropriate support mechanisms. The polity, or the governance, also reflects this duality. Traditional decision-making bodies such as tribal councils and *Manjhi* panchayats operate alongside formal administrative systems. This hybrid structure allows communities to adapt to changing legal contexts while preserving local authority and participatory governance rooted in customary law.

The integration of quantitative analysis, particularly PCA with qualitative field observations, enhances the credibility and depth of these findings. For example, the high cultural loading in Component 1 (0.724) statistically validates the field-level narratives of ritual persistence and symbolic resistance to imposed modernization. The findings have clear policy implications. Development programmes must recognize cultural resilience not as resistance to progress but as a resource for more effective, sustainable planning. Schemes under the Tribal Sub-Plan, Forest Rights Act, or PVTG initiatives should be designed in consultation with tribal communities, incorporating their epistemologies, customary norms, and governance institutions. This approach ensures that interventions are both inclusive and context-sensitive.

In essence, this study affirms that cultural resilience, ecological knowledge, and adaptive governance form the backbone of tribal life in Purulia. The enduring socio-cultural traditions of these communities in an era of rapid environmental and social change offer a model of sustainable coexistence

between human societies and nature. Their experiences provide valuable insights for reimagining development in ways that honour cultural diversity, ecological integrity, and human dignity, making this research not only locally grounded but globally relevant.

Competing interest

The author declares that he has no conflict of interest.

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