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JOURNAL OF THE
NORTH EASTERN COUNCIL

A half yearly journal of the North Eastern Council

2026
January - June

Volume 27, Number 1
ISSN: 0970-793X

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EDITORIAL NOTE

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VOLUME 27, NUMBER 1

It gives us immense pleasure to present the latest issue of the Journal of the North Eastern Council, which continues its commitment to promoting multidisciplinary scholarship and intellectual engagement on issues of contemporary relevance to Northeast India and beyond. This volume brings together a diverse range of scholarly contributions reflecting the region's rich cultural heritage, environmental concerns, socio-economic challenges, public health priorities, technological developments, governance issues, and emerging opportunities for sustainable development.

The present issue features seventeen scholarly contributions by researchers and academicians from diverse disciplines, along with a thought-provoking book review. Collectively, these contributions demonstrate the breadth and depth of research concerning the Northeastern region and highlight the importance of interdisciplinary perspectives in understanding its complex social, cultural, environmental, economic, and developmental realities. The articles examine issues ranging from indigenous knowledge and traditional food systems to disaster management, regional connectivity, public health, artificial intelligence, constitutional concerns, climate-responsive architecture, and sustainable resource utilisation.

The issue opens with a valuable study on indigenous food consumed by the Galo tribe of Arunachal Pradesh, documenting traditional food resources and examining their nutritional and mineral composition. The study underscores the significance of indigenous food systems as repositories of traditional knowledge, nutritional diversity, biodiversity conservation, and sustainable resource use. Complementing this focus on indigenous knowledge and environmental vulnerability, the issue presents an analysis of flood impacts in Golaghat District, Assam, covering the period from 2015 to 2024. The study highlights the varying impacts of floods on population, agricultural areas, villages, revenue circles, and human lives, while emphasising the importance of improved flood management, early warning systems, and sustainable mitigation measures.

Questions of regional identity, governance, communication, and security are also explored in this volume. The study on the Mon and Patkai autonomy demand movements in Arunachal Pradesh examines an important dimension of political and regional aspirations, while the contribution on communicative governance and collective action in the Assam–Arunachal Pradesh borderland draws attention to the role of communication and collective action in addressing issues affecting border communities. The volume further considers the strategic significance of Northeast India through an examination of economic and security regionalism in the Indo-Pacific and its implications for the region.

Public health and human development constitute another important area of enquiry in the present issue. The article on strengthening immunization in India's North Eastern Region examines the continuing need to take immunization efforts to the last mile. The volume also includes a study on participation in physical activity among older women in Manipur, examining the social, cultural, and environmental dimensions that influence active ageing and participation. Together, these contributions draw attention to the importance of accessible, inclusive, and context-sensitive approaches to health and well-being in the Northeastern region.

The issue also reflects the growing importance of science, technology, innovation, and sustainable utilisation of resources. The study on the extraction of gelatin from bovine byproducts explores the potential of underutilised animal byproducts for value-added applications, while the contribution on Generative AI in Academic Libraries examines applications, opportunities, and a Retrieval-Augmented model for multilingual library services in Northeast India. The inclusion of Generative AI in this issue reflects the rapidly changing technological landscape and the emerging possibilities of artificial intelligence in supporting knowledge access and library services. The study on sustainable development of underutilized natural fibres in Northeast India further explores advances in production, fibre blending, value addition, and market prospects, highlighting opportunities for sustainable resource-based livelihoods and regional economic development.

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The cultural, architectural, and social dimensions of Northeast India receive significant attention in the volume as well. The article on Khonoma Village reflects upon its life, landscape, and cultural heritage, while the study on integrating vernacular wisdom into climate-responsive buildings examines the relevance of traditional structures and indigenous knowledge for contemporary and environmentally responsive architecture. The contribution on re-conceptualising media education through indigenous communication patterns and functions further emphasises the importance of recognising indigenous communication traditions within contemporary educational and media frameworks.

Legal, constitutional, infrastructural, and developmental concerns are also represented in the present issue. The study on the Inner Line Permit system in Arunachal Pradesh examines the constitutional protection of Indigenous Tribes in contemporary India, while the article on road connectivity and socio-economic development in the border regions of Arunachal Pradesh highlights the relationship between connectivity and regional development. The volume also includes a field-based assessment of vulnerability, impacts, and disaster governance during the 2026 flood in Sivasagar, Assam, thereby contributing to the wider discourse on disaster preparedness, governance, and resilience in the region.

The issue concludes with a book review of Som Kamei's meticulously researched biography of Rani Gaidinliu. The review situates Rani Gaidinliu within India's freedom narrative while examining questions of tribal identity, the Heraka movement, and the continuing aspirations of the Zeliangrong community. By bringing together historical memory, indigenous identity, and the region's complex socio-political realities, the review adds an important cultural and historical dimension to the volume.

The Editorial Board extends its sincere appreciation to all the contributors for their valuable scholarly contributions and dedicated efforts. We are equally grateful to the reviewers, editors, and all those associated with the publication process whose collective efforts have contributed to maintaining the academic quality and integrity of the journal.

We hope that this volume will encourage further scholarly dialogue, stimulate interdisciplinary research, inform policy discussions, and promote deeper engagement with the diverse developmental, cultural, environmental, technological, and socio-economic realities of Northeast India. It is our earnest belief that the contributions presented in this issue will add meaningfully to the growing body of knowledge on the region and inspire further research, innovation, and informed discourse in the years ahead.

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A STUDY ON INDIGENOUS FOOD CONSUMED BY THE GALO TRIBE OF ARUNACHAL PRADESH

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Abstract

The tribe's of Arunachal Pradesh has unique lifestyle and food habits depending on the vagaries of nature. Galo tribe inhabiting in the lofty peaks of Himalayas in West Siang district. Varieties of wild plants and also ethnic processed food are consumed and served as an important source of their daily diet. Therefore, the present study was conducted to document and determine the nutritional contents of locally available green leafy vegetables and other traditional food consumed by the tribe. The knowledge about the wild edible vegetables and their uses by the indigenous tribes for food were documented. Nutrient analysis of various food items were carried out using standard methods and mineral estimation were carried out using atomic absorption spectrophotometer (AAS) for determination of minerals like Cu, Mn, Zn and Fe. The wild edible vegetables play a vital role in enrichment of the health of the tribal people. Total of 27 foods including wild vegetables and processed food were documented showing GLV's as the most dominating, also the fermented foods and non-vegetarian product act as staple food to the tribe. The study concluded that the ethnic wild vegetables and other traditionally processed food have a good potential in terms of food value and can serve as an easily accessible food resource.

Keywords : Indigenous food systems; Galo tribe; Arunachal Pradesh; North East India; Wild edible plants; Traditional knowledge

Introduction

The North Eastern Region (NER) of India is recognized as one of the country's richest centres of biological and cultural diversity, where indigenous communities have developed unique food systems based on traditional ecological knowledge and the sustainable utilization of natural resources (Singh et al., 2012; Das et al., 2017; FAO, 2019).

These indigenous food systems contribute significantly to dietary diversity, nutritional security, biodiversity conservation, and sustainable livelihoods, particularly among tribal populations (Kuhnlein et al., 2013; Bharucha & Pretty, 2010).

Arunachal Pradesh, popularly known as the "Land of the Rising Sun," is situated in the North Eastern Frontier of India, characterized by rich forest resources, diverse agro-climatic conditions, and exceptional biological diversity (Forest Survey of India, 2023; Government of Arunachal Pradesh, 2023). The state is home to more than twenty-six major tribes, each possessing distinct languages, customs, food habits, and traditional ecological knowledge (Elwin, 1959; Census of India, 2011; Mibang & Behera, 2004). This rich cultural and ecological diversity has shaped the traditional food systems of its indigenous communities.

Among these communities, the Galo tribe primarily inhabits the districts of West Siang, Leparada, Lower Siang, and adjoining areas, where their subsistence economy is closely linked to agriculture, forests, and riverine ecosystems (Megu, 2008; Mibang & Behera, 2004). Their traditional diet comprises cereals, millets, indigenous leafy vegetables, wild edible plants, bamboo shoots, mushrooms, freshwater fish, meat, and fermented food products, which are collected or cultivated using sustainable indigenous practices (Angami et al., 2006; Sundriyal & Sundriyal, 2001; Tsering et al., 2015). These traditional foods are increasingly recognized for their nutritional richness and functional health benefits (Tamang et al., 2016). The traditional food practices of the Galo community reflect a close relationship between biodiversity, cultural identity, and the sustainable management of natural resources. However, rapid socio-economic changes, urbanization, commercialization, and the gradual erosion of indigenous knowledge are threatening the continuity of these traditional food systems (Singh et al., 2012; FAO, 2019; Das et al., 2017). As a result,

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there is an urgent need to document and scientifically evaluate indigenous food resources before this valuable knowledge is lost.

Scientific documentation and nutritional evaluation of indigenous foods from North East India are essential for preserving traditional knowledge, promoting dietary diversity, supporting biodiversity conservation, and informing policies aimed at tribal welfare and nutritional security (NITI Aayog, 2021; Kuhnlein et al., 2013; Ministry of DoNER, 2022). Such studies also provide scientific evidence for promoting sustainable food systems and enhancing the utilization of locally available nutrient-rich food resources.

Against this backdrop, the present study aims to document the indigenous foods consumed by the Galo tribe of Arunachal Pradesh and to evaluate the nutritional and mineral composition of selected locally available green leafy vegetables and traditional food resources. The study seeks to contribute to the documentation of the indigenous food heritage of North East India while generating scientific evidence to support the conservation, promotion, and sustainable utilization of traditional food systems for improved nutritional well-being and rural livelihoods.

Materials and Methodology

Study Area: Five villages namely Daring, Yomcha, Kamba, Basar and Lir-moba of West Siang district were selected for the study. These villages represent the Galo tribe of Arunachal Pradesh. The tribe is mainly dependent on agriculture for food and also collects roots, tubers, leaves, flowers and fruits, as supplementary food.

Documentation

A questionnaire was developed to document the food habits of the tribe. Various foods which were mostly consumed were collected for chemical analysis. After collecting the samples to the laboratory, they were separated according to the food groups. The leaves were dried using hot air oven at 45°C for 24 hour and ground into fine powder and kept in air tight containers for further chemical analysis. The other foods were dried using hot air oven at 105°C for 4 hr.

Nutrient Analysis

The dried powdered samples were used for the analysis. The recommended methods of the Association of Official Analytical Chemists (AOAC) were used for the determination of moisture, ash, fat, crude fiber, nitrogen, carbohydrate (AOAC, 1990). Ash was determined by incineration in a muffle furnace at 600°C for 4h. Lipid was extracted by continuous soxhlet method with petroleum ether (b.p.60°C). Crude fiber was estimated in Pellican fibre plus by acid-base digestion with 1.25% H2SO4 and 1.25% NaOH solution (Maynard, 1970). Nitrogen was estimated by Kjeldahl method in with steam distillation and titrated with standard 0.01 M HCl solution. Crude protein was estimated by multiplying the crude nitrogen content by a factor of 6.25 (% Protein= % Nitrogen × 6.25). Carbohydrate content of the samples was estimated by difference method.

Mineral Analysis

All the samples were analyzed using atomic absorption spectrophotometer for determination of Cu, Mn, Zn and Fe.

Results and discussion

Total of 27 wild vegetables and processed food consumed by the Galo tribe of Arunachal Pradesh were documented. The consumption of wild plants is one of the strategies, adopted by the local people of Arunachal (Angami et al., 2006) for sustenance, intrinsically linked to their strong traditional & cultural system is inseparable. Varieties of wild vegetable are found available in the jungles, cultivated and also sold in the local village market. The tribe meals are always served with colours of wild green vegetables and non-vegetarian. Various wild edible plants in traditional delicacies were common among the tribal communities of Manipur (Konsam et al., 2016), Tripura (Deb et al., 2013), Sikkim (Sundriyal and Sundriyal 2004). The documented wild vegetables consumed frequently by the Galo tribe are listed below:

1.Local name: **Oyik**
Plant parts: leaves
English name: Graceful pouzolz's bush
Botanical name: *Pouzolzia hirta*

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2.Local name: **Onyor**
Plant parts: leaves
English name: Prickly ash
Botanical name: *Zanthoxyllum rethsa*
Foods prepared: It is consumed in the form of Boil curry and chutney and has positive effects in digestion

3.Local name: **Taka**
Plant part: leaves
English name: Edible fern
Botanical name: *Diplazium esculentum*
Foods prepared: Boil curry and dry fry

4.Local name: **Marsa**
Plant parts: leaves
English name: Electric daisy
Botanical name: *Spilanthes peniculata*
Foods prepared: Boil curry, chutney and seasoning. The extract of the leaves has the beneficial effects against toothache.

5.Local name: **Jogen**
Plant parts: leaves
English name: Hill gynura
Botanical name: *Gynura cusimbua*

6.Local name: **Raar**
Plant parts: leaves
English name: Peper plant
Botanical name: *Piper pedicellatum*

7.Local name: **Taier**
Plant part: seeds
English name: Mountain pepper
Botanical name: *Litsea cubaba*
Foods prepared: Chutney and seasoning

8.Local name: **Maan yaluk**
Plant part: Fruit
English name: King chili
Botanical name: *Capsicum spp.*
Foods prepared: spices

9.Local name: **Baag**
Plant part: Fruit
English name: Turkey berry
Botanical name: *Solanum torvum*
Foods prepared: Chutney

10.Local name: **Kopeh**
Plant part: Fruit
English name: Dutch egg plant
Botanical name: *Solanum khasianum*
Foods prepared: Boil curry and chutney

11.Local name: **Tallar**
Plant part: Root
English name: leek
Botanical name: *Allium ampeloprasum*
Foods prepared: chutney and seasoning

12.Local name: **Iku**
English name: Bamboo shoot
Plant part: Shoots
Botanical name: *Dendrocalamus hemiltonii*
Foods prepared: boil curry, chutney and Seasoning

13.Local name: **Ingin**
Plant part: Root
English name: Taro
Botanical name: Ipomea batatus
Foods prepared: Boiled and Roasted

14.Non vegetarian: **Mithun** (raw meat)
Scientific name: *Bos frontalis*
Foods prepared: boil curry, fried, roasted, grilled and smoked.

Ethnic processed food

The people of Galo tribe have unique technique of food preparation. Fermentation is an old practice followed by the tribe in order to preserve and enjoy the essence of the food. Fermented alcoholic beverages made out of rice or ragi are locally prepared and used as regular drinks. Other fermented products like bamboo shoots and soya bean are also common among the tribe. The tribes of Naga (Mao and Odyuo, 2007) often flavor their diets with fermented food and herbs viz., Anishi (colocassia), Axone (soyabean), bamboo shoot, fish, crab, animal fats. Galo tribe is also known for unique method of preparing various food items such as: -

1.***Opop*** **(yeast tablet)**: Rice paste is prepared to small flat balls. Extract of some green leaves viz., cyclosorus extensus, tender shoot of solanum khasianum or wild jackfruit may be added with the rice paste. Then the tablets are covered with cyclosorus extensus leaves and allowed to dry by placing near fireplace for 4-5 days. This yeast tablets are used for local beer preparation.

2.***Nyongring*** **(White beer)**: It is made out of rice and as such also called as white beer. The cooked rice is allowed to cool and then to this opop is mixed. This mixture allowed for fermentation (10-15 days) and the liquid extract is used as local alcoholic beverage.

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3.***Iyip*: (dry fermented bamboo shoot)**: After the fermentation of bamboo shoot is complete, the shoots are sun dried and used for various food products.

4.***Agya* (fermented soybean)**: The soyabean are cooked for 2 hours properly. Then it is wrapped in local leaves and allowed to ferment for 7-10 days under ambient temperature. It is one of the main delicacies enjoyed as chutney by the tribe.

*5.**Piinam* (bamboo rice)**: one of the unique style of the tribe is cooking of rice in hollow cylindrical bamboo. The washed rice is stuffed in bamboo and placed in fireplace. With constant monitoring for 20-25 minute the rice is cooked.

6.***Iti* (rice pancake):** It is one of the most common snacks item consumed by the tribe. The soaked rice is powdered then make a dough and wrap in packing leaf (Phrynium Pubinerve) and steamed.

7.***Lukteer* (local spice)**: It is one of the most popular delicacy prepared by the Galo tribe which is served along with the meal. The local chilli are dried, roasted and powdered. This powder is mixed with sesame powder, dried bamboo shoot and salt to taste.

8.***Namdoo* (Perilla ocymoides)**: The sesame seeds are roasted and pounded to powder to serve as spices or eaten as chutney by the tribe.

9.***Dinsen***: The mithun meat are cleaned properly and then cut into pieces. The pieces are then threaded onto bamboo sticks like skewers and slowly smoked by placing them
over fireplace.

Nutritive value

The nutrient content of the ethnic foods are shown in Table 1. Non vegetarian is a preferred choice in the tribe and the food is cooked mostly in boiled form with minimum spices thus making it bland. Among the non-vegetarian, Mithun is the most preferred meat which showed nutrient content of protein (27.27 %), fat (3.81%) and Fe (9.44%). In wild vegetables (GLV's, other vegetable and roots & tuber) high fiber (2.221-13.37%) and Fe (2.49-34.22mg/100g) content were observed. Ten out of 181 wild edible plant consumed by the Bodos tribes of Assam (Bhrahma et al., 2014) revealed to be a good supplement for various nutrients like proteins, carbohydrates and micronutrients.

Table 2 showed the nutrient contents of processed food consumed by the tribe. Nyongring (white rice beer), opo (black rice beer) and marwa (ragi beer) are the three alcoholic beverages and in which former was found to be rich in protein, fiber and Fe. Fermented bamboo shoot (Iku and Iyip) is one among the main food consumed as boil curry were found to be rich in protein, fiber and Fe content. Fermented soybean (Agya) is also one of the most relishing delicacies of the tribe consumed as chutney or mix boil curry which was observed to be rich in protein (28.46 %) and fat (11.09%). Similarly, Tamang et al. (2011) found that More than 250 different types of familiar and less familiar ethnic fermented foods and alcoholic beverages of Northeast India are good source of protein and minerals. Namdu (roasted sesame) often consumed as a spice was found to be high in protein (16.77%), fat (12.53%), ash (6.03%), fiber (8.72%), Fe (3.20mg/100g) and Zn (4.41m/100g), thus can be supplement as nutrient rich food. Das et al. (2005) found that nuts and oilseeds based recipes (laddu, chikki, samosa, etc.,) of Assam were good sources of energy, protein, fat, total mineral, calcium and iron. Smoking is another method the tribe has been practicing since time immemorial, Dinsen a traditionally smoked meat of Mithun was found to be rich in protein (30.20%) and Fe (12.29 mg/100g).

Conclusion

The present study demonstrates that the indigenous food system of the tribe represents a valuable repository of traditional knowledge, nutritional diversity, and sustainable resource use. The documented wild edible plants, particularly green leafy vegetables, along with fermented foods and non-vegetarian products, form an integral part of the community's traditional diet. Nutritional analysis revealed that the selected indigenous foods are rich sources of protein, dietary fibre, and essential minerals. It also highlights their potential to enhance food and nutritional security. In an era of changing food habits, and declining indigenous knowledge, documenting and scientifically validating these traditional food resources is essential for conserving the rich food heritage of Arunachal Pradesh and the North Eastern Region (NER) as well. The findings of this study provide scientific evidence to support the promotion of indigenous foods as nutritious, sustainable, and culturally significant resources. Also contributing to biodiversity conservation, improved community nutrition, and sustainable livelihood development.

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Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	CF (%)	CHO (%)	Fe mg/ 100g	Mn mg/ 100g	Cu mg/ 100g	Zn mg/ 100g
GLV										
Oyik	63.48	0.86	0.64	11.20	11.98	11.82	11.94	6.11	1.44	2.35
Taka	79.28	2.05	0.83	4.38	13.37	0.07	11.66	2.00	2.15	5.70
Marsa	65.00	1.30	0.85	18.87	11.08	2.89	34.22	19.28	1.44	8.37
Oyin	67.36	2.32	0.48	11.75	9.60	8.48	21.47	9.08	1.18	2.91
Onyor	75.96	1.88	0.51	9.34	11.11	1.19	25.11	20.41	0.38	1.86
Raar	72.48	1.10	0.56	7.61	14.84	3.41	29.79	4.36	1.41	4.44
Jogen	65.95	2.05	0.09	12.20	9.67	10.04	11.97	6.32	1.10	2.05
Other Vegetables										
Taier	12.99	1.97	2.21	6.07	8.56	68.18	4.53	1.81	0.14	2.90
King chilli	68.62	2.36	1.38	10.05	11.44	6.14	9.79	2.12	0.66	1.56
Kope	61.60	1.66	4.44	12.25	8.85	11.19	7.99	6.03	0.19	1.52
Baag	72.95	1.83	1.84	9.56	12.29	1.52	8.10	4.59	0.16	1.52
Roots and Tubers										
Ingin	60.29	7.90	0.14	3.64	2.21	25.81	2.49	0.34	1.23	1.29
Tallar	77.50	1.57	0.20	3.75	6.20	10.78	2.95	0.63	0.42	1.44
Iku (fresh)	68.43	12.51	2.11	2.31	7.38	7.25	6.45	3.40	0.91	3.62
Meat										
Mithun	53.51	27.27	3.81	2.67	0.69	12.05	9.44	0.58	0.24	11.16

Table 1. Nutrient composition of wild vegetables food consumed by the Galo tribes

Sample	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	CF (%)	CHO (%)	Fe mg/ 100g	Mn mg/ 100g	Cu mg/ 100g	Zn mg/ 100g
Alcoholic beverage										
Opop	13.48	11.94	0.69	7.28	0.59	66.01	4.13	2.62	0.47	1.38
Opo	60.04	4.25	0.22	12.96	5.07	17.45	1.79	4.08	0.43	2.32
Nyongri	86.58	2.00	0.44	4.67	0.56	5.74	1.17	2.29	0.44	5.00
Marwa	72.67	5.01	0.72	3.64	14.62	3.34	3.87	9.93	0.49	2.25
Fermented products										
Agyaa	51.62	28.46	11.09	1.53	1.49	5.81	7.20	3.32	0.21	2.11
Iku	82.29	9.15	1.50	1.34	5.63	0.09	4.50	4.15	0.46	3.32
Iyip	7.99	15.22	0.46	1.19	10.76	64.38	26.36	4.84	1.09	3.36
Cereals products										
Iti	73.76	3.37	1.04	0.42	0.42	21.00	1.83	0.44	0.40	2.18
Piinam	59.43	4.48	0.36	0.58	1.22	33.91	0.88	0.71	0.50	2.28
Lukteer	12.41	10.41	5.82	2.09	2.05	67.21	2.22	0.54	0.02	4.76
Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed	Oilseed
Namdu	8.37	16.77	12.53	6.03	8.72	47.58	3.20	1.94	1.72	4.41
Meat items	Meat items	Meat items	Meat items	Meat items	Meat items	Meat items	Meat items	Meat items	Meat items	Meat items
Dinsen	6.32	30.20	0.97	1.79	1.04	59.67	12.29	0.40	0.30	3.66

Table 2. Nutrient composition of locally processed food consumed by the Galo tribes

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Figure A(1-7) :1-Oyik; 2-Raar; 3-Taka; 4-Marsa; 5-Jogen; 6-Oyin; 7-Onyor



Figure B(1-9): 1- Maan Yaluk; 2-Baag; 3- Kope; 4- Igin; 6- Iyip; 6-Iku; 7-Aagya; 8- Namdoo; 9- Dinsen

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AN ANALYSIS OF FLOOD IMPACT IN GOLAGHAT DISTRICT, ASSAM (2015–2024)

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Abstract

Floods are among the most frequent and devastating natural hazards in Assam causing recurrent loss of life, property damage, and disruption of livelihoods. This study focuses on Golaghat district. Golaghat is one of the most flood-prone regions in upper Assam and analyses the extent and variability of flood impacts over ten years (2015–2024). The study used secondary data from the Assam State Disaster Management Authority and examines six key indicators: affected revenue circles, affected population, affected agricultural area, human fatalities, affected villages, and flood wave characteristics. The findings reveal year-to-year variability, with different indicators peaking in different years: the affected agricultural area peaked in 2016 and 2018; the number of affected people was highest in 2020; and human fatalities and affected villages were highest in 2024 (226 villages). Analysis of flood wave characteristics indicates that flooding was recorded over a longer period in 2023 and 2024 than in earlier years. However, this does not establish a long-term trend towards prolonged flooding. These results highlight the intensity and variability of flood impacts in Golaghat and underscore the importance of improved flood management strategies, early warning systems, and sustainable mitigation measures in the district.

Keywords : Floods, Golaghat district, Flood impact assessment, Flood-affected population, Agricultural loss, Flood waves.

1.0 Introduction

Floods are among the most common, frequent, and widespread natural hazards on Earth, often resulting in severe loss of life and significant economic damage. India is one of the most flood-prone countries in the world (Singh & Kumar, 2013). In India, floods are a major hazard with approximately 40 million hectares or around one-eighth of the total

An examination of annual flood frequency shows that Assam is among the worst-affected states in the country (Singh & Kumar, 2013). Assam experiences floods every year with a flood-prone area of about 31,500 sq. km (12,162.23 sq. miles), which is nearly 39.6% of its total geographical area (National Remote Sensing Centre, 2016; Bezboruah et al., 2021). In Assam, the Golaghat district is highly prone to floods due to the hydrometeorological and topographical characteristics of the basin in which it lies. The principal river of Golaghat district is the Dhansiri, which has long been regarded as a vulnerable river in the history of Assam because of its recurrent and extensive flooding. The Dhansiri Basin in Golaghat district faces persistent challenges from recurrent flooding. These floods are characterized by their large magnitude, high frequency and extensive devastation, particularly in the middle and lower reaches of the basin. The problem is most pronounced downstream of the NH-37 crossing at Numaligarh. Historical records show that floods of extreme magnitude occurred in the sub-basin in the years 1954, 1955, 1959, 1960, 1970, 1976, 1986, 1987, 1988, 1989, and 1991 (Mili et al., 2013). Golaghat district is located in upper Assam, which is among the most flood-affected districts with over 119,179 affected people from 109 villages. The villages under the Khumtai, Dergaon, Golaghat, and Bokakhat revenue circles are impacted by floods. This is caused by rising waters of the Brahmaputra and Dhansiri rivers (Baishya et al., 2024). Despite frequent and severe floods, detailed assessments and analyses of recent flood-related losses and impacts in Golaghat remain limited. Understanding the scale and pattern of impacts over the last decade is essential to guide effective flood management strategies. An analysis is needed to capture both the scale of destruction and the changing nature of flood impacts. Such an assessment can provide valuable insights for disaster management and policy planning in the district. Therefore, this study aims to examine the affected population, agricultural area, human fatalities,

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villages, and revenue circles resulting from floods in Golaghat during the period 2015–2024. The present study aims to analyse the extent, patterns, and variability of flood impacts in Golaghat district from 2015 to 2024 with reference to the affected population, agricultural area, human fatalities, villages, and revenue circles.

2.0 Research Methodology

The present study is based on compiled data on affected people, agricultural area affected (Ha), human fatalities, number of affected revenue circles, and number of affected villages as reported in the Assam Flood Memorandum published by the Assam State Disaster Management Authority, Government of Assam, India covering the period from 2015 to 2024. The availability of data varied across indicators and years, as the Assam Flood Memorandum did not report all indicators consistently for every year during the study period. Therefore, the analysis was based on the years for which data were available for each indicator.

Golaghat district has been selected as the study area. It is one of the most flood-affected districts in Assam, particularly in the upper Assam region. Golaghat district lies between 26°–27° N latitude and 93°–94°17′ E longitude. The Brahmaputra River forms its northern boundary, Nagaland lies to the south, the Kokadonga River and Jorhat district to the East, and Karbi Anglong to the West. The main rivers of the district are the Brahmaputra and its tributary, the Dhansiri. Other rivers and rivulets flowing through the subdivision include the Doyang, Kakodonga, Doigrung, Mokrong, and Gelabeel. The Brahmaputra River, flowing east-west along the northern part of the district together with its tributaries flowing northward controls the drainage system and plays a major role in flooding. The rivers originating from the Naga Hills are highly flashy in nature and have the potential to cause severe flooding, except for the Brahmaputra in the district (District Disaster Management Plan, Golaghat District 2024-2025).

Further, the compiled information was analysed for:

1. To assess the effect of flood impacts on the population, agricultural land, villages, and revenue circles in Golaghat district.
2. To examine the temporal variations in flood impacts during the period 2015–2024.

3.0 Data Analysis & Findings

This subsection presents the data analysis and findings. The study highlights the extent and variability of flood impacts in Golaghat district across different dimensions such as population, agriculture, human fatalities, affected villages, and flood wave characteristics. Data for certain years are not presented in the figures because the corresponding data for Golaghat district were unavailable in the Assam Flood Memorandum.

3.1 Flood Events and Affected Revenue Circles

Golaghat district was affected by floods every year from 2015 to 2024. The number of affected revenue circles fluctuated between four and seven between 2017 and 2024. The highest number was reported in 2018 when seven revenue circles were affected. The lowest number reported during this period was in 2021 when four revenue circles were affected. Floods in the district generally occur between May and October with impacts including loss of human life, livestock, crops, and damage to infrastructure.

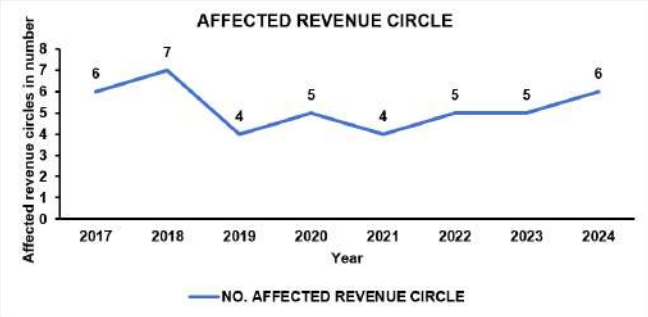


Figure 1: No. of affected revenue circles
(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

3.2 Flood-Affected People

Figure 2 presents the number of people affected by floods in Golaghat district between 2015 and 2024. The largest number of people affected was 124.84 thousand in 2020, followed by 2024 with 121.11 thousand and 2021 with 96.35 thousand.

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The figures indicated that flood impact on human populations was variable reflecting the irregular intensity and spread of floods across different years.

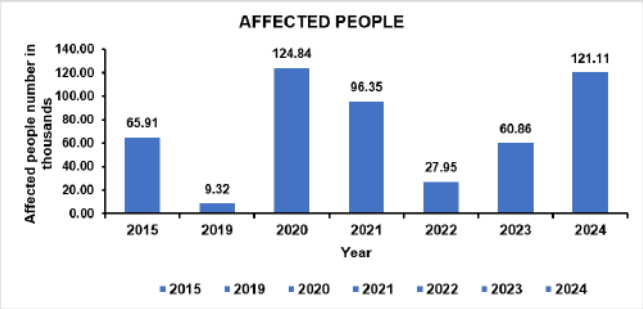


Figure 2: Annual variation in the flood-affected population
(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

3.3 Flood- Affected Agriculture Area (Ha)

Figure 3 shows the variation in flood-affected agricultural land in Golaghat district, Assam, during 2015–2024. The affected agricultural area varied considerably across the reported years, indicating that flood impacts on agriculture did not constantly increase throughout the study period. The maximum affected area was recorded in 2016, at 15,205 hectares, followed by 14,466.47 hectares in 2018. In contrast, the minimum affected area was recorded in 2022, at 108 hectares. After declining from 5,175.23 hectares in 2019 to 3,805.75 hectares in 2020, the affected area remained relatively low in subsequent reported years, except in years with substantially higher impacts.

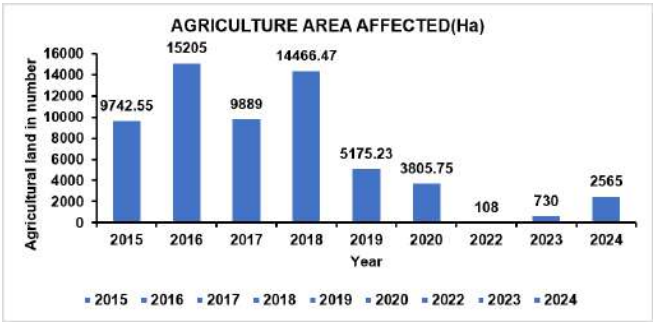


Figure 3: Flood-affected agricultural land (Ha)
(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

3.4 Flood-Related Human Fatalities

Figure 4 below represents the changes that have been experienced in human casualties caused by floods within the Golaghat district from 2017 to 2024. The highest number was recorded in 2024, which was nine human casualties. In 2017, there were eight human casualties, and there were six human casualties in 2020.

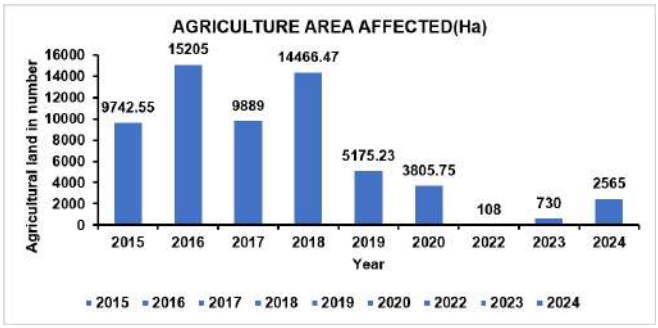


Figure 3: Flood-affected agricultural land (Ha)
(Source: Assam Flood Memorandum,
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3.4 Flood-Related Human Fatalities

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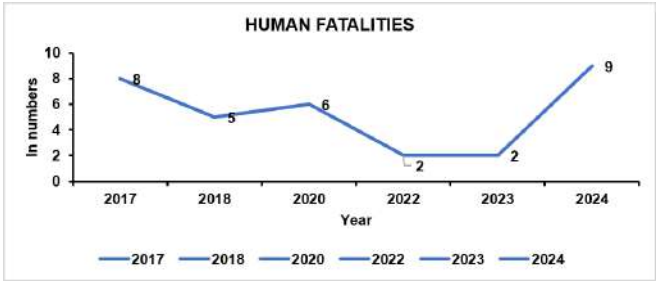


Figure 4: Flood-related human fatalities
(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

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3.5 Flood-Affected Villages

Figure 5 shows that the number of villages affected by floods in Golaghat district varied widely between 2018 and 2024. The maximum impact occurred in 2024, when 226 villages were affected, followed by 123 villages in 2018. The minimum impact was recorded in 2019 with 37 villages. Despite the significant rise in the number of affected villages in 2024, the substantial variations in the years shown above cannot be taken to signify any kind of increasing trend in Golaghat district.

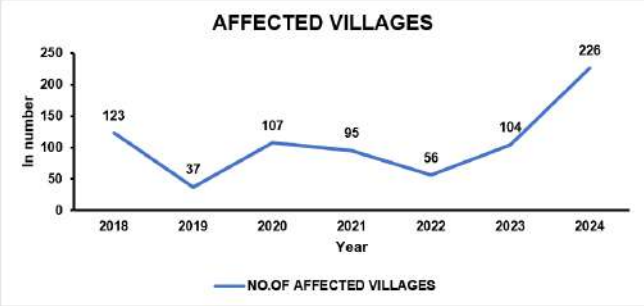


Figure 5: No. of flood-affected villages
(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

3.6 Flood Wave Characteristics

Table 1 presents the flood-wave characteristics recorded in Golaghat district during 2015–2024, highlighting variations in the timing and duration of flood events. The table records multiple flood waves in several years, including the second, third, and fourth waves in 2019 and three recorded waves in 2022. Flood activity in 2019 extended from June to November, with the fourth recorded wave occurring from 27 October to 1 November. The table records "ALL WAVE" for the period from 1 May to 31 October in each year, indicating an extended period of recorded flooding for 2023 and 2024. However, the entries in Table 1 may not represent every flood wave in each year. Therefore, the total annual number of waves cannot be established from listed entries alone. The claim that 2018 experienced the longest single wave has also been omitted pending verification of the recorded durations against the original Assam Flood Memorandum.

Year	Flood Wave Details	Duration of Wave
2015	2ND WAVE	27-06-2015 to 31-07-2015
2016	3RD WAVE	15-06-2016 to 5-08-2016
2017	2ND WAVE	17-05-2017 to 19-07-2017
2017	3RD WAVE	10-08-2017 to 30-09-2017
2018	2ND WAVE	28-07-2018 to 4-10-2018
2019	2ND WAVE	16-06-2019 to 2-09-2019
2019	3RD WAVE	13-09-2019 to 9-10-2019
2019	4TH WAVE	27-10-2019 to 1-11-2019
2020	2ND WAVE	18-06-2020 to 4-09-2020
2020	3RD WAVE	6-09-2020 to 14-10-2020
2020	4TH WAVE	19-10-2020 to 28-10-2020
2021	2ND WAVE	23-06-2021 to 3-08-2021
2021	3RD WAVE	13-08-2021 to 18-09-2021
2022	1ST WAVE	6-04-2022 to 12-06-2022
2022	2ND WAVE	13-06-2022 to 16-09-2022
2022	3RD WAVE	7-10-2022 to 28-10-2022
2023	ALL WAVE	1-05-2023 to 31-10-2023
2024	ALL WAVE	1-05-2024 to 31-10-2024

(Source: Assam Flood Memorandum, Government of Assam, 2015-2024)

According to the Assam Flood Memorandum report 2019 (Government of Assam, 2019), the fourth wave of floods in 2019 was associated with heavy rainfall in Assam and its neighbouring states. Between 24 and 28 October 2019, Arunachal Pradesh, Meghalaya, Assam, and Nagaland experienced exceptionally high rainfall with deviations from the normal of 228%, 272%, 591%, and 653%, respectively. This excessive rainfall led to severe flooding in Assam, particularly in Golaghat district resulting in widespread devastation.

The analysis of flood data in Golaghat district from 2015 to 2024 highlights the persistent and severe impact of floods on the region. Between 2017 and 2024, the number of affected revenue circles ranged from four to seven. The population impact was significant with the number of flood-affected people peaking at 124.84 thousand in 2020, while the reported figures also remained high in 2021 and 2024. Agriculture also faced heavy losses with the maximum affected area recorded in 2016 (15,205 Ha) and 2018 (14,466.47 Ha), though the extent varied sharply in other years. Human fatalities relatively low in number fluctuated between two and nine annually with the highest recorded in 2024. The number of affected villages also varied considerably, reaching its highest recorded value of 226 in 2024.

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The flood-wave records indicate multiple recorded waves in several years including 2019 and 2022. The entries for 2023 and 2024 cover the period from May to October, indicating an extended period of recorded flooding in those years. However, these records alone do not establish a consistent long-term trend towards increasingly prolonged floods. Overall, the findings demonstrate substantial variation in flood impacts across the indicators examined in Golaghat district.

4.0 Discussion

Golaghat district has been identified among the 25 most vulnerable districts in terms of climate change impact in India (Phukan et al., 2023). This provides important contextual background for examining flood impacts in the district. The Dhansiri River from a geomorphological perspective is marked by characteristics such as a meandering flow pattern, channel migration, and high flow velocity in the monsoon season, which may contribute to fluvial and geomorphological hazards. The present study provides empirical evidence of flood impacts through its analysis of affected population, agricultural area, human fatalities, affected villages, revenue circles, and flood-wave characteristics. The findings show substantial year-to-year variation: the highest recorded affected population occurred in 2020, while the largest affected agricultural area was recorded in 2016 and the highest recorded numbers of human fatalities and affected villages occurred in 2024. These variations demonstrate that the most severely affected year differs across indicators. Education is also affected by floods as school buildings are often damaged or submerged during floods, leading to irregular classes, inadequate infrastructure, and difficulties in the learning process (Mili et al., 2013).

According to Mili et al. (2013), flooding becomes more severe in the lower reaches of the Dhansiri River affecting the Sarupathar, Golaghat, Khumtai, and Bokakhat circles. The authors also identify potential contributing factors, including high-intensity rainfall, steep river slopes in the hills, deforestation and landslide-prone areas in the upper catchment, and the meandering course of the river in the plains. These geomorphological and environmental factors provide context for understanding flood hazards in Golaghat (Mili & Acharjee, 2014). However, their individual contributions were not quantified in the present study. The findings confirm that flood impacts extend across multiple dimensions, including population, agriculture, human fatalities, villages, and revenue circles. In particular, the 226 villages recorded as affected in 2024 indicate the geographical extent of the reported impacts. The present dataset does not directly measure displacement, migration, psychological stress, educational disruption, or long-term economic insecurity. These broader socioeconomic consequences should therefore be understood as contextual issues discussed in the existing literature rather than as outcomes directly established by this study (Baishya et al., 2024).

5.0 Conclusion

The analysis of flood impacts in Golaghat district from 2015 to 2024 shows the repeated effects of flooding and variation across the indicators. Floods affected multiple revenue circles, villages, human fatalities, thousands of people and agricultural areas. The affected agricultural area peaked in 2016, the number of flood-affected people peaked in 2020, and the highest recorded numbers of human fatalities and affected villages occurred in 2024. These findings demonstrate that flood impacts varied across years and dimensions.

The examination of flood waves revealed that the recorded timing and duration of flood events varied across the study period. The entries for 2023 and 2024 cover the period from May to October indicating an extended period of recorded flooding in those years. However, the available records do not establish a consistent long-term trend towards increasingly prolonged flooding. The Dhansiri River's meandering course, channel migration, and monsoon-season flow characteristics provide geographical context for understanding flood hazards in the district. However, these factors were not independently quantified in the present study. The findings highlight the importance of attention to flood management in Golaghat district, including the improvement of early-warning communication, preparedness and locally appropriate mitigation measures.

The information presented in this study collected above may serve as a basis for identifying years and impact indicators requiring attention. Future research incorporating more complete and consistent annual records, alongside assessments of local vulnerability and flood-management practices could further support evidence-based planning and policy development.

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COMMUNICATIVE GOVERNANCE AND COLLECTIVE ACTION IN ASSAM-ARUANCHAL PRADESH BORDERLAND

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Abstract

This study examines the communicative dimension of grassroots governance and collective action in Assam-Arunachal Pradesh borderland. The study was based on ethnographic method including participation observation and indepth interview. The findings reveal that borderland function as a communicative space where cultural practises, festivals, and crisis response mechanism strengthen inter-community cooperation across boundaries. Governance is constituted through process of dialogue, consensus-building, trust and reciprocity embedded within indigenous institutions such as the Adi-Mising Bane Kebang (AMBK) and Village Defence Party (VDP). These institutions function as a deliberative space where authority is negotiated, conflicted are resolved and collective decisions are legitimised through participatory communication. By foregrounding communication as the constitutive basis of governance, the study extends Habermas's concept of communicative action and advance the concept of communicative governance as a framework for understanding culturally embedded, participatory and community led governance in border regions.

Keywords : Grassroots Governance; Communicative Governance; Collective Action; Assam-Arunachal Pradesh Borderland.

1.0 Introduction

The study of governance has increasingly shifted from state-centric perspectives towards participatory and community-centred approaches that recognise governance as a socially negotiated process rather than a function exercised solely through formal state institutions. Grassroots governance has emerged as an important framework in this transition by emphasising decentralised decision-making, local participation and community-based accountability (Ostrom, 1990; Cornwell & Gaventa, 2001). In region where state presence is geographically constrained or institutionally limited, governance is often sustained through indigenous institution, shared norms and communicative practice that enable communities to organise collective life. Therefore, communication is limited, co-ordinated and reproduced in everyday social interaction.

The communicative dimension of governance is evident in indigenous societies, where deliberation, consensus building and collective reasoning constitute the foundation of decision making. Habermas's (1984) theory of communicative action provides a useful framework for understanding this process by arguing that legitimate social coordination emerges through dialogue oriented towards mutual understanding. Deliberative forum such as village assemblies, customary institution and inter-community meeting function as a communicative space where individual negotiate difference, construct shared meaning and determine collectively acceptable course of action (Dryzek, 2002). In such context, governance is not merely institutional but communicative, deriving its legitimacy from participation, reciprocity and consensus.

These dynamics become significant in border, where governance is shaped by overlapping jurisdiction, cultural interdependence and multiple system of authority. Borderland are increasing understood as a dynamic social space characterised by continuous interaction, negotiation and cooperation among diverse actors (Wilson & Donnan, 1998; Brunet-Jailly, 2007). Governance in such region is mediated through indigenous institution, kinship network, customary norms and everyday communication. Consequently, borderland communitive practices transcending boundaries.

The Assam-Arunachal border exemplifies these characters. Governance in this region is sustained through communicative practices rooted in trust, reciprocity and collective action. Although existing

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cholarship has examined indigenous governance, participatory institutions, and borderland dynamics, limited attention has given to communication as the constitutive mechanism through which grassroots governance and collective action are produced in border regions.

Against this backdrop, the present study examines how communication shape governance and collective action in the Assam-Arunachal Pradesh borderland. By integrating perspectives from communicative governance and borderland studies, the study contributes to deeper understanding of how communities negotiate authority, build trust, and sustain cooperation across boundaries. Specifically, the study addresses the following research questions:

RQ1: How do communicative practices shape grassroots governance in Assam-Arunachal Pradesh Borderland?

RQ2: How do communicative governance practices facilitate trust, cooperation and collective action among communities across the Assam-Arunachal Pradesh?

By addressing theses, the study contributes to emerging scholarship on communicative governance by showing that governance in borderland is constituted through dialogue, shared meaning-making, trust and participatory communication. It further argues that communication is the primary process through which authority, social cohesion, and collective action are created and sustained.

2.0 Review of Literature

The relationship between communication, governance and collective action has attracted scholarly attention as governance studies has shifted from state centric perspectives towards participatory and community-based approaches. Contemporary scholarship recognises governance as a socially negotiated process sustained through dialogue, trust and collective participation. (Rhodes, 1996; Peirre & Peters, 2000). This perspective is relevant particularly in interstate borderland, where formal state institution often co-exists with indigenous system of governance and where everyday communication plays a central role in maintaining social order.

The foundation for understanding communicative governance is provided by Habermas's (1984) theory of communicative action, which argues that legitimate social coordination emerges through rational dialogue oriented towards mutual understanding. Therefore, governance is a communicative process through which individuals negotiate shared meaning, resolve conflicts and build consensus. Habermas's concept of the lifeworld further explains how shared cultural values, traditions and everyday interaction create the normative foundation upon which governance depends upon inclusive communication that enables diverse actors to participate in collective decision-making, while Cohen (1989) emphasis that democratic legitimacy is derived from public reasoning. These perspectives position communication as the constitutive basis of governance.

Similarly, literature on grassroots governance highlights the capacity of communities to govern themselves through locally evolved institution. Ostrom's (1990) pioneering work demonstrates that communities can successfully manage collective resources through cooperation, reciprocity, monitoring, and trust. Cornwall and Gaventa (2001) further conceptualise grassroots governance as a participatory process in which citizens actively shape governance outcome through collective engagement. Likewise, Mansuri and Rao (2013) argue that participatory governance is effective when it is embedded within local cultural norms and social relationships. In the Indian context, Chambers (1997) notes that indigenous institution have historically functioned as a deliberative space where governance is negotiated through dialogue and consensus.

The communicative dimensions of governance become even more significant in borderland context. Borderland scholars conceptualise border as a dynamic social space characterised by interaction, negotiation, and interdependence (Wilson & Donnan, 1998; Newman, 2006). Borderland facilitate exchanges of culture, identity, and governance practices. Horstmann and Wadley (2006) describe borderland as a "laboratories of hybrid governance," where customary institution coexist with formal state structures to regulate everyday life. Similarly, Paasi (1998) argue that border is a continuously produced and reproduced through social and cultural practices. Van Schendel (2005) further demonstrates that borderland communities navigate overlapping system of authority, relying upon informal institution to manage disputes, facilitate cooperation, and sustain social cohesion.

Within Northeast India, indigenous governance institution continues to play a significant role in regulating community life. Scholars observes that the ethnic diversity,

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Within Northeast India, indigenous governance institution continues to play a significant role in regulating community life. Scholars observes that the ethnic diversity,

geographical remoteness and limited state penetration have enabled customary institutions to remain central to governance processes. These institutions resolve disputes, organise collective activities, preserve customary law and facilitate social integration through dialogue, consensus and community participation. However, existing studies have largely examined this institution from anthropological or political perspective, paying less attention to communicative processes through which they generate legitimacy and collective action.

Further, communication scholarship provides insight into these processes. Duranti (1997) argues that language, ritual, storytelling and everyday interaction are cultural practices through which authority, identity and social relationships are reproduced. Likewise, Fung (2006) and Nabatchi and Leighninger (2015) conceptualise participatory governance as a collaborative process that depends upon continuous communication between community members and governance institutions. Such perspectives demonstrate that communication is not merely an instrument of governance but the very process through which governance is constituted and sustained.

Despite the substantial studies on grassroots governance, communicative action, and borderland studies, an important theoretical gap remains. Existing studies have examined participatory governance and border dynamics independently, but few have integrated these perspectives to explain how communicative practices generate collective action. More specifically, there is limited empirical research examining how dialogue, trust, consensus-building, and everyday communicative interaction enable governance across border. This study addresses that gap by bringing together Habermas's (1984) theory of communicative action, Ostrom's (1990) theory of self-governance, and contemporary borderland scholarship to investigate communicative governance and collective action in the Assam-Arunachal Pradesh borderland. In doing so, the study contributes to the growing literature on communicative governance by demonstrating that governance in borderland is sustained through communication, reciprocity, and culturally embedded participatory practices.

3.0 Tools and Method

This study adopts a qualitative research design within an interpretivist paradigm to examine how communicative practices shape grassroots governance and collective action in the Assam-Arunachal Pradesh borderland. The interpretivist approach is appropriate because it seeks to understand governance as a socially constructed process emerging through everyday interaction, dialogue, and shared meaning (Creswell, 2013; Denzin & Lincoln, 2018). Accordingly, the study conceptualises governance as an outcome of communicative practices embedded in local cultural, social, and political context.

Fieldwork was conducted ins selected villages of Ruksin sub division, East Siang district, Arunachal Pradesh and the Jonai sub division, Dhemaji district, Assam. These adjoining border areas were selected purposively since they are characterised by long standing kinship ties, cultural exchange and indigenous governance institution that operate across administrative boundaries. Such a setting provides an ideal context for examining how communication facilitates governance and collective action.

Purposive sampling technique was employed to recruit 23 key informants possessing knowledge of local governance practices. Participants included village elders, community leaders, women representatives, youth leaders, Village Defence Party (VDP) members, and office bearers of the Community Based Organisation. Data were collected through participant observation, and semi-structured in-depth interview. Participant observation involved attending kebang meeting, AMBK deliberations, festivals, and other community gathering, enabling direct observation in their natural settings. Interviews explored participants' experiences of governance, trust, dialogue, and inter-community cooperation, while government reports, policy documents, and community records provided contextual evidence (Bowen, 2009).

Data were analysed using Braun and Clarke's (2006) thematic analysis through systematic coding, categorisation, and theme development. The analysis was informed by Habermas's (1984) theory of communicative action, and Ostrom's (1990) theory

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of common governance framework. Ethical standard was maintained through informed consent, confidently and adherence to culturally appropriate research practices (Lincoln & Guba, 1985; Isreal & Hay, 2006).

4.0 . Findings and Discussion

4. 1. Governance as Community-Led and Dialogic

Governance in the borderland is understood as a community-driven and dialogic process. It is constructed through continuous communication, where collective deliberation, negotiation and consensus-building constitute the primary mechanism of decision-making. Decision affecting community life are generally preceded by extensive discussion in both formal and informal forums, allowing different viewpoints to be articulated before arriving at a collectively accepted resolution. Henceforth, legitimacy is generated through participation and mutual agreement.

Dialogue performs multiple governance function. It enables conflict resolution, facilitates coordination, strengthen accountability and reinforce social cohesion. Therefore, governance emerges as a communicative process reproduced through everyday interaction. Village meeting, intervillage consultation and customary deliberative forums operate as a space where community members negotiate common concerns, exchange opinion and collectively determine appropriate responses to local issues. Thus, authority is relational, where legitimacy is derived from communicative engagement.

This communicative governance strongly reflects Habermas's (1984) concept of communicative action, which argues that legitimate social coordination emerges through rational dialogue oriented towards mutual understanding. Decisions become morally legitimate as they are collectively negotiated and socially accepted. These findings therefore challenges state-centric conception of governance by showing that governance in borderland is embedded with communicative practices, shared cultural norms and collective agency. Communication function a not merely as an instrument of government but as the very process through which governance is constituted and continuously reproduced.

4. 2. Village Defence Parties: Communication, Trust, and Moral Regulations

The village Defence Party (VDPs) constitute important institution of grassroots governance whose effectiveness extend well beyond their conventional security function. VDPs perform communicative and moral regulatory roles within the borderland.

Their activities illustrate how governance is sustained through dialogue, persuasion, community participation and intervillage cooperation. Social problem such as drugs abuse, youth delinquency and local disputes is generally addressed through collective discussions. Communication serves as the mechanism for identifying problem, consulting affected families, negotiating solution and encouraging behavioural changes. This emphasis on deliberation reflects a restorative approach to governance, where reconciliation and social harmony are prioritised over formal sanction. Consequently, governance is understood as a process of moral regulation achieved through communication.

The VDP maintain extensive communication network across villages located on both the sides of the border. Co-operation between neighbouring communities facilitates coordinated responses to shared social challenges, demonstrating that governance transcends boundaries. These communicative networks enable information sharing, joint decision-making and collaborative action, reinforcing the interconnected nature of grassroots governance.

Trust emerges as the central communicative resources underpinning these governance process. Compliance with collective decisions depend upon interpersonal trust, social reputation, and shared moral values. Regular interaction, transparency in deliberation and long-standing kinship relationships cultivate mutual confidence, allowing governance institution to function effectively despite limited state presence. This finding supports Fukuyama's (1995) argument that trust constitutes a form of social capital that enables cooperation and collective action. In the Assam-Arunachal Pradesh borderland, trust function as a governance infrastructure through which communication facilitates accountability, legitimacy and social order.

4. 3. Collective Action and Crisis Communication

Another important finding concerns the relationship between communication and collective action during periods of crisis. The governance is visible when communities respond collectively to emergencies situation such as flood, displacement humanitarian crisis and other social challenges. during such situation, communication serve as the mechanism through which collective action is organised and coordinated. Communities mobilise through interpersonal networks, indigenous institutions and informal communication channels. Quick consultation enables community members to assesses emerging situation, allotting responsibilities, mobilises resources and co-ordinate relief activities within a relatively short period. The fast and effectiveness of

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these responses reveal the resilience of communicative governance in the context of where state intervention may be delayed or geographically constrained.

Institution such as the Adi-Mising Bane Kebang (AMBK) plays an essential role by facilitating dialogue among communities across the border. Humanitarian assistance, resource mobilisation and collective problem solving are organised through continuous communication, illustrating that governance during crisis depends upon reciprocal relationships and shared responsibility. Therefore, collective action emerges as the outcome of sustained communicative interaction that transform shared concern into social action.

These findings are consistent with Tilly's (2004) understanding of collective action as a coordinated mobilisation based upon shared interests and organisational capacity. Within the borderland, communication strengthen institutional legitimacy by enabling communities to respond effectively to collective challenges. Thus, crisis situation reveals the capacity of communicative governance to generate solidarity, resilience, and coordinated action through dialogue and cooperation.

4. 4. Communication as the Foundation of Grassroots Governance

Communication constitutes the foundation upon which grassroots governance is organised, sustained, and reproduced in the borderland. Whether within customary deliberative institutions, inter-village consultations, economic exchanges, cultural practices, or crisis response mechanism, governance is enacted through communication. Dialogue, negotiation, reciprocity, and shared understanding function as the principal mechanism through which communities maintain social order and coordinate collective life.

Governance is embedded within a broader communicative ecology where multiple institutions and social practices reinforce one another. Indigenous institutions such as the Adi-Mising Baane Kebang (AMBK), Opin Kebang, and Village Defence Parties are interconnected through recurring communicative practices that facilitate cooperation across boundaries. These institutions sustain participatory governance system grounded in shared cultural values, kinship networks and mutual trust. These findings affirm Habermas's (1984) proposition that social integration is achieved through communicative understanding. They also reinforce Ostrom's (1990) argument that communities possess the capacity for effective self-governance when communication is iterative, inclusive, and supported by shared norms. In the Assam-Arunachal Pradesh borderland, communication operates as a cultural practice, governance mechanism, and instrument of collective mobilisation. Every deliberative meeting, customary consultation, ritual gathering, and collaborative activity contributes to reproducing governance within everyday community life.

5.0 Conclusion

This study shows that communicative governance constitutes the foundation of grassroot governance and collective action in Assam-Arunachal Pradesh borderland. Here, governance is understood as a community-led, dialogic process rooted in participation, consensus and shared responsibility which is constituted through everyday communication practises that enable communities to deliberate, negotiate and collectively determine acceptable course of action. This finding reinforces Habermas's (1984) argument that social coordination and legitimacy emerge through communicative action, where consensus is achieved through reasoned dialogue.

Indigenous institution such as Adi-Mising Bane Kebang (AMBK), Opin Kebang Clan (Organisation) and Village Defence Parties (VDPs) function as a communicative arena where deliberation, persuasion and moral reasoning generate collective decisions. These institutions derive their authority from community participation, mutual recognition and collective acceptance, supporting Ostrom's (1990) proposition that communities are capable of effective self-governance through locally evolved institution based on communication, reciprocity and shared norms. Equally significant is the role of trust, which emerge as the central communicative sustaining governance. Built through recurrent interaction, transparency and shared cultural values, trust enable cooperation even in context where state mechanism remains limited, corroborating the argument that trust constitute an essential form of social capital facilitating collective action (Fukuyama, 1995).

Communicative governance was visible during period of crisis. Collective responses to humanitarian emergencies and social challenges are coordinated through informal communication network, rapid consultation and voluntary participation. These practices transform shared concern into coordinated collective action, reflecting Tilly's (2004) understanding of collective as emerging through coordinated social mobilisation. Further, the borderland itself function as a communicative space where everyday interaction, cultural exchange and institutional collaboration across division, consistent with cotemporary borderland scholarship that view border as a space of interaction (Paasi, 1996; Newman, 2006).

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The study contributes to the literature on communicative governance and borderland studies by showing that governance in frontier societies is communicative and relational. The study contributes to literature on communicative governance and borderland studies by showing that governance in frontier societies. It extends Habermas's (1984) theory of communicative action by illustrating how dialogue, consensus and moral reasoning operate within indigenous governance system. Simultaneously, it enriches scholarship on collective action by showing that communication is constitutive foundation of governance. Therefore, the Assam-Arunachal Pradesh border offers an empirically grounded model of governance in which dialogue trust, reciprocity and collective agency enable communities to govern themselves, maintain social cohesion and address common challenges through embedded participatory practices.

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STRENGTHENING IMMUNIZATION IN INDIA'S NORTH EASTERN REGION: THE ROAD TO THE LAST MILE

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Prof. Sumit Kar & HoD,
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1.0 Introduction

Immunization programmes have emerged as one of the largest and most impactful public health initiatives globally, playing a pivotal role in reducingchild mortality and controlling vaccine-preventable diseases. In recent years, the focus of immunization has expandedbeyond childhood illnesses to include the prevention of certain non-communicable diseases, such as cervical cancer through HPV vaccination. Recognizing the transformative impact of vaccines across all age groups, the world annually observesWorld Immunization Week from 24th to30th April under the theme, "For Every Generation, Vaccines Work."

Over the past five decades,the universal immunization programmehas saved more than 150 million lives worldwide and prevents nearly 4 - 5 million deaths annually. Despite this progress, around 14 million children in the world still do not get even one vaccine("zero-dose children") and global vaccinecoverage is around 85% only. These persistent global inequalities in vaccine access, particularly after the COVID-19 pandemic, led to the development of the Immunization Agenda 2030 (IA2030) framework by WHO and global partners particularly in geographically difficult and underserved regions across the world.

India has made substantial progress in immunization coverage, with Full Immunization Coverage (FIC) referring to children receiving all vaccines recommended under the National Immunization Schedule increasing from nearly 62% in 2015 to over 90% in several states by the end of 2025. Despite these remarkable achievements, significant urban-rural disparities in immunization access and coverage continue to persist.

In North-Eastern Region,states have shown encouraging progressin immunization through localized outreach, digital monitoring, and community participation. Sikkim has achieved over 95% Full Immunization Coverage(FIC) with less than 5% dropoutrate through (Human Papillomavirus) HPV and (Measles, Mumps, and Rubella) MMR vaccine expansion, while Assam has reported over 90% FIC through GIS-based micro-planning and JE vaccine integration.

States such as Tripura (~88.7%), Mizoram (~89.3%), Manipur (~86.1%), and Meghalaya (~83.6%) have also strengthened immunization delivery through awareness campaigns, NGO-led outreach, and urban session planning. However, challenges remain in Arunachal Pradesh (64.9% FIC) and Nagaland(57.9% FIC), in these states difficult terrain, scattered habitations, and accessibility issues contribute to higher dropout rates.

2.0 Importance of Immunization in Public Health

The Universal Immunization Programme (UIP) continuesto remain one of the most effective and cost-efficient public health interventions for reducing vaccine-preventable diseases, child mortality, and morbidity. It provides direct protection to individuals while also creating herd immunity that safeguards communities. Vaccines have played a vital role in:

- Eradicating smallpoxglobally;
- Eliminating polio from India;
- Reducing maternaland neonatal tetanus;
- Preventing outbreaks of measles, diphtheria, pertussis, and other infectious diseases; and
- Reducing antimicrobial resistance by decreasing the need for antibiotics.

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India's immunization success reflects the efforts of frontline healthcare workers, scientists, policymakers, volunteers, schools, and communities working together to build trust and ensure vaccine acceptance across the nation.

3.0 Immunization Agenda 2030 and India's Progress

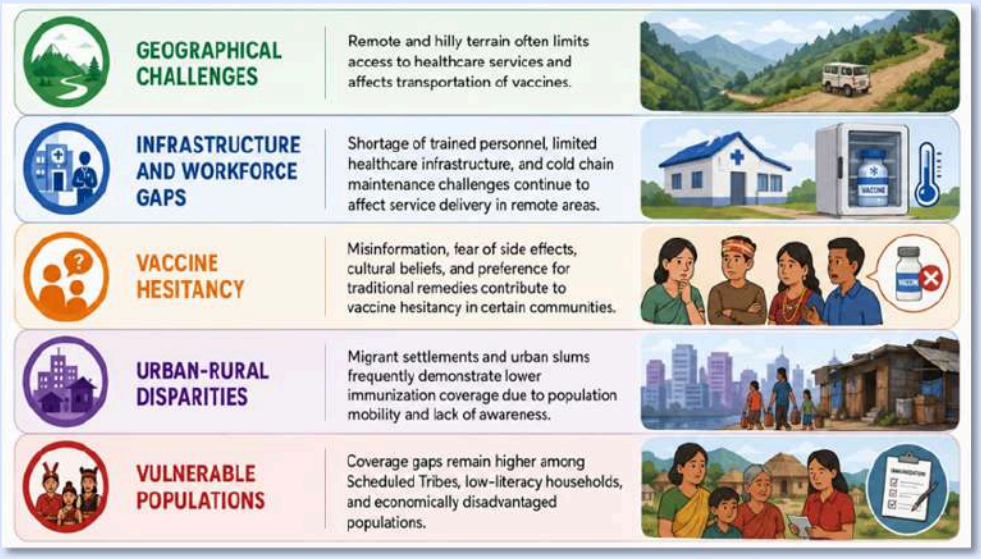
The Immunization Agenda 2030 (IA2030), developed by the World Health Organization and global partners, was introduced to address persistent gaps in routine immunization coverage, rising numbers of zero-dose children, outbreaks of vaccine-preventable diseases, and inequalities in vaccine access, particularly in geographically difficult and underserved regions. The COVID-19 pandemic further emphasized the need for resilient, equitable, and sustainable immunization systems worldwide. India aligned its immunization strategies with the objectives of IA2030 following its endorsement by the World Health Assembly in 2020, with a special focus on identifying and vaccinating zero-dose and partially immunized children in vulnerable populations.

In India UIP being one of the world's largest public health programmes is targeting nearly 2.6 crore infants and approximately 2.9 crore pregnantwomen annually. Over past decades, India has achieved several major public health milestones, including Smallpoxeradication in 1977, Polio-free certification in 2014, Maternal and Neonatal Tetanus elimination in 2015, and Yaws-free declaration in 2016. Full Immunization Coverage (FIC) has improved significantly from nearly 35% in the early 1990s and 62% in 2015 to over 90% in several States by 2025-26 through sustained policy interventions, Mission Indradhanush, Intensified Mission Indradhanush (IMI), strengthened outreach services, and digital innovations.

In February 2026, India launched one of the world's largest HPV vaccination campaigns targeting approximately 1.2 crore adolescent girls aged 14 years, representing a major public health initiative towards prevention of cervical cancer and strengthening adolescent immunization coverage nationwide.

4.0 Focus on the North-Eastern Region

The North-Eastern Region of India, comprising Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim, and Tripura, has shown significant improvements in healthcare indicators over the years; however, the immunization programme is facing challenges as outlined below:



Recognizing these challenges, the Government of India and the North Eastern Council Secretariat have prioritized targeted outreach and last-mile immunization strategies. As part of these efforts, the initiative envisages creating an interactive platform connecting sectoral experts, academic institutions, policymakers, healthcare professionals, district-level functionaries, and frontline workersfor the exchange of experiences, best practices, and field-level insights,thereby strengthening public awareness and capacity building through informed dialogue and knowledge sharing.

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5.0 Recommended Technology-Driven Innovations in the NER

In the North-Eastern Region, characterized by difficult terrain,scattered habitations, adverse weather conditions, and limited road connectivity, drone technology has emerged as an innovative approach for strengthening last-mile healthcare delivery and immunization outreach.

The initiatives such as i-Droneand the deployment of hybrid (Electric Vertical Take-Off and Landing) e-VTOLaircraft systems are the emerging technologies that several North-Eastern states have increasingly utilized drone-assisted healthcare logistics to ensure uninterrupted delivery of vaccinesand essential medical supplies to remote and inaccessible areas of the Region.

These technology-driven interventions have facilitated:

- Rapid transportation of vaccinesand emergency medical supplies.
- Timely delivery to remote hilly and border regions.
- Reduction in transit time and dependencyon difficult road networks.
- Improved access to healthcare services in geographically isolated communities.
- Strengthening of emergency responseand outreach immunization sessions

The adoption of drone-based logistics shall have significantly supported routine immunization activities and enhanced healthcare accessibility in hard-to-reach areas across the region.
To further strengthen immunization outreach in NER primarily focussing on geographically vulnerable areas, the adoption of GIS-based area mapping and digital micro-planning mechanisms has gained increasingsignificance in the NER.

Geospatial mappingtools may support health authorities in:

- Identification of underserved and high-risk habitations.
- Mapping of difficult-to-reach villages and migrant settlements.
- Real-time monitoring of immunization coveragegaps.
- Planning outreachsessions based on terrain and population distribution.
- Strengthening surveillance and monitoring mechanisms.

Such data-driven approaches can significantly improve resource allocation, beneficiary tracking, and targeted immunization interventions, particularly in remote border and tribal areas across the NER.
The Electronic Vaccine Intelligence Network (eVIN), complemented by strengthened digital logistics management systems, has significantly enhanced vaccine supply chain monitoring and cold chain management across the Region. Real-time tracking of vaccine stock availability and storage temperatures has enabled health authorities to ensure vaccine potency, minimize stock-outs, and reduce vaccine wastage, particularly in remote healthcare facilities where infrastructural limitations continue to pose operational challenges. Furthermore, the success of the Co-WIN portal during the COVID-19 pandemic in improving vaccine accessibility and utilization has paved the way for the launch of the U-WIN portal. This digital platform has not only strengthened coordination between vaccine providers and distributors but has also made immunization services more accessible, efficient, and user-friendly.
The integration of digital tracking systems has further strengthened transparency, accountability, and efficiency in vaccine management, thereby contributing to improved immunization service delivery across the NER.

6.0 Role of Frontline Health Workers

Frontline healthcare workers,particularly ASHA and Anganwadi workers, continue to remain central to immunization outreach activities in immunization outreach across the NER. Their individual responsibilities include:

- Mobilizing communities.
- Conducting householdvisits.
- Tracking missed beneficiaries.
- Addressing vaccinehesitancy.
- Supporting routine immunization sessions.

Performance-based incentives aimed at maximizing vaccine coverage, coupled with supportive community engagement approaches to uplift the morale of frontline workers and beneficiaries, have further strengthened collective efforts toward achieving full immunization coverage.

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7.0 Strategic PriorityAreas

A strengthened immunization system in the North Eastern Region requires an integrated and mission-mode approach focusing on resilient health system infrastructure and robust cold chain networks, accelerated digital health integration for real-time monitoring and service delivery, community-centric behaviour change communication to addressvaccine hesitancy, sustainedcapacity building of frontline health workforce, expansion of life-course immunization including adolescents and adults, improved last-mile connectivity and logistical efficiency in hard-to-reach areas, and enhanced inter-state and cross-border diseasesurveillance to ensure early detection and rapid response to public health threats.

8.0 Conclusion

The World Immunization Week 2026 serves as a reminder that vaccines remain among the most powerful tools available to public health systems worldwide. India's continued progress under the Universal Immunization Programme reflects continued effortsby healthcare workers,state governments, and local communities.

For the North Eastern Region, strengthening last-mile healthcare delivery, digital innovations, and community-based outreach will remain critical for ensuring equitable vaccine access across remote and underserved populations. Last-mile strategies acted as the final driving force in overcoming the sluggish progress witnessed during the COVID-19 pandemic. Sustained investments in healthcare infrastructure, technological interventions, and public awareness will not only improveimmunization coverage but also contribute significantly to building healthier, resilient, and more inclusive communities across the NER. For every generation, vaccines continue to work - ensuring equitable healthcare access and improved public health outcomes across the region.

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ECHOES OF TRADITION: THE LIFE AND LANDSCAPE OF KHONOMA VILLAGE

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Abstract

Khonoma Village lies on the western side of Kohima, the capital of Nagaland. It is about 20 kms from Kohima. The population according to Village Development Board 2004 is around 3000 and has about 600 household. The name of the village is derived from Khwüno (Glouthera Fragrantisima) a plant which grows wild in Khonoma and so the people of Khonoma are called Khwünomia. Khonoma has played an unparalleled role in the history of the Nagas in Nagaland. Although a small village situated in the harsh and rugged terrain it has long been considered to be the most powerful and feared in the Naga hills. Khonoma played a very significant role in nurturing the growth of the Naga struggle for Independence. Khonoma was declared as a Green Village on the 25th of October, 2005 and it is supposed to be the first green village in Asia. In the background of modernity, the village, to this day, is still very traditional.

This paper will give an insight into the lives of Khonoma people, their culture and traditions, their economy, flora and fauna and tourist hotspots of Khonoma village.

Keywords : Khonoma, Lifestyle, Culture, Traditions, Morung, Dzüleke, Dzükou Valley

Introduction

Nestled amidst the verdant hills of Nagaland, Khonoma stands as a living testament to the rich cultural heritage, communal harmony, and ecological wisdom of the Angami Nagas. Known as India's first "Green Village," (Papu S, et.al 2020), Khonoma embodies a unique mixture of tradition and sustainability, where cultural identity and environmental stewardship coexist in remarkable balance. The village's distinctive lifestyle, agricultural practises, age-old festivals, reflect a deep-rooted social structure that continues to shape the moral and cultural upbringing of its inhabitants. Khonoma's landscape, characterized by terraced fields, forested ridges, and diverse ecosystems, has long influenced its people's relationship with nature. This interdependence is evident in their agricultural practices, rituals, and community governance systems that promote collective responsibility.

This study seeks to explore the intricate relationship between Khonoma's geography, cultural traditions, and social institutions. By examining its festivals, History, and patterns of daily life, the research aims to understand how the people of Khonoma preserve their cultural identity while adapting to modern influences. Ultimately, this paper portrays Khonoma not merely as a geographical location but as a living heritage that continues to echo the enduring spirit of the Naga people.

Lifestyle of the inhabitants of Khonoma

Agriculture in Khonoma

The main occupation of the people in Khonoma is agriculture. Agriculture is carried out in two ways. The Jhum cultivation is carried out on the hillside or in places where terraced fields cannot be done. Jhum cultivation starts somewhere around October to November. The Forests for Jhum cultivation are cut down, dried and burnt. After burning, the areas are cleared and prepared for crops like rice, Job's tears, Maize, Chilli, Potatoes, Cabbages, Carrots and other vegetables. Shifting of Jhum fields needs to be done after every 3-5 years for it to fallow. The Alder tree, a native of Khonoma forests revives the fertility of the soil. There are two kinds of land ownership, private and community, the people largely practice terrace cultivation and so private ownership is recognized but usually for jhum cultivation the land is owned by the community. Jhuming method of cultivation is done in areas where it is difficult to provide irrigation. Terraced fields are generally cut out of the hilly slopes running down on both sides of a stream which could be provided with water by means of irrigated channels. While relating about the

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terraced fields, Milanda Ganguli (Milanda,1984) says, "The carefully graduated terrace are walled by solid embankments of stones taken out of the soil at the time of preparing the fields, and are irrigated by a remarkable system of channels, in which water is carried from a stream that may be miles away, flowing from terrace to terrace. In some places there are long hollow bamboo trunks that carry the clear mountain water from a terrace higher up to flood an adjoining smaller field. The human effort that must be necessary to construct the enormous network of Water channels paved with stones dug out from the soil is undoubtedly tremendous." Summing up the whole system of Terrace cultivation, C.D King states "This whole enterprise was a wonderful proof of the sturdiness and industry of the men of Khonoma and a most remarkable feat of engineering when considered as the achievement of men so low in the scale of development as Nagas have always been supposed to be." A series of tasks are undertaken for the cultivation of terraced fields. As soon as the harvest is over, the farmer will then dig the soil, uprooting the weeds which in turn change into manure for the soil when decomposed. Then, the farmer clears the water channel and brings it to irrigate his field. When everything is decomposed under the water the farmer will puddle the mud and ultimately the paddy seedlings which are already growing in the seed-bed are transplanted. This is done in June and July and the paddy is harvested in October and November. Terraced farming is a permanent form of cultivation. Its productivity is more and it does not need to lay waste as Jhumming cultivation does. The paddy seeds which are sown thickly in late March and early April on a patch of ground germinates by the beginning of June and soon after the seedlings are ready for transplanting. The technique of cultivation is crude, the soil is dug manually with a hoe and it needs intensive human labor. Thus a farmer has to give his full attention to his field throughout the year and he is only free for a short while after the harvest and on non-working days.

The people of Khonoma may not be as primitive as C.D King stated long ago, but agriculture remains the main activity of the people till date. Varieties of rice are grown, and the people have resorted to inter cropping with different kinds of cash crops like garlic, potatoes, carrots, cardamom etc and green leafy vegetables which are organic and sell like hot cakes when brought to towns like Kohima and Dimapur. These cash crops have become a very good source of income boosting the economy of the people.

Major Festivals celebrated in Khonoma

Being an agrarian society, all the thenyi or festivals are always centered on the agricultural cycle to keep the farmer well nourished and religious ceremonies are held to ensure the protection of an individual and his crop. The important festivals are mentioned here serially in accordance with the season.

Terhünyi is one of the biggest festivals of Khonoma and it takes place in the month of December. The celebration usually lasts for ten days. The festival symbolizes love and joy and it is a time to give thanks to God for the good harvest and for granting good health.

On this third day of the festival, a celebration is organized in the name of the first born child of the newly married couples, the relatives of the wife send huge quantities of rice-beer and meat to the couple and they invite the kinsmen of the husband to enjoy the feast. On the seventh day they show their gratefulness to the supreme power by bringing paddy and other crops which are offered to *Zievomia or Kemevo* (priests). In return, the priest offers some prayers of intercession to the spirits on their behalf.

The festival also offers an opportunity to a wealthy man to throw a grand feast known as 'Feasts of Merit'. He does this in order to demonstrate his kindness and fellow-feelings. After performing this feast, his guests erect a huge stone for him by the side of the path leading to the village. The giver of the feast is then entitled to wear a special designed shawl which uplifts his status in society. It is said that while *Sekrenyi* is meant for young ones to purify themselves, therünyi is especially for the rich and the old to acquire name and fame.

Sekrenyi is the next important festival which is celebrated in the month of February. This festival is celebrated to ask God's blessing for good health throughout the year. It is also known as *Phousanyi* or 'Festival of purification' as the males observe series of rituals for purifying themselves.

Stretching over ten days the festival begins with Kizhie (literally means cleaning the house). For this purpose a little quantity of fresh rice beer called *Zumho* is put into banana leaves and placed to the

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central post of the partition wall between two main rooms of the house. They do this as a token of thanksgiving to the supreme power by letting him have his share first before they start enjoying the festival. Next to the supreme power, their ancestors are treated with respect by serving them with the same item or food over their graves. In fact most of the festivals start with *Kizhie* which is an act of honor to their gods and ancestors. The first day of *Sekrenyi* starts by cleaning the village well by some boys. They drain the water out of the well after which no one is allowed to use it until the next morning. By early dawn all the males except the young boys go to the well to wash themselves and also their weapons and tools. They do this act by pronouncing that all their misfortunes and illness have gone down the drain along with the water which they have just used. After they return home, every male who has taken a bath kills a healthy cock by throttling it with his bare hands and watch the legs as it dies. If the right leg crosses over the left while dying, it is considered to be a good sign. He then cooks it and eats it himself. From the fourth day a three-day session of singing begins. On the eighth day, bridge-pulling or gate-pulling ceremonies are performed and also inter-village friendships are renewed by feasting together.

Ngonyi is the next important festival which is held in the month of April. It marks the completion of the sowing on the newly prepared jhum fields. Ngonyi festival spreads over a period of fourteen days. During the Ngonyi festival, excursions are arranged for young people to go hunting and fishing.

Thekranyi the next festival falls either in May or June. This festival marks the beginning of paddy transplantation marking the beginning of the busiest season. Thekranyi is accompanied by the ceremonial pounding of rice, singing and dancing. When the festival is completed *Tekhusekhrüpfü* (Starter of transplantation) gives the green signal for transplantation of paddy-seedlings in the terraced-fields and only then they can start the transplantation. During this festival the members of a particular age group are counted and accordingly depending upon the size of the age group, arrangement is being done to split the age-group into small units to work in different fields.

Tsünyi or millet festival is celebrated at the end of the rainy season which marks the completion of millet harvest. It is generally held either in the last part of August or first part of September and observed for five days. It is also called *Chadanyi* (path clearing festival), because in this festival the people make an effort to give the village a face-lift by working on the paths leading to the village and also public properties like the village wells are being repaired and cleared. It is also an occasion to remember the ancestors who have passed away and works are organized to clean up their graveyards.

Liekhwenyi (literally means field-guarding festival) is celebrated for three days after the Tsünyi which occurs either in the month of September or October. It stretches for a period of three days. As the name indicates it is time to protect their crops with meticulous care. So during this season they put up scarecrows in various shapes and sizes in the fields to frighten birds away. This is also an important festival especially for the girls. In the midst of the festival, a particular day is set aside for the young girls to perform a ceremony which is called *Theyuu khutie cii* (eating toad's meal) where they are offered a special feast of special harvested rice and fish curry, specially caught for her from the stream and their field by her parents and elder siblings. After the ceremony, a girl is then considered as an adult who is legally responsible for her action. They perform another ceremony five days later which is known as *titho* (sky-ceremony) which is a very serious and important ritual for the protection of the ripening crops from natural calamities like hails and storm

Liede marks the beginning of harvesting of rice which happens in the month of November. The inaugural function for the harvest has to be done by an old lady. The festival lasts for two days, during which it is strictly forbidden for anybody to go to the field except the *liedepfü* (harvest-starter).

Tiekede or *Kevakete* festival is celebrated during the last part of November which heralds the completion of harvest. The granary is full and now is the time to enjoy the fruits of hard labor. It is the festival which offers thanksgiving to the supreme power who once again led the people to a year of plenty. This festival also marks the completion of yearly cycle.

The Morung

One of the most important features of the social structure of the Angamis and Khwünomia in particular is the institution of the Morung. The Morung plays a very important role in the society. Various names for this institution are given by different authors like 'male club', 'men's hall',

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'public school', bachelor's dormitory' and so on, however the khwünomia have their own term Thehu/kichüki. Thehu which means a meeting house and Kichüki, a sleeping place.As for the entry to the dormitory, the boys who are fit for manual work can join as regular members who are to be taught and disciplined by their elders. Thus, next to the family this dormitory system can be called as the most important institution of the village. In this regard Prakash Singh (1977) says, "It was in these Dormitories or club houses that younger generations of the village was reared to manhood in the tradition of those particular tribes." Again Chattopadhya (1978) has this to say, "It is here that the foundation of each generation are laid moulded and built up. The growing youth is taught the meaning and significance of tradition, told of the valour and heroic deeds of the earlier generations and that it is in the glory of the past that the seeds of the future have to sprout."

The menfolk sit around the fire in the dormitory during the morning hours and in the evening on ordinary working days but they usually spend their whole time on a feasting day filling their bamboo or Mithun mugs with rice beer and talk about the season, crops, domestic affairs, village politics, adventure in the plains, recounting hunting trips and current affairs. Morung is also an institution for the young boys to learn about their traditions, legends and heroic deeds of their fore-fathers. They learn about the do's and dont's of their society and also render services to their community. Baskets of various designs, indigenous musical instruments, wooden utensils and the like are important arts learnt here. They also learn how to use a spear, a dao and a shield in battle. Announcement of an important event, a meeting, a death or even danger are given through these institutions. Again if there is a genna (a custom that does not allow people to work) on a particular day, the message is relayed from Morung to Morung. During the festivals when people stop working to celebrate a special event, a wide range of sporting activities like high jump, long jump, shot-put, wrestling etc are held in the yard infront of the Morung. It is here they learn the age-old values, to mention some values which are treasured dearly even today are- Independence, hospitality, honesty, integrity, helpfulness, respect for elders, the spirit of giving ones best, obedience etc.

The Morung has strict rules which maintain the prestige of the dormitory; these rules are called Thehu-Mhosho. A Thehu-maxim goes that, *"A son of the Thehu never gets spoilt."*

Even though there is no class distinction in the society, yet women do not enjoy the same status as that of their male counterparts. It is taboo for the women to enter the male dormitory because there is a belief that by doing so they bring bad luck to the males. Misfortunes may come in the form of failure in hunting expeditions or suffering casualties in the event of a fight.

The Morung- Kichüki /Thehou may be phasing out, however the purpose they serve are still relevant in the present times. The strong attachment to the age group, village and tribe, the civic sense and community responsibilities ingrained and instilled by tradition still remarkably manifest in their spontaneous participation in natural calamities, funerals, etc. Today if one visits Khonoma you will still see the Thehu, the meeting place where village elder sits and talks with their rice beer or tea and some of them are still making baskets or carving out their plates and spoons. Merhümia Khel has five Morungs, Thevomia Khel has nine and Semomia Khel has five. In earlier times it was taboo for women to be in Thehou/Kichüki but today it is not as strict as before so a visitor either male or female can sit with its members and have a conversation.

The cultural upbringing of Khonoma's inhabitants

The social life of the khwünomia starts when boys and girls around 9-13 years of age are organized into age groups called thesü. The age difference may vary from 1-5 years. After every 4-5 years a new age group is formed. Age groups are confined to Khels only. However all the Khels form the new age group at around the same time. When a group of children come of age to be able to know their own responsibilities, the formation of a new age group takes shape under the guidance of a reputed man called Kikrakikeseu. He is also referred to as the father of the group and their group is called by his name. During the Thekranyi festival when a new age group is formed, the elders will lead the new group to the house of the group father. In this first gathering, the elders will instruct the younger group on the various norms and customs, age-group duties and obligations on various occasions. Visebi Dolie 1983, while talking about thesü said, "By entering into an age-group, being twelve or thirteen years, one begins to take up responsibilities in the society." After formation of said age-group, the members do

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peli that is, they will have to take turn to work in each other's field. During festivals the various age-groups get together and enjoy recreational activities. They spend the day singing folk songs, cracking jokes and getting to know each other better. They take great care to avoid hurting each other's feelings and sentiments. No separate group is formed within the age-group. In other words everyone is given equal treatment and there is no room for favoritism. Such social gathering is also an occasion where its members are on the lookout for their prospective future partners.

The various divisions of age groups in a village work hard in an attempt to help the village and also bring good name to their group. They undertake the kind of work related to sanitation and beautification of the village. Construction of rest houses by different age-groups is also very common. Even though the age group thesü are formed in the three different khels, all the thesü combine to form one big age group and one identifies with one's age group as uthsümia meaning 'my age group', which gives one a sense of identity in the social structure.

Today the thesü (age group) is no less important, the pride of belonging to your own thesü is even stronger. Though the majority of the younger generation may not till the soil yet activities like camping together and activities for societal benefit is still as strong if not more. If one goes to Khonoma, you will see rest houses along the way which have been built by the different thesü. And if one happens to be in a Khwünomia wedding you will see the men from her age-group jumping upon a raised plank to show their strength and agility and together ask for her price called thesa. The groom has to give them this thesa for taking her away which is usually a very big cock and some money. They will have a very big get together with that later on. A man's life is attached to his age-group until his death.

Rüffüno

Rüffüno is an organization which binds all the people of Khonoma together. Even though this Rüffüno in spirit was supposed to have existed ever since the existence of the village, it was only in 1994, that it was formally established. Why such an organization? There were many reasons, to mention a few:

1. To uphold the spirit of unity.
2. To strive for the betterment of the people.
3. To protect the people of Khonoma.
4. To promote and preserve its cultural heritage and traditions
5. To preserve and promote its ideals and values.

On the 1st of September every year Khonoma people anywhere whether it is Khonoma, Dimapur, Delhi, etc or abroad gather together. On this day wearing a Khonoma shawl is compulsory. A song of Rüffüno goes…

Hie Rüffüno Kehu

Hie Rüffüno Kehu
Uramia bu vikehielietuoHie
Rüffüno kehu
Uramia bu keze thie lie tuoü
Di Rüffüno kehu
Thepfü zodi uremia la
Thie shüyie.

translation
We gather together-
For the betterment of our people
We gather together so that our
People can stand together
With courage we stand together
For our people.

Geographical Diversity and natural features of Khonoma

The mountains surrounding Khonoma village are-Khurüthi, Hoperathi, kedieutsü Kerü, Dzükouthi and Terhüputhi. And on the foot of these mountains lies the rivers Dzüza, Khwüno dzükhurü, Khurü, Shüzhano dzürü, Notsorü, Vikhakurü, Nyieliedzürü and Dzüyierü. On the mountains and hill slopes and besides the rivers are found a rich diversity of flora and fauna. According to Environment Impact Assessment Report, Khonoma Tourism Development Board November 2004 there are:

Sl No	Items	No. of Varieties
1.	Medicinal Plants	99
2.	Trees	204
3.	Orchids	45
4.	Cane	11
5.	Bamboo	19
6.	Creepers	27
7.	Edible wild fruits	84
8.	Edible wild vegetables	116
9.	Mushrooms	9
10.	Natural gum extract	7
11.	Natures dyes	5

Flora

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11.	Natures dyes	5

Fauna

Sl No	Items	No. of Varieties
1.	Bees	12
2.	Honey Bees	7
3.	Crabs	5
4.	Grasshoppers	10
5.	Local fish varieties	33

Other Wild Produce

This assessment shows how rich the village is in its biodiversity and it makes for a popular hotspot for bird watchers, for trekking, for researchers on its flora and fauna to tourists from all over the world.

On the upper slopes of the village one can see the Mithuns (Bos frontalis). They are highly prized. A full Mithun today may range from 50,000 to 80,000 Rupees. They are usually used for bride price, a very honored and rare gift and for meat which is considered a delicacy. Blyth's Tragopan is found in the forest of Khonoma. The Khonoma native conservation and Tragopan sanctuary (KWCTS) have been set up for its conservation.

Khonoma Nature Conservation and Tragopan Sanctuary Trust (KNCTS)

Khonoma Nature Conservation and Tragopan Sanctuary Trust (KNCTS) was established on 11 December 1998. The aims and objectives of this NGO are:

1. To promote nature conservation and environmental protection.
2. To establish a Tragopan Sanctuary in its natural habitat at the Khonoma Dzükou area.
3. To conserve the flora and fauna and all biodiversity in the sanctuary.
4. To promote protection of all wildlife and birds and to ensure freedom of living in the sanctuary.
5. To crusade against killing of wildlife and burning of jungles.
6. To promote eco-tourism.
7. To promote and undertake studies of nature and eco-system.
8. To impart training in the studies of nature, the environment, wildlife and eco-tourism.
9. To promote and undertake tree plantation and sanitation drives.
10. To fight against environmental pollution by way of education, training, social activities and by intelligent and resourceful management.

Under the KNCTS rules and regulations, Article 13 the Tragopan Sanctuary Wildlife Protection and Research states that:

1. The KNCTS Trust will establish a Tragopan Sanctuary at Khonoma Village, which has a total area of approximately 122.959 sq. km. The Trust will carve out an area of about 20 sq.km that is approximately 96 sq.km if measurement of the physical contours of the hills and valleys are accounted, encompassing the entire Khonoma Dzüku and some of the adjacent areas exclusively for the purpose of the Tragopan Sanctuary. It is estimated that at present there are about 500 Blyth's Tragopan in the Sanctuary Area. The Tragopan is an endangered species of the Pheasant family, and protection and conservation with intensive care is called for. The Trust will ensure that the Tragopans in the sanctuary live and thrive in its natural habitat without any threat. Hunting in any form shall be strictly prohibited within the sanctuary.
2. Research and studies of wildlife and the environments in the KNCTS area by any resource person shall be allowed; but only with the approval of the Trust on payment of nominal fees depending on the type of studies and research.
3. The executive shall take disciplinary action against any person such as research scholars, visitors, villagers and the KNCTS Trust members and staff if found indulging in any activity which is detrimental to the preservation of nature, or in violation of all rules and regulations issued by either the Khonoma Village Council or KNCTS Trust.

The setting up of this KNCTS has been a milestone for the development of nature conservation in the village

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Khonoma and its surrondings: Dzüleke and Dzükou Valley

Dzüleke is a small settlement, an extension of Khonoma village. According to 2018 Village census, there are 48 houses with a population of 158. It is beautiful, natural and still untouched by modern civilization. It is situated in a narrow valley with mountains like Gwenuzüthi, Ketibochuthi, Kevethethi, Paunathi on both sides. The rivers flowing side by side Dzüleke are Dzülerüdi, Dzüsierü, Teisou Khurü and Tekhwekhwirü. Nature cannot be closer than Dzüleke as one can hear the barks of deers and different animal sounds. The clean, clear and cold flowing stream is famous for trouts and crabs. This place has become a tourist spot especially for animal and bird lovers.

Beyond the mountains surrounding Khonoma lies Khonoma's share of Dzükou valley. It has often been referred to as 'Nature's Utopia' It is surrounded by high mountain ranges, the rivers and waterfalls freeze in winter but in Spring different varieties of flower bloom like the special Dzükou valley and Rhododendron. Dzükou is known for its biodiversity but the native plant is a small tough bamboo brush because of which from far away the valley looks like a big mowed lawn. It has been and is a very exciting place for Trekking for those who dare. About two hours walking distance from Dzükou, we find the beautiful Sanctuary water fall. It is said that in this beautiful valley roamed the white elephants in the earlier times, today only its footprints can be seen.

The people of Khonoma settled here in the 1950's during the Indo Naga War. But due to the cold climate came back to their original village after the war.

Myths and Legends of Khonoma

Khonoma has its share of myths and legends- On one side of the mountain Hoperathi, a human like face can be seen on the rocks. The villagers called it Shükhieu meaning the guardian of all wild animals. So when hunters go hunting they will look at Shükhieu's face to find out if they will be able to hunt any animals that day, because if the face look gloomy or sad means they will be lucky for the guardian is sad to lose one of his flocks. But on the day his face looks happy and cheerful means the hunter will not be very lucky to be able to hunt any animals. So legend says he has difference expression on different days. Even today hunters acknowledge Shükhieu for his benevolence. Another one that stands out is Terhotsiese where an owl like stone stands. Legend says that one night they heard a lot of noise and commotion and people Kehu and Mekwü (traditional war cry). The next day they found an owl like stone and attached to it were ropes made of thatch leaves, so they believed that Terhomia (spirits) have pulled the stone and kept it there. Visitors have been coming to Khonoma to see the face of Shükhieu and Terhotsiese which is in the middle of Khwünobasa.

Christianity in Khonoma

Christianity invaded this small culturally protect village in 1897. Since then there have been gradual changes in the culture and lifestyle of the people. To quote Khrieleno Terhüja, "If one responsible dynamic factor were to be singled out of an overall change in the life of the Nagas it would undoubtedly be the introduction of Christianity among them." Today the village is 100% Christian and on Sundays one can see the constant flow of villagers in their beautiful attires coming out or going into the churches. However, being so deeply rooted in their traditions, the festivals are still celebrated of course without their animistic religious ceremonies.

Tourism in Khonoma

This small village nestled in between the mountains and the hills, its quiet flowing rivers and the large green forest all around with birds chirping and squirrels popping out their heads curious to see the new visitors, the flowers and orchids blooming with their variety of fragrances and not being very far away from the capital, makes it an ideal place to get away from the hustle and bustle of the city life and to rejuvenate.

Since there have been a steady flow of tourists all year round the Eco-Tourism Management Committee of Khonoma (ETMC) maintains a tourist information centre located at the entrance of the village- Dzüsie. This ETMC provides guidelines and assistance to all visitors. This centre is functional from 7 am to 5 pm everyday. The ETMC collaborates with

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1. Homestay/Lodge
2. Tourist guides
3. Local organizational bodies
4. Khonoma tour operators
5. Taxi Drivers Union Khonoma

There are a number of homestays in Khonoma as well as Dzüleke. Besides there is Dovipia Inn which is located in the heart of Khonoma. It has modern amenities with luxury bedrooms and bathroom attached, laundry services and a restaurant which serves Naga and simple Indian cuisine, Veg and Non-veg. Their brochure states "Be apart of our Inn and experience fresh things to see and do in this little piece of paradise." If you are ever in Khonoma please do so.

Conclusion

Khonoma today stands as a remarkable example of how history, nature, and cultural heritage can be preserved in harmony. More than just a tourist destination, it embodies the perfect balance between tradition, conservation, and modern life. Through its dedication to safeguarding its historical legacy, natural environment, and cultural practices, Khonoma shines as a model of sustainable living and community-led conservation. The village serves as a powerful reminder of the deep bond between people and nature, inspiring us to protect both our natural resources and our cultural roots—while recognizing that true progress should never come at their expense.

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EXTRACTION OF GELATIN FROM BOVINE BYPRODUCTS

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Abstract

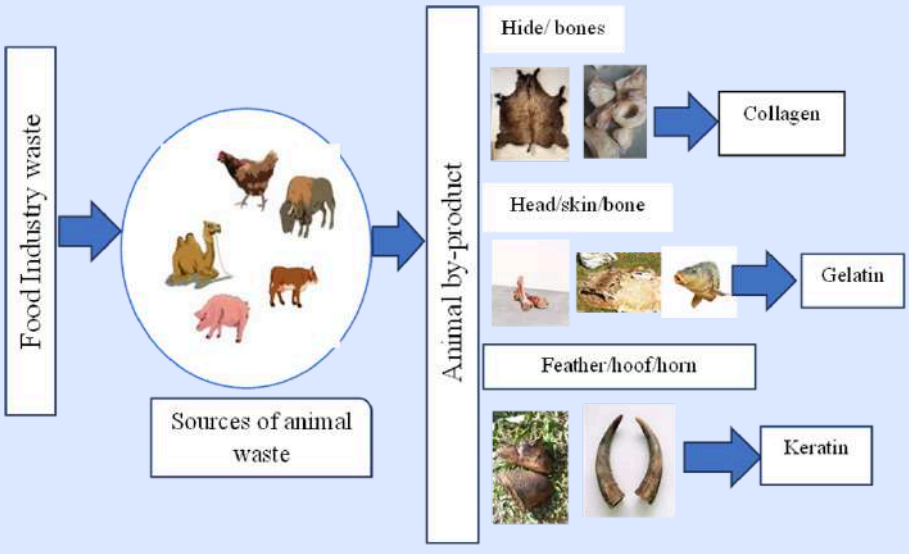
In the present study, the waste material of Mithun (Bos frontalis) was utilised for the extraction of gelatin. Preliminary trials were conducted to obtain gelatin. Mithun bones were crushed initially. The sample was dissolved in 5% w/v, 0.1 M NaOH solution at 4℃ for 48 hours to eliminate non-collagen protein. Subsequently, the sample treated was cleaned using ultrapure water until its pH reached 7. Then, the solution was mixed with 10% n-hexane (2 days) and replaced every 12 hours to eliminate fats, again dispersed in 0.25 M EDTA with distilled water to eliminate calcium. Acid extraction of the sample was carried out by submerging the sample in HCL (0.025 M) for 24 hrs, then washing 5 times with distilled water until pH 5. The demineralised sample was mixed with deionized water (1:5 w/v), and heated in a water bath at 70 °C for 7 h. After mixing continuously at 200rpm for 7 hrs (70 °C), the decalcified and gelatinised sample was added to deionised water 1:5 (w/v) to produce yellowish gelatin. The gelatin yield was 13.7%. The proximate analysis of raw bone were moisture content (6.9±0.35%), ash content (5.5±0.35%), and fat content (1.25±0.35). The average soluble protein concentration of gelatin (136.25 µg/ml) was determined by using the Bradford assay. FTIR of the sample showed the presence of various functional groups. Mithun bone gelatin shows potential as an alternative source of gelatin manufacturing.

Keywords : Mithun (Bos frontalis), bones, gelatin, alkaline treatment, waste utilization

Introduction

An essential protein called gelatin is created when collagen from animal parts and its byproducts-such as cartilage, bones, tendon, hide, and hoof is partially hydrolysed. (Zhao et al.,2016; Shahiri Tabarestani et al.,2016). Gelatin is a remarkable food ingredient because it can form a thermoreversible gel at room temperature and with a and with a high water content. Key characteristics of gelatin include biodegradable, biocompatible, and non-toxic due to its naturally high amino acid content (Fatimah et al., 2023). Gelatin, a protein derived from collagen, is extracted by thermal denaturation from Mithun's bone (Rigueto et al., 2022). Mithun (Bos frontalis) is a rare and exceptional species of bovine that is indigenous to some regions of the Northeastern Himalayas. It is significant to ethnic communities in India's social, cultural, and religious fabric (Bhattacharya et al., 2005). In order to remove the gelatin from Mithun's bones, alkaline pretreatment was carried out for seven hours at 70 degrees (Cao, et al., 2020).

Figure 1. Food Industry waste and its by-product utilization



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Materials and methodology

Mithun (Bos frontalis) bones were collected from Rajiv Gandhi University during theIndigenous Faith Day celebration and also from Lutak village, Tirbin Circle, Arunachal Pradesh for extraction of biopolymer, i.e. gelatin.

Preparation of Mithun bone sample

During the Indigenous Faith Day celebration, Mithun bone samples from the leg portion were freshly collected from Rajiv Gandhi University (RGU), a Central University, in Arunachal Pradesh. The collected bone samples were washed properly in water, and the meat attached to the bone was removed using a knife. The bone samples were broken into small pieces at least 3cm long and soaked in hot water for 25 minutes. Later, all the remaining meat and marrow were cleaned with a knife. Again, the bone was hammered into smaller pieces, soaked in distilled water for 2 hours, then drying at 40℃ for 24 hours and grinding into powder. Figure 2 shows the bone-crushing process.



Figure 2: The process of crushing Mithun's bone.

Proximate analysis of Mithun's bone

Determination of Moisture Content

The hot air oven method was used to estimate the moisture content of Mithun's bone (AOAC, 1999).

The empty Petri dish was dried for 1hr at 105℃, and for cooling the sample were kept in a desiccator, weigh the empty Petri dish and 6.94 g of the bone sample were weighed. For six hours at 105°C, the Petri dish containing the sample was placed in a hot air oven. For cooling dish and the sample were kept in a desiccator. The moisture content can be calculated by using the following formula i.e.

$$\text{Moisture content } (\%) = \frac{w2-w1}{w3} \times 100 \qquad \text{(Eq…1)}$$

$W_{1=}$ weight of the petri dish
W_2 = weight of dried sample with petri dish
W_3 = weight of sample
Ash Content Estimation

The gravimetric method was used to analyse the ash (Asadi et al.,2021). The sample was ashed by heating two grams in a crucible for five hours at 600°C in a muffle furnace. The container was burned, cooled in a drying chamber, and weighed after that. The sample's ash content was computed using the subsequent formula.

$$\text{Ash content } (\%) = \frac{w1-W2}{w3} \times 100$$

$W_{1=}$ The crucible's weight with residue
W_2= The crucible's empty weigh
W3= The sample's weight

Fat Content Estimation

Fat content can be determined by using the Soxhlet method. A moisture-free sample (2g) was extracted with n-hexane solution in a Soxhlet apparatus for more than 6 hours in order to determine the fat content. The sample was placed into an extraction thimble. The remaining solvent was evaporated, and the flask was then dried at 80°C. After cooling, the ultimate weight was noted. The sample's fat content was determined using the formula below.

$$\text{Fat content } (\%) = \frac{w1-w2}{w3} \times 100 \qquad \text{Eq…3.}$$

W1 =Thimble weight with sample
W2 = Thimble weight
W3 = The sample weight

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Alkaline Pretreatment of Mithun's Bone

After being immersed in distilled water for two hours, little pieces of bone were dried for twenty-four hours at 40°C in an oven dryer. To eliminate non-collagen proteins, 5% of the powdered Mithun bone was dissolved in 0.1 M NaOH solution at 4 °C for two days; every 12 hours, a new 0.1 M NaOH solution was added. Subsequently, the bone powder that had been treated was cleaned using ultrapure water until its pH reached 7. After that, fat was removed from the treated bone powder by mixing it with a 10% n-hexane solution (1:5 w/w) for two days at 4 °C. New 10% n-hexane was added every six hours. In order to extract calcium, the treated bone powder was combined with 0.25 M EDTA solution at a weight-to-volume ratio of 1:10 (w/v) among the two ingredients. For four days, a new 0.25 M EDTA solution was added every twelve hours. The slurry was then rinsed five times with distilled water. Slightly modified in centrifugation the slurry was centrifuged for 20min at 5000rpm

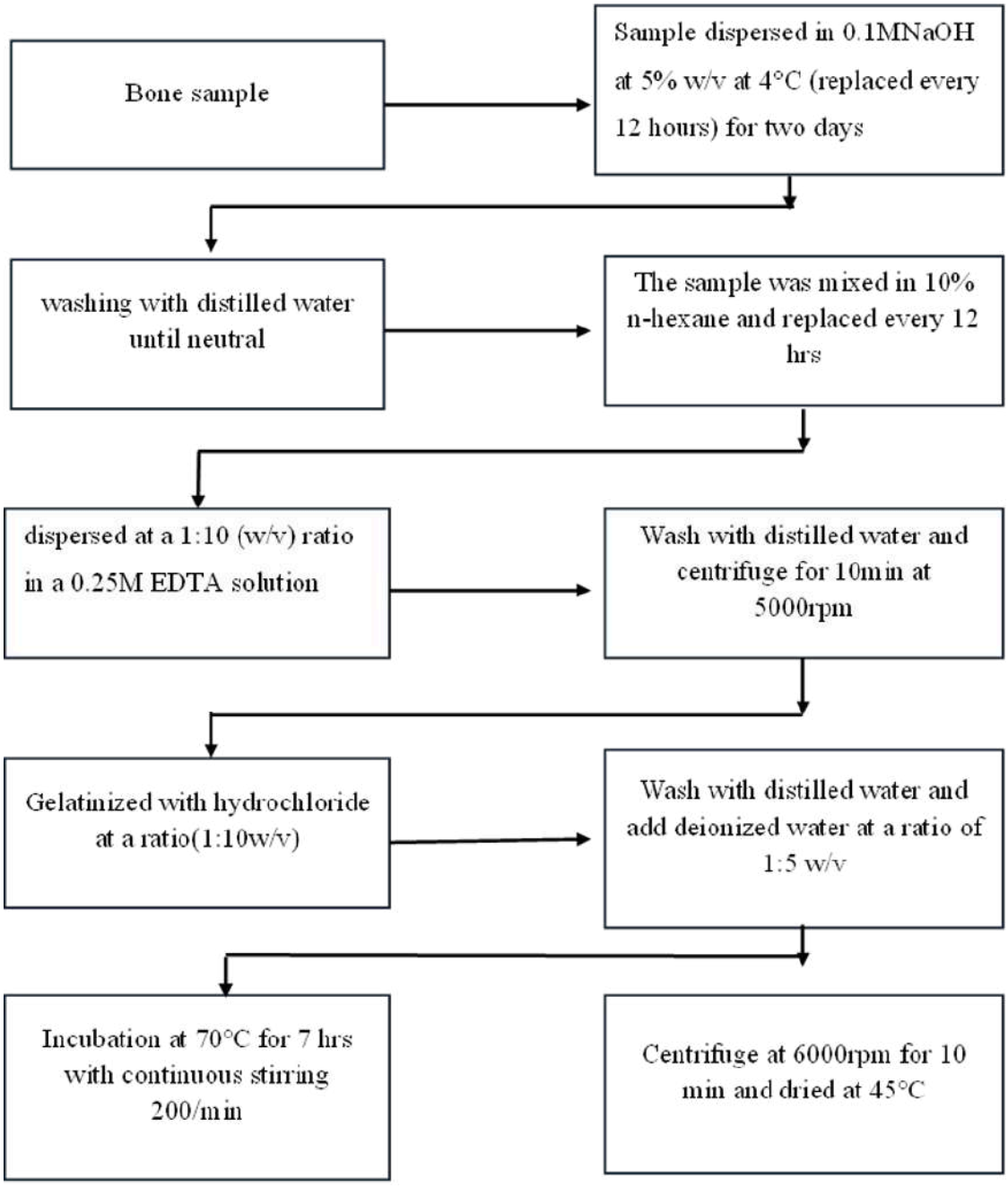


Figure 3: Schematic extraction methodology of gelatin

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Mithun Bone Extraction Procedure

Hydrochloric acid (HCL) and decalcified bone powder were mixed, and gelatinized. It was continuously agitated at 200 r/min in a bone powder/acid solution with ratio of 1:10 (w/v). The slurry was rinsed at least five times with distilled water until the wash water's pH approached 5. After being mixed continuously at 200 r/min for 7 hours at 70 °C, the decalcified and gelatinized, Mithun bone powder was added to deionized water at a ratio of 1:5 (w/v). To get rid of the sediment, the liquid was centrifuged for 20 minutes at 5000 rpm. The resulting Mithun bone gelatin was calculated after drying it in an oven at 45 °C.

The yield was determined by using the equation to consider the raw material's wet weight and the gelatin's dry weight (Cho et al., (2006).

$$\text{Yield } \% = \frac{Wight\ of\ powdered\ gelatin(g)}{Weight\ of\ raw\ sample\ bone(g)} 100 \qquad \text{(Eq...4)}$$

Proximate analysis of gelatin

Determination of pH

The pH of gelatin was carried out by using Ahmad et al., 2018. A pH meter was used to measure the 1% (w/v) gelatin concentration that was prepared by dissolving 0.2 g of gelatin in 20 mL of distilled water at 60°C, being continuously agitated for 30 minutes before cooling to room temperature 25 °C.

Moisture content of gelatin

The method (AOAC, 1999) was used to estimate the moisture content of the sample by using a hot air oven. A 2g sample of gelatin was placed in a Petri plate and dried for 6 hours at 105°C in a hot air oven.

$$\text{Moisture content (\%)} = \frac{W1-W2}{W3} \times 100 \qquad \text{(Eq..5)}$$

W_1 =The sample weight before dried with a Petri dish
W_2=The sample after dried with a petri dish
W_3=The sample weight

Ash content of gelatin

Ash content is determined by using gravimetric methods (Asadi et al., 2021). The 2g of sample was burned at 600 ℃ for 5 hours in a muffle furnace model no. After burning, the container was weighed after being cooled in a drying chamber. The following formula was used to determine the sample's ash content.

$$\text{Ash content } \% = \frac{W1-W2}{W3} \times 100 \qquad \text{(Eq...6)}$$

$W_{1=}$ Crucible weight with residue
W_2=Empty crucible weight
W3=The sample weight

Determination of melting temperature

Das et al. (2017) explained how to measure the melting point. A spatula was used to heat and mix the sample (1 g) three times.

Characterisation of gelatin

Quantitative analysis of extracted Gelatin

The quantitative analysis of extracted Gelatin was performed by employing the Bradford method for protein estimation (Bradford, 1976). In this method, 1% Gelatin is dissolved in 100mL of distilled water, which is followed by mixing 200µl of diluted sample with 5mL of Bradford reagent. The absorbance value of the Gelatin sample and the calibration standard curve generated from the Bovine serum album were compared to determine the protein concentration. The test was repeated three times, and the resultant average soluble protein concentration determined using Bradford assay.

(FTIR) Fourier transform infrared spectroscopy

The chemical and structural makeup of gelatin powder was identified by recording a Fourier transform infrared (FTIR) spectrum (Jasco-FTIR 4100 type A, Japan). The FTIR spectrophotometer's crystal cell was coated with 2 mg of gelatin powder and 100 mg of potassium bromide. Automatic signals were gathered from 32 scans at a resolution of 4 cm^{-1} during the measurement, which was carried out at 4000–400 cm^{-1} at room temperature

Statistical Analysis

Experiments were carried out in triplicate presented as mean ± standard deviation. Origin Pro 8.5 software for plotting graphs and ChemDraw Professional 16.0 were effective in delivering 2D structures.

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Results and Discussion

Before finalizing the extraction methods of animal by-products various trials were conducted (Table 1)

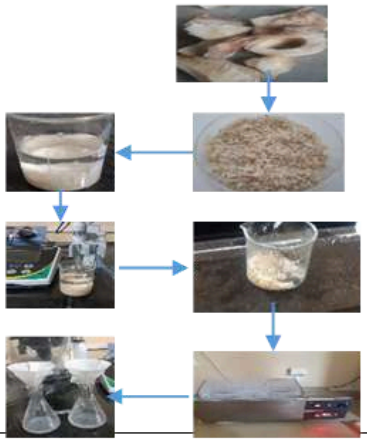
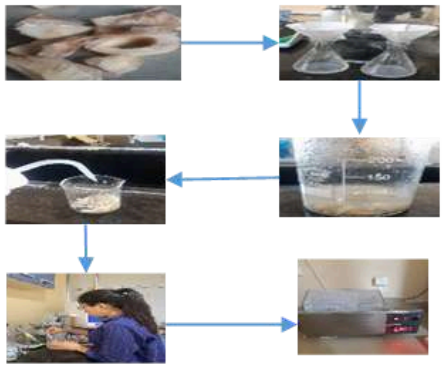
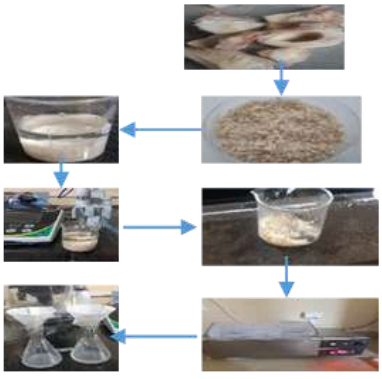
Trial	Sample	Extraction methods	Preparation	Results
1	25g	Crushed bone was soaked in 2% HCL for 48 h, washed with distilled water till neutral and soaked in 1 M NaOH for 48 hrs at 4°C and extracted at 100°C for 90 min in a water bath with shaking; the filtrate was dried at 40°C for 24 h		 Extraction of Mithun's bone gave a yield of 1.65% gelatin
2	100g	The sample was soaked in 0.5 M HCl to demineralize for 72 hrs and neutralized with ammonium sulphate 4%w/v and extracted at 75°C for 3hrs and centrifuged at 6000 rpm for10min, superannuated were dried at 45°C.		 Extraction of Mithun's bone gave a yield of 0.67%
3	100g	Crushed bone was soaked in 2% HCL for 48 hrs. washed with distilled water till neutral and soaked in 1M NaOH for 48 hrs. and change fresh NaOH in every 12 hrs. and extracted at 100°C for 90min. in water bath without shaking filtered was dried at 45°C for 24 hours.		 0.2%

Table 1: Preliminary trials of gelatin extraction:

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Proximate analysis of raw bone

The raw bone sample of Mithun (Bos frontalis) was analysed to determine the moisture, fat and ash content. Table 2 shows the proximate composition of bone. The moisture content (8.0±0.39%) of Mithun bone was found lower when compared with the cattle femur of 13.2% (Field et al.,2000). The percentage of ash content was 43 ±7.07 %, probably due to the high composition of minerals and fat content in raw bone (Benjakul et al., 2017). The result of the fat content of Mithun's bone was 1.25 ±0.35 %.

Table 2 The proximate composition of bone

Moisture content of the bone was 8.0±0.39 %, and the dry matter content obtained was 92.57%. The ash content obtained was 43 ±7.07. which was quite high compared with the cattle ash content. The high amount of ash content indicates the amount of inorganic matter and the possibility of high mineral content. The fat content was 1.25±0.35 %. A high dry matter content suggests that both organic and mineral components make up a sizable amount of the bone. Given the increased yield of solid extractable components that this high percentage suggests, gelatin extraction benefits from it Gómez-Guillén et al.,2011).

Extraction of gelatin from bone:
The extraction of gelatin from the bone was performed by alkaline pretreatment using 0.1 M NaOH solution. The yield obtained was 13.7%. The gelatin extraction from bovine bones through these two types of pretreatments, i.e. acidic and alkaline, produces two types of gelatins, viz., Type A gelatin and Type B gelatin.

Yield % of gelatin:
The alkaline extraction technique effectively removed gelatin from Mithun's bones. Out of 100 g of bone, 13.7% yield was obtained. In general, the type of raw material and the extraction process significantly impact gelatin yield (Jamilah et al., 2011). Figure 3 shows extracted gelatin from MBG (Mithun's bone gelatin).

Proximate Composition	Value
Moisture content (%)	8.02±0.39
Ash content (%)	43±7.07
Fat content (%)	1.25 ±0.35

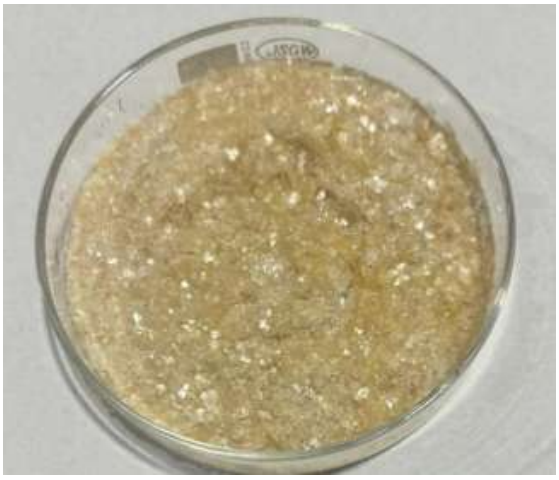


Figure 3. Extracted gelatin from the bone of Mithun

Moisture content and ash content of gelatin were also analysed. The moisture and ash contents found out were 6.9±0.35% and 5.5±0.35%. The values attained were consistent with the GMIA standard (2019), which specifies that commercial gelatin's moisture content should not go above 12%. The alkaline treatment of Mithun bone gelatin (MBG) was lower than that of cow bone (7.87). The ash content of MBG was 5.5±0.35%. The ash value of the MBG however, it was less than that of the bovine bone gelatin (13.33 ± 0.57%) (Arioui et al., 2018) and pekin duck feet gelatin (9.54 ± 1.44%) (Abedinia et al., 2017). Consequently, this suggests that the demineralisation procedure used in this study's pre-treatment successfully decreased the minerals in the sample. One of the most important variables influencing the chemical composition of bones is thought to be age. Typically, high-quality gelatin has an ash content of less than 2% (Karim & Bhat, 2009). Therefore, the MBG obtained during the investigation may have a potential biopolymer application as a reliable source of gelatin, appropriate for a range of industrial uses. The gelling properties of gelatin extracted by alkaline pretreatment methods were greatly impacted by its melting temperature of 27±5°C.

Determination of pH:
The pH value of gelatin extracted by alkaline pretreatment methods was 4.4. Rather et al. (2025) stated that the pH was 5.14 for a chicken feet gelatin sample. Widyasari et al., (2014) stated the pH of 3.71 and 4.81 for the black chicken skin and feet gelatin, respectively and concluded that the variation in pH may be owing to the type and strength of solvent used in the extraction process. Pharmaceutical procedures use high-pH gelatin, whereas the food industry uses low-pH gelatin. (Taheri et al.,2020; Baziwane et al.,2003).

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Quantitative analysis of extracted Gelatin

The quantitative analysis of the extracted gelatin was conducted using the Bradford method for soluble protein estimation (Bradford, 1976). The test were repeated three times, and the resultant average protein concentration determined using the Bradford assay was 136.25 µg/ml.

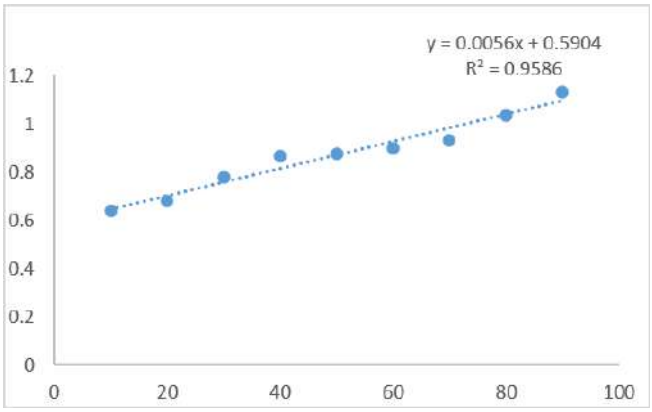


Figure 4: Standard curve for protein estimation

Characterisation of gelatin by FTIR:

The functional groups were detected using FTIR spectroscopy in the spectra of the Mithun bone gelatin (MBG) sample. Functional groups were identified and shown in Figure 5. The frequency area (cm^{-1}) ranges between 500-4000. Various peaks were identified at the range of 627- 3504 cm^{-1}. The amide A band of MBG was found at a wavenumber of 3,397cm−1. According to Sow and Yang (2015), the Amide A band (found between 3400 and 3440 cm^{-1}) is associated with the stretching vibration of free N-H that is linked to intramolecular hydrogen bonds. A shift of the amide A bands to a lower wavenumber suggests an increase in the number of hydrogen bonds and a greater density of hydrogen bonds present in the sample (Cai et al., 2016). Also, CH group is present, as shown by the amide B region. There were ranges of broad peaks at 1629 cm1, 1531 cm^{-1} and 1237 cm^{-1}, which correspond to amide I, amide II and amide III, respectively cm-^{1} (Fig.3), The absorbance area of amides A, I, and III is v = 3600-2300 cm^{-1}, v = 1636-1661 cm^{-1}, v = 1560-1335 cm^{-1}, and v = 1240-670 cm^{-1} by Muyongga (2004). The C=O group, the protein's secondary structure, is seen in the amide I region. On the other hand, the amide II and III regions demonstrate the presence of NH and N-H bonds, respectively, indicating the presence of a helical structure (Miwada et al,.2023). Polyphenols may be the cause of the band's vibration at 1000–840 cm−1, as they change the intensity of the peaks formed by gelatin absorption (Tran et al.,2023).

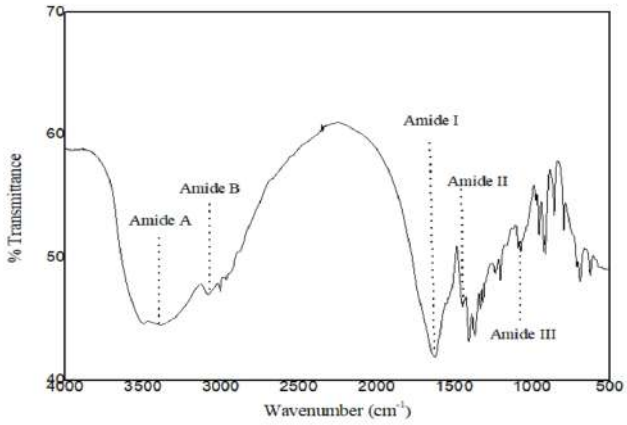


Figure 5: FTIR test for Mithun bone gelatin (MBG)

Conclusion

In conclusion, MBG extracted using 0.025 M hydrochloric acid showed the highest yield (13.7%) among the preliminary extraction trials, indicating that the extraction method plays an important role in gelatin recovery. The raw bone's high ash content, low fat content, and low moisture content made it ideal for gelatin production. FTIR analysis showed the characteristic amide A, amide I, amide II, and amide III bands, confirming the presence of gelatin protein. Overall, the findings suggest that Mithun bone, an underutilised by-product, has the potential to be a sustainable source of gelatin for application in the food, pharmaceutical, cosmetic, and other industries. Further research on its functional attributes and commercial applications is recommended.

Acknowledgments

The authors would like to acknowledge the Department of Food Technology for laboratory facilities. Also, the authors thank the Seed Money Grant (No.RGU/PC-573/(SM)2024), Rajiv Gandhi University, for the funding during the research period.

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Author contributions

Minba Lombi– formal analysis; writing original draft; writing review and editing.
Duyi Samyor – supervision, validation; writing review and editing.

Conflict of interest

The authors have declared no conflict of interest.

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GENERATIVE AI IN ACADEMIC LIBRARIES: APPLICATIONS, OPPORTUNITIES, AND A RETRIEVAL-AUGMENTED MODEL FOR MULTILINGUAL LIBRARY SERVICES IN NORTHEAST INDIA

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Abstract

Generative Artificial Intelligence (GenAI or Generative AI) encompassing large language models (LLMs), retrieval-augmented generation (RAG), and multimodal generative systems is reshaping the way academic libraries deliver reference services, organise knowledge, and support research. This paper reviews the emerging body of literature on Generative AI adoption in libraries, identifies the principal domains of application (reference and discovery, cataloguing and metadata generation, research support, information literacy support, and collection development), and examines the ethical and infrastructural challenges that accompany adoption, including hallucination, bias, data privacy, and the marginalisation of low-resource languages. Building on this review, the paper proposes and justifies a four-layer, tiered-LLM, retrieval-augmented model for library deployment that combines an on-premise open-weight model for routine and sensitive queries, a regional-language model for multilingual access, and a cloud-based frontier model as a fallback for complex reasoning tasks. The proposed architecture is particularly suited to university libraries serving linguistically diverse and resource-constrained regions such as Northeast India, where commercial, English-centric Generative AI tools presently offer limited support. The paper concludes that a hybrid, layered model rather than a single monolithic chatbot offers the most sustainable, accurate, and equitable pathway for Generative AI integration in academic libraries.

Keywords : Generative Artificial Intelligence; academic libraries; large language models; retrieval-augmented generation; library and information science; multilingual AI; Northeast India

1.0 Introduction

Academic libraries have been adopting information technology from the very early stage, moving from card catalogues to online public access catalogues (OPACs), and from print collections to federated discovery systems. The emergence of Generative AI, systems that are capable of producing original text, summaries, images, and code in response to natural-language prompts or queries, represents a comparably significant inflection point (Lund & Wang, 2023). Unlike earlier automation, which largely digitised existing workflows, Generative AI can actively participate in knowledge work: answering reference questions conversationally, drafting metadata, summarising literature, and even tutoring users in information literacy skills.

The rapid, largely unplanned diffusion of consumer tools such as ChatGPT into student and faculty workflows has placed academic libraries in a reactive position (Cox & Tzoc, 2023). Librarians are increasingly expected not merely to observe this shift but to guide it, evaluating tools, building institutional capacity, and, in some cases, deploying library-specific generative systems. This is especially pressing in linguistically and infrastructurally diverse regions, where mainstream Generative AI tools are trained overwhelmingly on English and other high-resource languages and therefore serve local user communities imperfectly.

This paper addresses two connected questions. First, in what specific functional areas can Generative AI be effectively and responsibly used within a university library? Second, what technical model or

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architecture is best suited to realising these applications in a way that is accurate, affordable, and linguistically inclusive? The paper answers the first question through a structured review of the literature, and the second through a proposed layered model, justified against the review findings.

2.0 Literature Review

2.1 The Emergence of Generative AI as a Library Concern

Early scholarly engagement with Generative AI in libraries followed closely on the public release of ChatGPT in late 2022. Lund and Wang (2023) provided one of the first professional commentaries, discussing how GPT-based tools could plausibly affect search and discovery, reference services, cataloguing, and content creation, while flagging concerns about privacy and bias. Cox and Tzoc (2023) extended this discussion specifically to academic libraries, arguing that ChatGPT and comparable tools would force libraries to reconsider reference desk workflows, information literacy curricula, and academic integrity guidance simultaneously.

Cox (2023) offered a more structural analysis, applying the sociology of professions to ask which library competencies are most exposed to AI substitution versus augmentation. This work is important because it moves the discussion beyond tool-by-tool commentary toward a competency framework: routine, rule-bound tasks (basic ready-reference, records description) are more readily automated, whereas complex reference negotiation, research consultation, and information literacy pedagogy require professional judgement that generative systems can support but not replace. In a related contribution, Cox and Mazumdar (2024) noted that librarians often use the term "artificial intelligence" inconsistently, and proposed a clearer definitional framework to help the profession evaluate specific tools against specific use cases rather than reacting to AI as an undifferentiated phenomenon.

Lo (2023) reviewed the implications of a U.S. Department of Education report on AI for academic libraries, concluding that libraries have a distinctive role to play in institution-wide AI literacy efforts, given their existing mandate for information literacy instruction. This positions the library not simply as a consumer of Generative AI tools but as a campus-wide educator and evaluator of them a theme echoed by Carroll and Borycz (2024), who describe practical approaches for embedding large language model instruction directly into information literacy curricula, including exercises that make model limitations (such as fabricated citations) visible to students.

2.2 Functional Domains of Application

Across this literature, five recurring functional domains emerge for Generative AI in academic libraries.

- Reference and discovery services: conversational agents that interpret natural-language questions, clarify user intent, and route users to appropriate resources, reducing the gap between how users ask questions and how catalogues are structured (Lund & Wang, 2023).
- Cataloguing and metadata generation: automated generation of descriptive metadata, subject headings, and abstracts from digitised or born-digital content, reducing backlog in technical services (Cox, 2023).
- Research support: summarisation of literature, assistance with systematic review screening, and drafting of literature matrices, positioned as an extension of existing research-support and scholarly-communication services.
- Information literacy and AI literacy instruction: embedding critical evaluation of AI-generated content, including detection of fabricated citations and biased outputs, into instruction sessions (Carroll & Borycz, 2024; Lo, 2023).
- Collection development and multilingual access: using generative systems to translate, summarise, or make discoverable materials in regional and low-resource languages, extending the library's reach to linguistically diverse user communities.

Of these, the first four are well represented in the international literature, which is concentrated in North American and European institutional contexts. The fifth multilingual and regional access is comparatively under-studied, despite its evident relevance to library systems operating outside the dominant English-language technology ecosystem.

2.3 Regional Context and the Multilingual Gap

University libraries in linguistically diverse regions such as Northeast India serve communities that read, write, and search in Assamese, Bodo, Bengali, Garo, Khasi, Mizo, Nepali, and a range of other regional languages, alongside English. Commercial Generative AI tools are trained predominantly on high-resource languages, and empirical assessments consistently show degraded factual accuracy, fluency, and cultural appropriateness when such tools are used for lower-resource languages.

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architecture is best suited to realising these applications in a way that is accurate, affordable, and linguistically inclusive? The paper answers the first question through a structured review of the literature, and the second through a proposed layered model, justified against the review findings.
This creates a structural equity gap: the same Generative AI tools celebrated for improving reference services in English-medium contexts may simultaneously underserve, or actively mislead, users querying in regional languages. Addressing this gap requires either fine-tuned regional-language models or hybrid architectures that route regional-language queries to models specifically trained or adapted for those languages, an approach elaborated further in Section 4.

2.4 Risks, Limitations, and Ethical Considerations

The literature is consistent in flagging four risk categories that any library deployment must manage. First, hallucination the generation of plausible but false content, including fabricated citations poses a direct threat to the library's core mission of accurate information provision (Lund & Wang, 2023). Second, bias embedded in training data can be reproduced or amplified in generated content, a concern that is compounded for regional language content that is under-represented in training corpora. Third, data privacy is a concern where cloud-based commercial tools log or retain user queries, which is difficult to reconcile with the profession's longstanding commitment to patron confidentiality. Fourth, over-reliance risks eroding the information literacy skills that library instruction is designed to build, unless AI literacy is explicitly integrated into instruction (Carroll & Borycz, 2024).
Taken together, the literature review suggests that the central design problem for libraries is not whether to adopt Generative AI, but how to architect its adoption so that accuracy, privacy, and linguistic equity are preserved. This motivates the model proposed in Section 4.

3.0 How Generative AI Can Be Effectively Used in Libraries

Drawing on the domains identified in the literature review, this section outlines concrete, library-specific use cases that go beyond generic chatbot deployment. First, at the reference desk, a retrieval-augmented conversational assistant can answer directional and basic informational queries around the clock, freeing professional staff for complex reference interviews and research consultations that require judgement. Critically, the assistant should be grounded in the library's own catalogue, subject guides, and institutional repository content through retrieval-augmented generation (RAG), rather than relying purely on a model's internal, and potentially outdated or hallucinated, knowledge (Lewis et al., 2020).

Second, in technical services, generative models can draft descriptive metadata, subject classifications, and abstracts for digitisation backlogs, with librarian review functioning as a quality-control checkpoint rather than a bottleneck, substantially accelerating processing of archival and heritage collections a use case of particular relevance to institutions holding regional manuscript and oral-history collections.
Third, in research support, generative tools can assist with structured literature summarisation, citation formatting, and drafting of preliminary research questions, always with mandatory human verification given known citation-fabrication risks (Lund & Wang, 2023).

Fourth, in information literacy instruction, librarians can use live demonstrations of model hallucination and bias as teaching material, converting a risk of Generative AI into a pedagogical asset that strengthens, rather than substitutes for, critical thinking (Carroll & Borycz, 2024).

Fifth, and most distinctively for multilingual regions, Generative AI can power a chatbot capable of understanding and responding in regional languages, translating between English and regional-language query terms, and surfacing regional-language holdings that keyword-based catalogue search frequently misses due to script and transliteration inconsistencies.

4.0 Proposed Model: A Tiered, Retrieval-Augmented Architecture

Based on the applications and risks identified above, this paper proposes a four-layer model for Generative AI deployment in university libraries, organised as a User Interface layer, an Application Modules layer, an AI Engine layer, and a Data

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Foundation layer.The User Interface layer comprises a web and mobile-accessible portal offering role-aware dashboards for students, faculty, and library staff, with a conversational chatbot as the primary interaction mode alongside conventional catalogue search.

The Application Modules layer contains discrete, purpose-built modules a reference-and-discovery module, a metadata-generation module, a research-support module, and an information-literacy module each of which calls the AI Engine layer with a task-specific prompt template and validation rule, rather than exposing a single undifferentiated chatbot to all use cases.

The AI Engine layer is the technical core of the proposal and is deliberately tiered rather than built around a single model, for three reasons developed below: cost, data sensitivity, and linguistic coverage. It combines (a) an on-premise, open-weight LLM (such as a Llama-family model) for routine queries and for any query involving patron-identifiable data, ensuring that sensitive interactions never leave institutional infrastructure; (b) a regional-language model, fine-tuned or adapted for Assamese, Bengali, Khasi, and other regional languages, to which queries in these languages are routed; and (c) a cloud-based frontier model, accessed via API (Application Programming Interface), reserved as a fallback for complex reasoning or synthesis tasks that exceed the reliable capability of the on-premise models. All three tiers operate within a retrieval-augmented generation framework, meaning that responses are grounded in retrieved passages from the library's own catalogue, digital repository, and subject guides rather than generated purely from parametric memory.

The Data Foundation layer consists of the library's catalogue records, digitised special collections, institutional repository content, and subject guides, indexed in a vector database to support the retrieval step described above, together with a continuously updated feedback log used to monitor accuracy and flag hallucinated responses for librarian review.

4.1 Justification for the Tiered, RAG-Based Design

Three considerations justify this architecture over a simpler, single-model deployment.

Accuracy and hallucination control: Retrieval-augmented generation grounds model outputs in retrieved, verifiable source documents rather than relying solely on parametric knowledge, and has been shown in the technical literature to reduce hallucination on knowledge-intensive tasks compared with ungrounded generation (Lewis et al., 2020). For a library, whose institutional credibility rests on accurate information provision, this is not an optional refinement but a functional requirement.

Data governance and cost: Routing routine and sensitive queries to an on-premise open-weight model keeps patron query data within institutional control, addressing the privacy concern repeatedly raised in the literature, while avoiding recurring per-query costs for the majority of traffic. Reserving the cloud-based frontier model for genuinely complex queries rather than using it for all interactions allows the library to access frontier-level reasoning capability without the sustained operating cost of routing every query, including simple directional questions, through an expensive commercial API.

Linguistic equity: A single, English-centric model, however capable, will systematically underserve regional-language users, reproducing the equity gap identified in Section 2.3. Including a dedicated, adapted regional-language tier is therefore not merely a technical enhancement but a design response to a documented gap in the literature, ensuring that Generative AI narrows, rather than widens, existing disparities in library service quality across language communities. Foundation-model research more broadly recognises that no single general-purpose model performs uniformly well across all languages and domains, reinforcing the case for a tiered rather than monolithic architecture (Bommasani et al., 2021).

Taken together, these three considerations indicate that a tiered, RAG-based architecture is better justified for academic library deployment than a single commercial chatbot integration, particularly for institutions serving linguistically diverse populations with constrained infrastructure budgets.

5.0 Discussion

The proposed model addresses the risks identified in the literature review directly: hallucination is mitigated through retrieval grounding, privacy is protected through on-premise processing of sensitive queries, cost is managed through selective use of cloud inference, and linguistic equity is advanced through a dedicated regional-language tier. This does not eliminate the need for human oversight librarian review remains essential at each application-module checkpoint, consistent with Cox's (2023) argument

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that professional judgement remains central even as routine tasks are automated. Rather, the model reframes the librarian's role from direct information provision toward curation, validation, and instruction around AI-generated content, a shift that is consistent with, rather than a departure from, the profession's established competencies.

Implementation would require institutional investment in computing infrastructure for the on-premise tier, partnership with regional-language NLP research groups for the multilingual tier, and staff training in prompt design and output verification. These are non-trivial requirements, and smaller institutions may need to begin with a simplified two-tier version of the model an on-premise model plus a cloud fallback, deferring the regional-language tier until adapted models of sufficient quality become available while still preserving the core RAG-grounding principle throughout.

6.0 Conclusion

Generative AI offers academic libraries a genuine opportunity to enhance reference services, accelerate technical processing, strengthen research support, and extend information literacy instruction, but only if adoption is architected deliberately rather than adopted as an undifferentiated commercial chatbot. The literature reviewed here converges on hallucination, bias, privacy, and linguistic exclusion as the central risks of ungoverned adoption. The four-layer, tiered, retrieval-augmented model proposed in this paper responds to each of these risks directly, and is particularly well suited to university libraries in linguistically diverse regions such as Northeast India, where mainstream Generative AI tools presently offer incomplete support. Future empirical work should pilot this model within a live university library setting to measure accuracy, user satisfaction, and cost against the conceptual justification advanced here.

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INNER LINE PERMIT (ILP) SYSTEM IN ARUNACHAL PRADESH: ASSESSING CONSTITUTIONAL PROTECTION OF INDIGENOUS TRIBES IN CONTEMPORARY INDIA.

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Abstract

The Inner Line Permit (ILP) system has its roots in the Bengal Eastern Frontier Regulation (BEFR) 1873. It has long safeguarded indigenous communities in Arunachal Pradesh and other Northeast States from the external influx. Although the Inner Line Permit is considered an essential device for safeguarding these regions and hailed as a pivotal instrument for preserving the cultural and social ethos of these areas, it also raises questions about its constitutional validity in contemporary India. This article critically examines the Inner Line Permit system in Arunachal Pradesh and its legal foundations, its relationship to fundamental rights, and emerging judicial interpretations that have shaped this concept over time.

Keywords : Safeguard, Indigenous rights, fundamental rights and cultural preservation.

Introduction

The Inner Line Permit is a licensing system introduced during the colonial period to protect certain tribes in the North-Eastern part of India. Implemented under the Bengal Eastern Frontier Regulation 1873, it continues to be enforced in Arunachal Pradesh, Nagaland, Mizoram, and on 11th December 2020, the President signed the order extending ILP to Manipur, which became the fourth state where the ILP regime is applicable. The main idea behind the creation of the Inner Line Permit was to protect the indigenous culture of all the tribes residing in the restricted regions. It was intended to halt influx, protect indigenous culture, thereby safeguarding and maintaining the rich cultural legacy of the North Eastern Tribes. The Bengal Eastern Frontier Regulation (BEFR) 1873, which embraced the "isolationist policy" allowing tribals to settle in these regions to have some degree of autonomy over their internal affairs, was founded on a similar idea even during the colonial era. This article aims to study the constitutionality of the ILP system, especially in Arunachal Pradesh.

Origin and Evolution of Inner Line Permit (ILP) and legal framework

The British introduced the Inner Line to demarcate their areas in Northeast India for the convenience of administrative, economic, and geo-political considerations. After the Burmese were driven back during the Anglo-Burmese War, North East India (as it exists today) was part of Assam when the British took over the region's administration in 1826. Apart from Assam, there were two separate kingdoms Manipur and Tripura. Two major reasons that led to the British acquiring the Assam region are

- Strategic reason: The British wanted to keep the area as the initial line of defence between their existing Indian colonies and possible rivals and competing European powers. Signs of this interest may be found in the British decision to step in and stop the Burmese push westward starting in 1824.
- Economic reason: It was discovered that this region is rich in mineral and forest resources. Its potential as a tea-growing area had already become evident.

The unrestricted movement that formerly existed between British subjects in Assam and the wild tribes living across the frontier frequently led to quarrels and sometimes to serious disturbances. Another important purpose of the Inner Line permit was to prevent tea planters from grabbing more land in the

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hills, which would have caused conflict between the government and the hill people. Planters were prohibited from purchasing land from the government, local chiefs, or tribes beyond the Inner Line. The Bengal Eastern Frontier Regulations (BEFR) were passed in 1873 with the sole purpose of safeguarding the lives of British subjects in Assam and Cachar as well as the interests of traders. The regulation formed an Inner Line that no British subject was allowed to cross without authorisation. Governor General in Council of British India in a resolution on January 17, 1872, declared that the Government would not be responsible for protecting life beyond that line and stipulated that British citizens' travels beyond that boundary would be subject to restriction. The tribes were allowed to handle their affairs with the border officers only interfering in their political capacity when necessary. Before entering these tribal areas, visitors must get the Inner Line Permit (ILP), as required by this regulation, as a temporary travel permit. The government of India has continued to enforce the system even after independence, despite its initial goal being to stop British subjects from encroaching on tribal territory. The restrictions now apply to Indian citizens instead of British Subjects, with the aim of safeguarding indigenous communities.

The important sections of the Regulation were Section 2, section 3, and Section 7 which are as under: -

"It shall be lawful for State Government to prescribe, and from time to time to alter, by notification in the [Official Gazette], a line to be called The Inner Line in each or any of the abovenamed districts. The [State Government] may, by notification in the [Official Gazette], prohibit all [citizens of India or any class of such citizens], or any persons residing in or passing through such districts from going beyond such line without a pass under the hand and seal of the chief executive officer of such district, or of such other officer as he may authorise to grant such pass; and the [State Government] may, from time to time, cancel or vary such prohibition."

"Any person so prohibited, who, after The Inner Line has been prescribed and notified in accordance with section 2 of this Regulation, goes beyond such line without a pass, shall be liable, on conviction before a Magistrate, [to imprisonment of either description which may extend to one year, or to a fine not exceeding one thousand rupees, or to both]."

"It shall not be lawful for any person, not being a native of the districts comprised in the preamble of this Regulation, to acquire any interest in land or the product of land beyond the said Inner Line without the sanction of the [State Government] or such office as the [State Government] shall appoint in this behalf. Any interest so acquired may be dealt with as the [State Government] or its said officer shall direct. The [State Government] may also, by notification in the [Official Gazette], extend the prohibition contained in this section to any class of persons. Natives of the said districts, may from time to time in like manner cancel or vary such extension."

The Constitutional validity of the Inner Line Permit system

The Constitution of India guarantees certain fundamental rights to all citizens, including the right to move freely throughout the territory of India under Article 19(1)(d) and the right to reside and settle in any part of the country under Article 19(1)(e). The right to movement and residence goes together in most cases. Both these rights are simultaneously affected. And more or less, the same principles are applied in the matter of restrictions on any of these two rights and hence these are being discussed together. By imposing restrictions on these rights, the Inner Line Permit system raises questions about its constitutionality. However, the Constitution also allows for reasonable restrictions on these rights under Article 19(5), which permits the state to impose restrictions in the interest of the general public or for the protection of the interests of any Scheduled Tribe. The Inner Line Permit system can be argued to fall within the scope of these permissible restrictions, as it is designed to protect indigenous communities and preserve their cultural heritage.

Three significant characteristics of clauses Article 19 (2) to Article 19(6) of the constitution of India

- The restriction can be executed only under the authority of law.
- Each restriction must be reasonable and
- A restriction must be related to the purposes mentioned under clauses Article 19(2) to 19 (6).

The Constitution nowhere defines the expression "reasonable restriction" no general and universal test of reasonableness can be laid down as has been observed in State of Madras v. G. Row. In Rupinder Singh Sodhi v. Union of India, Akalis from Punjab threatened to stage a protest in Delhi on the occasion of the inauguration of the Asian Games. The governments of Haryana and Uttar Pradesh used severe tactics to put an end to the rally, including blocking highways, making arrests and seizures, and stopping Akalis from crossing the border and going to Delhi. A writ petition was filed before the Supreme

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Court to contest these actions. The court ruled that to safeguard public property and prevent undue disruption to other people going about their lawful business, the police have the right to impose reasonable restrictions on the physical mobility of members of the public. Although the Inner Line Permit system certainly prohibits all Indian citizens from their right to travel or to reside. However, it does not name any specific class of citizen thus restriction under the Bengal Eastern Frontier Regulation (BEFR) 1873 is neither arbitrary nor needlessly discriminatory. It is merely a tool to safeguard the Indigenous communities of Arunachal Pradesh and other North-Eastern states from the influx of non-indigenous and also to protect their rich cultural heritage. Although Article 29 primarily pertains to the protection of the interests of minorities, it also emphasises that any group of citizens who live anywhere and have a unique language, script, or culture has the right to conserve the same.

Constitutional Protection of Tribal and Cultural Rights

The constitutional validity of the Inner Line Permit (ILP) system in Arunachal Pradesh cannot be examined only from the perspective of the fundamental rights to freedom of movement and residence guaranteed under Articles 19(1)(d) and 19(1)(e) of the Constitution. The Constitution also recognises the distinctive identity, culture and interests of tribal communities and provides a broader framework for their protection. The ILP system can be understood not only as a restriction on the movement of citizens, but as a protective measure made to safeguard the interests, identity and cultural heritage of the indigenous tribal communities of Arunachal Pradesh. Article 29(1) provides that any section of citizens having a distinct language, script or culture has the right to conserve the same. Although Article 29 relates to cultural and educational rights, its protection extends to the preservation of the distinctive cultural identity of communities. This provision is vital for Arunachal Pradesh, where different indigenous tribal communities have their own languages, customary practices, traditions, social institutions and cultural heritage. The protection of tribal interests is also reflected in Article 46, which directs the State to promote, with special care, the educational and economic interests of weaker sections of society, particularly the Scheduled Castes and Scheduled Tribes, and to protect them from social injustice and all forms of exploitation. Although Article 46 forms part of the Directive Principles of State Policy and is not independently enforceable, it provides important constitutional guidance for policies concerning the welfare and protection of Scheduled Tribes. The Constitution further recognises the special position of tribal communities and tribal areas through various provisions. Article 244 provides for the administration of Scheduled Areas and Tribal Areas under the Fifth and Sixth Schedules, while Article 275(1) provides for grants-in-aid for promoting the welfare of Scheduled Tribes and for the administration of Scheduled Areas. Article 338A establishes the National Commission for Scheduled Tribes to safeguard and protect the rights and interests of Scheduled Tribes. Within the broader constitutional framework, the ILP system may be understood as one of the measures intended to protect the indigenous tribal population and preserve its distinctive cultural identity. At the same time, constitutional protection of tribal and cultural rights does not mean that every restriction imposed upon non-indigenous citizens is automatically constitutionally valid. Any restriction upon the fundamental rights guaranteed under Article 19 must have the authority of law, pursue a constitutionally permissible objective and satisfy the requirement of reasonableness under Article 19(5). The implementation of the ILP system must therefore remain fair, transparent and non-arbitrary, while remaining proportionate to the legitimate objective of protecting the interests of Scheduled Tribes and preserving the cultural integrity of Arunachal Pradesh.

Judicial interpretations

The Inner Line Permit (ILP) system has been subject to judicial scrutiny, particularly concerning its constitutionality and conformity to contemporary legal principles. In addressing the legal challenges to the ILP system over the years, several courts including the Supreme Court of India have created a balance between the rights of citizens and the necessity of defending the indigenous communities in Arunachal Pradesh and other north-Eastern states.

State of Arunachal Pradesh v. Khudiram Chakma citing illegal encroachment and anti-social activities, the government of Arunachal Pradesh issued a notice directing the Chakmas to relocate to an area where other Chakmas families were already residing. The issue was whether the notice issued by the government of Arunachal Pradesh to relocate the Chakmas was illegal and arbitrary. The Gauhati High Court cited section 7 of the Bengal Eastern Frontier Regulation 1873, which explicitly prohibits non-natives of the district from acquiring any interest in land without state government approval.

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Additionally, clause 9(2)(a) of the Foreigner Order 1948 also forbids the acquisition of any land or interest thereon. Supreme Court dismissed the appeal filed by Khudiram Chakma.

Arunachal Pradesh Students Union (AAPSU) v. Election Commission of India additional guidelines for the revision of electoral rolls issued by the Election Commission of India in 2005 and 2007 about areas where Chakmas and Hajongs are substantially present. These areas are the 14-Doimukh (ST), 46-Chowkham (ST), 49-Bordumsa-Diyum, and 50-Miao (ST) Assembly Constituencies in the State of Arunachal Pradesh. The petitioners contend that these guidelines are discriminatory and violate both the Constitution and statutory laws. According to section 2 and 7 of the Bengal Eastern Frontier Regulation, 1873, only local native of Arunachal Pradesh is permitted to pass through the tracts without a "pass." The petitioners thus, argued that in the absence of possession of a valid Inner Line Permit by the Chakmas, who are settled in Arunachal Pradesh, they could not be said to be ordinary residents of the aforesaid four Assembly Constituencies and hence, not entitled to be included in the electoral rolls in any part of Arunachal Pradesh. It was decided by the Court that the guidelines did not supersede any existing laws, but rather served to safeguard the rights of Chakma refugees as bona fide citizens. The court observed "We are of the view that no case has been made out for any interference by this court as these guidelines had been issued in conformity with the policy decision of the Government of India to settle the Chakmas in various parts of India including Arunachal Pradesh and to grant citizenship to them, and had been issued to protect the interest of these Chakma refugees including their right of franchise as a bona fide citizen of this country. Consequently, the present Public Interest Litigant petition is dismissed as devoid of merit, however, without any cost."

In Committee for Citizenship Rights of Chakmas of Arunachal Pradesh v. State of Arunachal Pradesh A writ was filed under Article 32 of the Constitution, seeking the Supreme Court for directions regarding the citizenship of the Chakma and Hajong refugees. The petitioners argued that although the rights were recognised in the National Human Rights Commission v. Arunachal Pradesh case, no significant steps were taken to grant citizenship. The court held that residents of Arunachal Pradesh would not require the Inner Line Permit. Since the Government of India has granted them citizenship, it stands recognised through the judiciary that they need not required to obtain an Inner line permit as they are already settled in the state of Arunachal Pradesh. "Once, these Chakma refugees have been granted citizenship, they are entitled to enjoy all the rights and privileges that flow on becoming a citizen of this country and further, they are entitled to have their rights as citizens of this country protected and safeguarded.

Conclusion

The applicability of the Inner Line Permit system in contemporary India is frequently discussed. Supporters contend that the system is necessary to preserve the North-Eastern states' demographic and cultural integrity, especially in light of rising immigration and also argue that without the Inner Line Permit system, the Indigenous populations would be at risk and vulnerable to displacement and cultural erosion. Critics on the other hand argue that the ILP system is outdated and incompatible with the standards of a contemporary democracy. they contend that the ILP system creates barriers to national integration and economic growth.

The ILP system guarantees the protection of indigenous identity and land rights, halts the influx, and maintains the balance between the development and preservation of rich cultural heritage. In multiple rulings, the Supreme Court has upheld the constitutional validity of the ILP, acknowledging it as a reasonable restriction on the freedom of movement as guaranteed by Article 19(5). Rapid development and migration threaten indigenous rich cultural heritage, lands and resources, the ILP system is crucial for Arunachal Pradesh. Without these safeguards, the indigenous people are vulnerable to losing their land, cultural legacy, and identity. As such, the Inner Line Permit must be maintained and reinforced to ensure that Arunachal Pradesh continues to thrive as a distinct, protected region.

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INTEGRATING VERNACULAR WISDOM INTO CLIMATE RESPONSIVE BUILDINGS: EVIDENCE FROM TRADITIONAL STRUCTURES IN ASSAM

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1.0 Abstract

Vernacular architecture in assam is a rich source of knowledge of climate responsive design strategies which can handle the environmental conditions. This paper examines the traditional architecture of Assamese houses such as Mishing stilt houses, Sonowal Kachari houses and Ikra houses to see how they can solve the issues related to the climatic conditions of that area including, flooding, heavy rainfall, earthquakes. This study looks at the elevated plinth, sloping roof, ventilation and locally available materials which support thermal comfort and environmental sustainability and also explores the cultural significance of these traditional styles and how they are used with contemporary architectural practices in present days. This study reveals how vernacular architecture provides efficient and sustainable solutions for climate adaptation and helps to preserve cultural identity. This research finds that integrating vernacular design methods with modern technologies can make buildings stronger, eco-friendly and suitable for Assam's climate.

Keywords : Climate-responsive design, traditional buildings, local materials, climate, culture.

2.0 Introduction

For centuries, the riverine landscape of Assam has compelled its inhabitants to negotiate with earth, water and sky in a delicate, non-static balance. The Brahmaputra Valley experiences heavy monsoon floods, high humidity, and earthquakes have not only shaped livelihoods but have also quietly shaped a vernacular architecture that is Inherently adapted to climate and hazard. Light and flexible bamboo frames, raised bases on plinths and stilts, breathable wall assemblies, and much overhanging roofs did not become lightweight bamboo frame, raising the plinth on stilts, porous wall assemblies, and deep shadowing of the roofs were not some of the architectural style choices but rather they reflected the people's way of life like in response to the flooded soils, the summer heat and humidity.

As Assam is repeatedly identified as one of India's most climate susceptible states, with large parts of its territory exposed to floods and other climate induced extremes, The loss of this kind of knowledge about specific situations is a big threat to the strength of homes and everyday comfort. Climate, socio-cultural setup, economy, building materials and technology availabilities are the main factors that greatly influence the building architecture and its sustainability. Buildings based on local climate provide uniqueness, sense of belonging, social and cultural identity.

In this context, traditional houses, from Assam-style homes on raised plinths to stilted chang ghar and bamboo and ikra buildings, are a living record of climate-responsive strategies that have not been fully documented or measured. Vernacular architecture is often forgotten in modern times could be the best example of harmony among the human behaviour, building and the physical environment.

3.0 Aim

To study the climate-responsive strategies of vernacular architecture in Assam and analyse their role in promoting thermal comfort, cultural continuity, and resilience to local climatic conditions.

4.0 Objective

i) To evaluate the performance of vernacular strategies to tackle environmental challenges like floods and heavy rainfall.

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ii) To analyse how traditional design elements (such as stilt houses, sloping roofs, and natural materials) support thermal comfort and ventilation.
iii) To analyse the role of vernacular architecture in preserving cultural identity and continuity within local communities.
iv) To explore the significance and applicability of vernacular architectural principles in modern design practices.

5.0 Research Gap

a) The way buildings are made in Assam is often not good for the climate. They use methods that are not right for the local environment in Assam.
b) When people design buildings in Assam, they often forget about problems like it getting too hot not having enough air and being in danger of flooding in Assam.
c) The importance of architecture in keeping our culture going is often not thought about when people design new buildings in Assam.

6.0 Research Question

How can we look at the things about traditional architecture in Assam that help with the climate and use them in modern building design in Assam to make people comfortable to help with the weather and to keep our cultural identity, in Assam?

7.0 Methodology

For Objective I:
- Find case studies of traditional houses in flood-prone areas of Assam.
- Carry out site observations to understand features like stilt construction, roof designing and drainage system

For Objective II:
- Study the design of homes including the way they face the windows, the materials used and the shape of the roof and how these things help keep the air inside cool and comfortable.
- Analyse already available literature and weather information related to Assam.

For Objective III:
- Study spatial layout and cultural practices reflected in house design.

For Objective IV:
- Analyse the new style buildings in Assam and compare them with vernacular examples.

8.0 Literature Review

In past year vernacular architecture is about building homes based on the weather the materials available and the local culture not using formal design rules. In India the way people build homes is very different in parts of the country because the weather and culture are so varied. The North-East part of India, which includes Assam has a special kind of traditional architecture that is not well documented. This area has a lot of rain, earthquakes and forests and many different tribes, which has resulted in homes that are lightweight, flexible and elevated with a lot of meaning behind their design.

8.1.Architectural Characteristics of Assam Vernacular Dwellings

i. Form and Spatial Organization

The shape of the home and how the space is organized Most homes are rectangular or have sides and are built on platforms or stilts. This helps keep the floor dry and allows air to circulate.



Figure 1: Stilt house



Figure 2: Stilt house

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The front porch is a space that connects the community with the family and helps people interact with each other. In some cases the porch also helps keep the sun and rain out, making the inside of the home more comfortable. (Das Bijay Kumar, 2026)

ii. Roof Typology and Climatic Response

Steeply pitched thatched roofs dominate the architectural vocabulary. The high slope ensures rapid rainwater runoff during monsoon seasons and reduces leakage. Extended eaves protect bamboo walls from direct rain exposure while creating shaded outdoor spaces (Figures 3).

Thatch acts as an excellent insulator, maintaining cooler interiors during humid summers and retaining warmth during cooler nights.



Figure 3: Stilt house

iii. Ceiling:

A separate layer within the houses as a ceiling is not observed. Beneath the roof, a bamboo mat is placed that acts as the ceiling. Bamboo is used due to its easy availability and easy construction.

iv. Openings and ventilation

Predominantly the openings are oriented in the prevailing wind direction which allow for the release of warm air in the houses. The majority of these openings were seen on the South-West and North-West façades. The doors and windows were placed in opposite directions, and some would open to the verandah. (Chettry, 2022)

iii. Materials and Construction Techniques

Bamboo is the principal construction material due to its abundance, tensile strength, flexibility, and renewability. People use bamboo to make the columns and beams and the roof. The doors and posts are made of wood and other things. The roof is covered with grass that grows in that place.



Figure 4: Woven bamboo wall

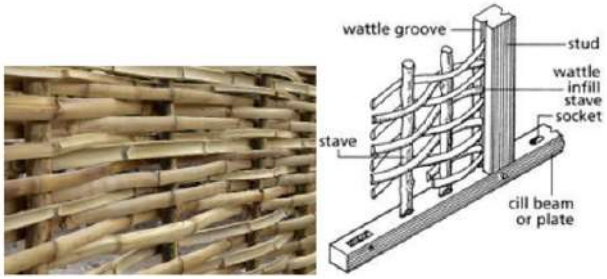


Figure 5: Wattle bamboo

The Joinery techniques avoid metal fasteners, instead using rope, cane, or wooden pegs, enhancing seismic resilience through flexibility. Bamboo mats, wattle and daub, or woven bamboo strips (bahareque in Latin America or tabique in Asia) fill the gaps between the frame.

8.2. Traditional connections

i. Friction tight rope connection:

The 'friction tight rope' connection is widely used in traditional construction. These connections use natural materials like rattan, coconut fiber to join the bamboo culms together. Lashings, wraps, fraps, and clove-hitch are some knots used in these connections. For tighter connections, using green bamboo strips. These strips are watered before use and shrink while drying, resulting in a stronger connection.

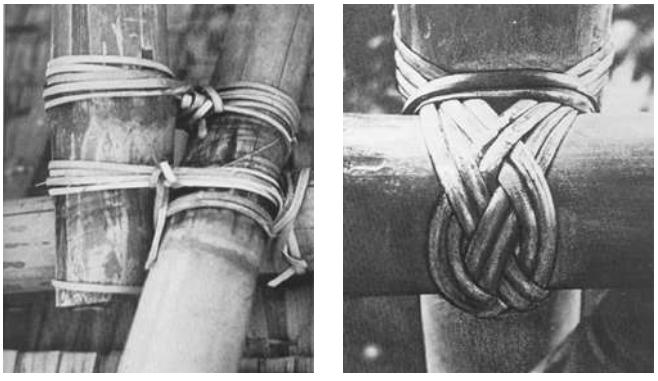


Figure 6: Friction tight rope connection

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ii) Plug-in bolt connection:
A wedge-shaped wooden piece is driven at the joint of two bamboo members. However, this connection requires additional reinforcement through the use of lashing or bolts.

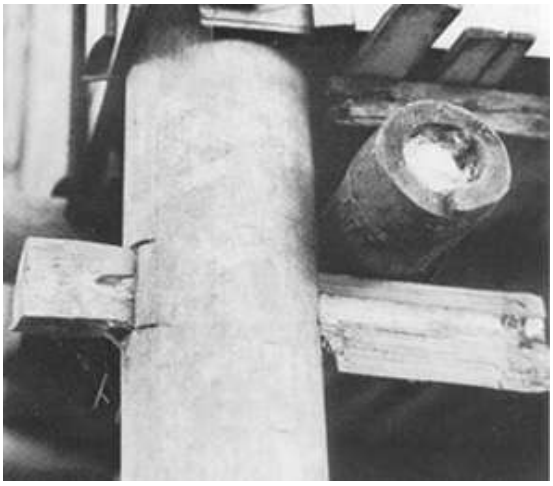


Figure 7: Plug-in bolt connection

iii) Positive Fitting :
These connections involve carving a hole in a bamboo culm and inserting a bamboo of a slightly smaller diameter. The joint is further strengthened using bolts or dowels. The disadvantage of this jointing technique is the reduction of the strength of the bamboo because of the cutting of the hole. (Syidanova, 2018)



Figure 8: Positive Fitting

8.3. Cultural Symbolism and Aesthetic Expression:
A defining feature of Assamese vernacular architecture is its expressive façade art (Figure 9,Figure 10,Figure 11). Painted designs, carved reliefs and wooden decorations show animals, people, symbols of farming and patterns. Roof decorations often made of crossed pieces, means of protection, having children or being a strong fighter. Decorations on big buildings, these symbolic things are a key part of the buildings' meaning and special events. (Bijay Kumar Das, 2026)



Figure 9: painted bamboo wall (Karbi tribe)



Figure 10: large post, thick roof (Tiwa tribe)



Figure 11: wooden carving, cross element (Dimasa tribe)

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8.4. Combination of vernacular strategies to contemporary structures:

Traditional Assam buildings are very well designed for local climate response with features like light materials and construction techniques, open spaces, raised bases and sloping roofs. These provide visual and physical comfort by effectively maintaining the internal temperature.

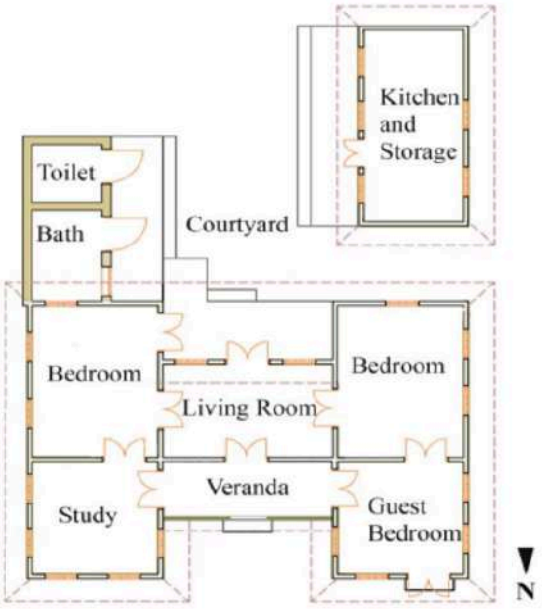




Figure 12: Traditional house plan

Many contemporary houses retain only the visual aspects of traditional forms while omitting critical functional elements like natural ventilation systems, courtyards, and breathable materials. There is a need for closing the gap between vernacular knowledge and current practices by incorporating the ideas from vernacular knowledge in modern buildings. These principles remain highly relevant as they provide sustainable, context-specific responses to climatic challenges such as high humidity, heavy rainfall, and flooding. (Farha Shermin, 2025))

Decorations on big buildings, these symbolic things are a key part of the buildings' meaning and special events. (Bijay Kumar Das, 2026)

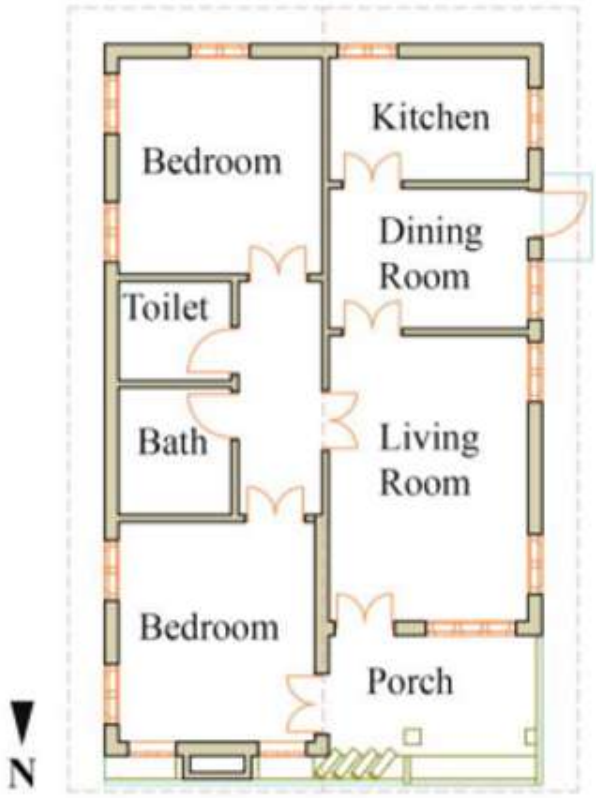


Figure 13: Contemporary house plan



Figure 14:Contemporary house

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Figure 15: Integration of modern design in vernacular architecture

9.0 Case Study

9.1 Bamboo house of the mishing community: Location: Karatipar, Majuli, Assam

The village named Karatipar is located on the river island Majuli in the Brahmaputra River, Assam. The Mishing community dominates the village of Karatipar. They believe in eating their own grown food and even building their own houses. The primary material used in construction is bamboo. The different main structural and roofing components are: the stilts, the posts, bamboo flooring, bamboo wall, bamboo truss, bamboo purlins, and the thatch (locally called Kher).

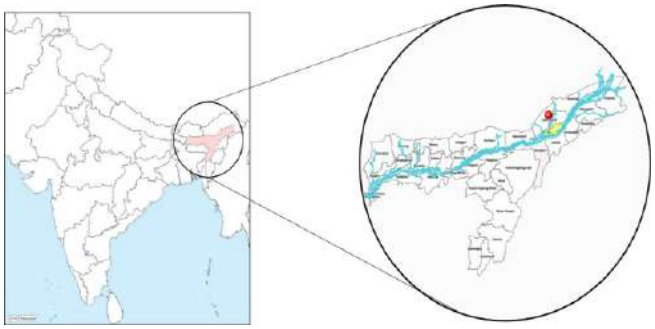


Figure 16: Context of the site (Padiya, 2023)

Posts:
Traditionally bamboo was used as stilts, which used to go till the floor and as posts, which used to go till the roof as a single member of bamboo. When it's kept in direct contact with the ground it starts absorbing moisture and once its moist, the termites and the insects are attracted to the bamboo as they find the bamboo juice sweet. To overcome this hustle they have start using RCC precast columns as a post and the stilt and with that they have also replaced the use of bamboo as a plinth beam with RCC precast plinth beams (Figure 17)

Flooring:
Porous bamboo flooring is made, keeping in mind the ventilation . The bamboo flooring is made in 4 different layers and the bamboo used for the flooring belongs to the specie of Jothya Mukal bamboo (native name of the specie). Diameter of this bamboo ranges from sixty to 75 millimeters (60 -75 mm) and have a wall thickness of approx. eight-millimeter (8 mm). (Figure 18)



Figure 17: RCC post (Padiya, 2023)



Figure 18: bamboo flooring (Padiya, 2023)

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Walls:
The bamboo wall is made from the same species of bamboo from which the flooring is made Jothya Mukal. Such wall is made by making half cuts on the bamboo till it gets flattened and once it flattened the wall thickness of the bamboo is reduced to five to six millimeter (5-6 mm). Once this process is completed its time to weave the bamboo mat walls, now there are different styles and ways in which the weaving could be done. Firstly, is the orthogonal weaving which is seen on most of the walls of the house and second is the angular weaving (Figure 20).

Truss and roof:
Bamboo trusses are made from the species of bamboo called Bholuka bamboo Diameter of this specie ranges from hundred to hundred and 25 millimeters (100-125 mm). For the purlins Jothya Mokal is used and Thatch (locally known as Kher) is tied to the purlins (Figure 19, Figure 21). They use Thatch as we use Mangalore tiles so avoid water percolating inside the house. (Padiya, 2023)



Figure 20: orthogonal and angular weaving (Padiya, 2023)



Figure 19: thatch roof (Padiya, 2023)



Figure 21: thatch with purlins (Padiya, 2023)

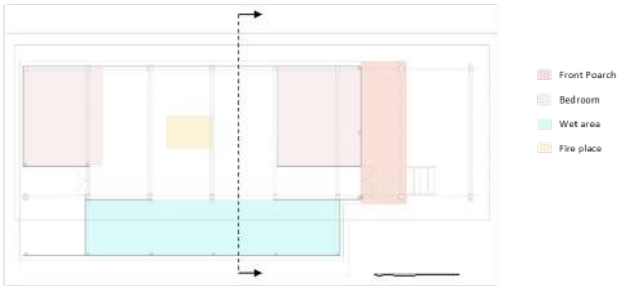


Figure 22: plan of mishing house (Padiya, 2023)

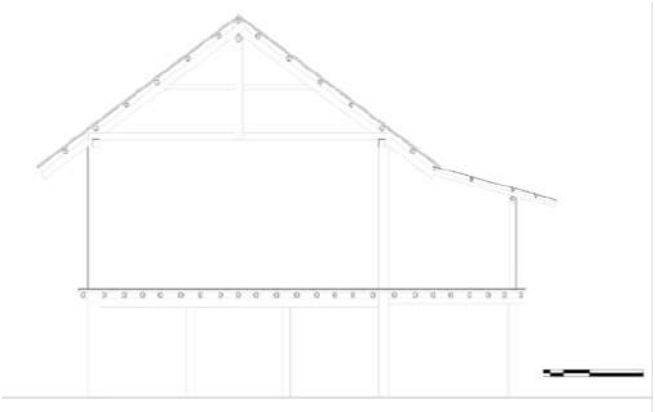


Figure 23: Section of house of the Mishing community (Padiya, 2023)

Conclusion:
Comparing both the materials under the same loading conditions and forces it can be said that the people of Majuli using RCC post instead of the bamboo post which is their traditional knowledge, is acceptable as in both the conditions so that it can withstand the environmental forces.
·Using of traditional design elements support thermal comfort and ventilation and also it reflects the identity of Mishing community since stilt structure is one of the features of their traditions.

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9.2 Sonowal Kachari house:

- Constituting 18% of the total population of Majuli, The Sonowal Kacharis are another major tribal community of Majuli. Unlike Misings and Deuris, Sonowal Kachari people build their traditional houses in the ground with raised plinth by using wood, bamboo, cane, reed, thatch etc. Typical Sonowal Kachari house has following characteristics:
- The typical house of Sonowal Kacharis is two sloped single ridge house for joint family system.
- Main Entry to the house is from South side.
- The interior is divided into partitions for sleeping and has a wide verandah where from the entry is made to the rooms.
- In Sonowal Kachari tradition, kitchen has three divisions based on the use of the spaces. 'Thapana' is a place where prayer is done which is made of clay raised from the floor.
- They construct the walls of the houses with bamboo mesh and plastered with cow dung and mud plasters.
- They have a chotal (courtyard) in front of their houses. (Amal Barman, 2020)

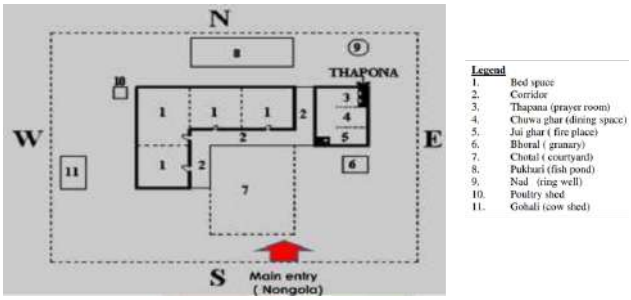


Figure 24: plan of Sonowal Kachari house (Amal Barman, 2020)

Salient Features of the structure:

- **Foundation:** Bamboo columns are inserted underground up to a depth of 1000mm.
- **Column:** Bamboo column for supporting roof.
- **Flooring:** Earth flooring over raised plinth.
- **Wall:** Bamboo mesh wall with cow dung & mud plastering.
- **Roof:** Thatch roofing over bamboo truss. (Amal Barman, 2020)
- Thatch roofing and mud walls support in maintaining indoor thermal comfort.
- The raised plinth protects the house from rainwater, dampness and minor flooding.
- Open verandah and courtyard improve natural ventilation and airflow. Also the courtyard acts as a social and cultural gathering space.
- "Thapona" (prayer room) reflects the spiritual beliefs and traditions of the Sonowal Kachari community.



10. Findings

10.1Bamboo house of the Mishing community:

- House design on stilts is a flood and damp ground protection feature in Majuli.
- Multi-layer bamboo flooring not only ventilates but also helps to regulate temperature in the bamboo house of the Mishing community
- Use of locally available natural materials (bamboo and thatch) supports the affordable and environmentally sustainable construction.
- The use of RCC posts in traditional bamboo construction helps to improve durability and structural stability.

10.2 Sonowal Kachari house:

- The raised earthen plinth protects the house from rainwater, dampness and minor flooding.
- The thatch roof and bamboo mesh walls with mud and cow dung plaster provide thermal insulation and comfortable indoor conditions.
- "Thapona" (prayer room) reflects the spiritual beliefs and traditions of the Sonowal Kachari community.

11. Conclusion

Vernacular architecture in Assam creates a strong relationship between climate, culture and construction where it offers solutions for environmental challenges.

Some traditional features such as stilt structure, sloping roof, verandah and courtyard improve flood resilience, ventilation and thermal comfort.

The use of local materials such as bamboo, wood, thatch, mud help in enhancing sustainability, affordability and reducing environmental impact.

Vernacular architecture also preserves the culture and tradition of indigenous tribes through their spatial organization and architectural form.

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This study shows that use of vernacular design principles in modern architecture develop building design strategies where it reflects the cultural identity and also can withstand environmental problems.

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PARTICIPATION IN PHYSICAL ACTIVITY AMONG OLDER WOMEN IN MANIPUR: SOCIAL, CULTURAL AND ENVIRONMENTAL PERSPECTIVES

Bidhyapati Nongthombam , PhD

Abstract

Population ageing has increased the importance of promoting healthy and active ageing, particularly among older women who may experience multiple social, cultural,health-related, and environmental barriers to physicalactivity. Regular physical activity contributes to physical functioning, independence, psychological well-being, and the prevention and management of several chronicconditions. However, participation in later life is influenced by more than individual motivation. This narrative review examines physical-activity participation among older women in Manipur through social,cultural, and environmental perspectives. Published research,systematic reviews, national Indian ageing data, regional evidence, and international guidelines were examined to identify evidence relevant to physical activity and active ageing. Evidence from the Longitudinal Ageing Study in India indicates substantial physical inactivity among middle-aged and older adults, with inactivity increasing with age. International and South Asian systematic reviews identify health limitations, fear of falling, lack of motivation, family responsibilities, limited social support,cultural expectations, and environmental barriersas important influences on participation. Evidence from Manipur and Northeast India remains limited but indicates that women's participation in physical activity is influenced by social and cultural circumstances and that functional ability is an important consideration in later life. A recent systematic review of older South Asians further highlights the interaction between individual, family, social, cultural, and environmental factors. The review argues that physical activityamong older women in Manipur should be understood broadly and include walking, recreational activity, yoga, strengthening, balance exercises, and other culturally acceptable forms of movement rather than focusing exclusively on competitive sport.
Community-based, affordable, socially supportive, women-friendly, and age-sensitive programmes may provide a practical pathway towards active ageing. More community-based research involving older women across urban, rural, valley, and hill areas of Manipur is required to develop locally appropriate interventions.

Keywords : Older women; Physical activity; Active ageing; Manipur; Social determinants

Introduction

Population ageing has become an increasingly important public-health issue in India. Increasing longevity creates opportunities for individuals and communities, but it also requires greater attention to maintaining functional ability, independence, psychological well-being, and social participation during later life. The World Health Organization (WHO, 2020) conceptualises physical activity as an important component of health across the life course and provides specific recommendations for older adults,including people living with chronicconditions or disability. The guidelines emphasise that physical activity should be adapted to individual abilities and health circumstances.

For older adults, physicalactivity should not be understood exclusively as organised or competitive sport.Walking, recreational movement, household activities, yoga, strengthening exercises, balance activities, and active transportation can all contribute to an active lifestyle. The WHO recommends that older adults undertake regular aerobic and muscle-strengthening activities and include activities that emphasise balancewhen mobility is reduced (WHO, 2020). Thus, the concept of physical activity provides a broader and more inclusive framework than participation in formal sports alone.

The health relevance of physical activityin later life is supported by substantial reviewevidence. Cunningham et al. (2020), in a systematic review of reviewsand meta-analyses, found that physicalinactivity among older adults was associated

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with a range of adverse outcomes, including mortality, functional limitation, disability, falls, cognitive decline, dementia, and depression.Physical activity was also associated with better quality of life and healthier ageing. Di Lorito et al. (2021), reviewing meta-analyses of exercise interventions among older adults, reported evidence that appropriately designed exercise programmes can improve outcomes such as muscle strength and balance and can contribute to falls prevention.

The Indian context is particularly important because physical-activity behaviour is influenced by health, socioeconomic circumstances, social participation, family responsibilities, and access to facilities. Pengpid and Peltzer (2022),using data from the first wave of the Longitudinal Ageing Study in India (LASI),reported substantial physical inactivity among middle-aged and older adultsand found that inactivity increased with age. Theirfindings also indicated relationships between physical inactivity and several health and social characteristics. Such evidence suggests that physical activity among older adults cannot be explained solely by individual motivation.

The issue is especially relevant to older women. Women's opportunities for physical activity may be shaped by life-course experiences, domesticand caregiving responsibilities, social expectations, economiccircumstances, health status, and access to safe recreational spaces. Women who have spent much of their lives undertaking unpaid domestic work may continue these responsibilities into later life, potentially leaving limited time for recreational exercise. Manipur provides an important setting for examining these issues. The state has a strong sporting tradition and a notable history of women's participation in competitive sport. Nevertheless, the existence of a strong sporting culture does not necessarily indicate that older women have sufficient opportunities for recreational physical activity or active ageing. Researchspecifically examining physical-activity participation among community-dwelling older women in Manipur remains limited. This review therefore considers the social, cultural, and environmental circumstances that may shape participation.

Review Methodology

This article adopts a narrative review approach. Literature concerning physical activity, healthy ageing, older women, barriers and facilitators to physical activity, social and cultural determinants, environmental accessibility, South Asian populations, Indian older adults, and women's participation in sport was considered. Prioritywas given to systematic reviews, meta-analyses, national population-level studies, peer-reviewed research concerning India and South Asia, and authoritative international guidelines.

The evidencewas organised thematically around four interconnected areas: health and functional outcomes, social influences, cultural and gender-related influences, and environmental accessibility. Particular attention was given to evidence concerning adults aged 65 years and above, women, South Asian populations, and community-based physical-activity participation. Evidence concerning Manipur and Northeast India was considered separately because national Indian findings cannot automatically be assumed to represent the distinctive geographical, cultural, and social circumstances of the region.
This article is a narrative review rather than a systematic review or meta-analysis. Its purpose is to synthesise relevant evidence, identifyimportant themes, and highlight researchgaps concerning physical-activity participation among older women in Manipur.

Physical Activity and Healthy Ageing

Physical activity contributes to several dimensions of healthy ageing. Cunningham et al. (2020) synthesised evidence from systematic reviews and meta-analyses and identified associations between physical inactivity and a broad range of adverse outcomes among older adults. These included mortality, functional limitation, disability, falls, cognitive decline, dementia, and depression. Such evidence supports the view that physical activity is an important component of healthy ageing rather than simply a recreational behaviour.

Exercise interventions can also be adapted to different levels of functional capacity. Di Lorito et al. (2021) found evidence that resistance training can improve muscle strength and that multimodal exercise can contribute to better balance and falls-related outcomes. Nicolson et al. (2022), focusing on adults aged 80 yearsand older, also reported beneficial effects of therapeutic exercise on physical and psychosocial outcomes. These findings are relevant to older women becausephysical-activity programmes can be adaptedto differences in mobility, strength, chronic conditions, and previous exercise experience.

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Physical activitymay also be associated with cognitive and broader healthy-ageing outcomes. Kumar et al. (2022), using Indian LASI data,examined the relationship between physical activityand cognitive functioning among older Indian adults. Mandi et al. (2023) examined lifestyle behaviours and healthy ageing using LASI data and highlighted the importance of lifestyle-related factors within a multidimensional understanding of healthy ageing.
These findingssuggest that physicalactivity may contribute to several dimensions of later-life well-being, although associations observed in observational studies should not automatically be interpreted as evidence of causation.

Physical Inactivity among Older Adults in India

National evidenceprovides an important foundation for understanding physical activity in later life in India.Pengpid and Peltzer (2022) found that a considerable proportion of middle-aged and older Indian adults were physically inactive and that inactivity increased with age. The study also identified relationships between physical inactivity and health and social characteristics. These findings have particular relevance for women because gender can influenceopportunities for leisure-time physical activity. Differences in employment histories, domestic responsibilities, social expectations, access to recreational facilities, and family rolesmay contribute to different activitypatterns among olderwomen and men.

However, national estimates cannot fully explain the experiences of older women in Manipur. India is geographically, socially, and culturally diverse, and opportunities for physical activity can vary substantially between states and between urban and rural populations. Manipur itself includes urban, rural, valley, and hill communities with potentially different levels of access to safe walking environments, transportation, healthcare, andrecreational facilities. Consequently, national evidence should be used as a background rather than as a direct representation of older women in Manipur.

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Social Perspectives on Participation

Social support is consistently identified as an important influence on physical-activity participation among older adults. Spiteri et al. (2019),in a systematic review of barriers and motivators among middle-aged and older adults, identified interpersonal relationships, social support, motivation, health beliefs, and environmental circumstances as important influences on participation.

More recent evidence strengthens this socioecological perspective. Chen et al. (2025) systematically reviewed barriers and facilitators among community-dwelling older adults and organised the evidence into intrapersonal, interpersonal, and environmental factors. The review found that fear of injury, pain, low motivation, lack of time, insufficient social support, family obligations, poor environmental conditions, and the cost of accessing facilities could restrictparticipation. Social support,group participation, enjoyment, age-friendly environments, and access to programmes could facilitate activity.

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These findings have potential relevance to older women in Manipur, although they should not be treated as direct evidence from the Manipuri population. Family responsibilities may be particularly important because olderwomen may continue to perform household and caregiving roles. A woman may therefore have the motivation to exercise but have limited time or family support to participate in structured activities.

Family relationships can also facilitate participation. Encouragement, companionship, assistance with transportation, and recognition of the importance of personal healthmay enable olderwomen to participate more regularly. Community groupsmay provide anothersource of socialsupport. Walking groups,supervised exercise sessions, yoga groups, and recreational activities can combine physical movement with social interaction.

Moore et al. (2016),in a systematic review of community-based physical-activity interventions for older adults living in rural and regional areas, found evidence supporting some community-based approaches for improving physical activity and physical functioning. Although the evidence was not specific to Manipur, community-based delivery may be particularly relevant in settings where specialised exercise facilities are limited or geographically distant.

Cultural and Gender Perspectives

Cultural expectations can influence perceptions of ageing, exercise, recreation, and women's roles. Older adults may sometimes be expected to prioritise family and household responsibilities rather than leisure-time physical activity. Such expectations can unintentionally reduceopportunities for olderwomen to prioritise their own health.

The South Asian context is particularly relevant. Horne and Tierney (2012), in a systematic review of qualitative studies involving South Asian older adults, identified cultural beliefs, social relationships, family support, perceptions of exercise, and environmental circumstances as influences on participation. Their findings suggest that interventions designedwithout cultural sensitivity may fail to address the reasons why older SouthAsian adults participate or do not participate.

This evidence has been strengthened by Ezeokoli et al. (2026), whose qualitative systematic review specifically examined barriers and facilitators to physical-activity uptakeand adherence amongolder South Asians.The review identified interconnected individual, family, social, cultural, and environmental influences on participation. Social support, family responsibilities, cultural expectations, motivation, appropriate environments, and professionally supported group activities were among the themes relevant to participation. The South Asian focus of this reviewmakes it particularly valuablefor the presentdiscussion, although its findings shouldstill be interpreted as regional evidence rather than direct evidence from Manipur.

Research concerning women and sport in Manipur also indicates that women's participation can be affected by social and cultural circumstances. Farooque et al. (2017) examined participation in games and sports among Manipuri Meitei-Pangal women and identified parental, community, traditional, personal, and sport-related factors as influences. However, because the study concerned younger women ratherthan older adults,its findings should not be directly generalised to older women. Its value for the present review is primarily contextual: it demonstrates that women's participation in physical activity in Manipur can be influenced by social and cultural factors.

Cultural factors should not be considered only as barriers. Activities that are familiar, enjoyable, socially accepted, andcompatible with community life may facilitate sustained participation. Walking,yoga, recreational exercise, and group activities may therefore provide culturally adaptable options for older women.

Environmental Perspectives

The physicalenvironment can influencewhether older adults who wish to be active are able to participate. Chen et al. (2025) identified environmental conditions, cost, access to facilities, and age-friendly built environments among the factors associated with physical-activity participation. Cortés Gómez et al. (2023) similarly highlighted environmental and other barriers in their systematic review of physical-activity participation among older adults.

Environmental barriers may be particularly important for older people with mobility limitations. Poor walking surfaces, unsafe roads,inadequate lighting, lack of seating,limited transportation, distancefrom

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facilities, and the absence of accessible toilets can discourage participation. These factors may be especially relevant to older women who may be less willing or able to travel independently to distant exercise facilities.

Manipur's geographical diversity makes environmental accessibility an important issue for future research. Older women living in Imphal may have different opportunities from womenliving in ruralor hill communities. Differences in roads, public transportation, community spaces, healthcare access, and recreational infrastructure may influence participation.

The type of facilityis also important. A sports facility designedprimarily for competitive athletes may not meet the needs of older women with reduced mobility. Age-sensitive environments should provide safe and accessible spaces for low- and moderate-intensity activities and should accommodate differences in physical capacity.
Community-based programmes may help overcomesome of thesebarriers. Activities delivered in neighbourhood spaces, community halls, women's groups, health centres, or other familiar locations may reduce travel and accessibility problems. Such approaches would require local assessment rather than assuming that the same programme is suitable for every community.

Functional Ability and Older Women in Northeast India

Functional ability is central to healthy ageing because it influences independence and the ability to perform everyday activities. Reducedmuscle strength, balanceproblems, chronic illness,pain, mobility limitations, and fear of falling may all affect physical-activity participation.

Regional evidence concerning older women remainslimited. Powdel (2025)examined 78 olderwomen residing in two old-age homes in Northeast India, including 32 women from the Ima Leimarel Women Welfare Association in Imphal and 46 from an old-age home in Agartala, Tripura. The study used performance-based assessments to examine physical functioning, cognitive status, and mental well-being. Because the participants were residents of institutional settings and the study used a cross-sectional design, its findings cannot be generalised directly to community-dwelling older women in Manipur. Nevertheless, the study provides locally relevant evidence that functional ability shouldbe considered when examining the health and activity needsof older womenin Northeast India.

The wider literature also demonstrates the importance of functional limitations. Kilgour et al. (2024), in a systematic review concerning adults aged over 70 years, identified health concerns and fear of falling among important barriers to physical activity. Di Lorito et al. (2021) found evidence that appropriately designed exercise interventions can improve strength and balance and contribute to falls-related outcomes. Therefore, physical-activity programmes for older womenshould consider functional ability rather than assuming that all older adults can participate in the same activities.

Physical Activity Beyond Competitive Sport

A majorconceptual issue in the contextof Manipur is the distinction between physical activityand competitive sport. If participation is assessed only through organised sports competitions, much of the physical activity undertaken by older women will remain unrecognised.

An olderwoman who walksregularly, practises yoga,performs strengthening or balance exercises, participates in recreational activities, or remains physically active through daily tasks may have an active lifestyle without participating in competitive sport. The WHO guidelines recognise physical activity across different domains of life and emphasise that older adults should be active according to their abilities and health circumstances (WHO, 2020).

This broader understanding is particularly important for Manipur becausethe state's strongsporting identity could potentially be extended into an active-ageing agenda. Sports organisations, local government, healthcare providers, women's organisations, and community groups could collaborate to create recreational and
health-oriented opportunities for older women.

The objective should not be to encourage older women to become competitive athletes. Rather, programmes should provide safe, enjoyable, socially meaningful opportunities for regular movement. This would allow the state's sporting culture to support healthyageing while recognising that older women'sphysical-activity needs differ substantially from those of competitive athletes.

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Research Gap

Despite increasing research on ageing and physical activity in India, evidence specifically concerning community-dwelling older womenin Manipur remainslimited. National studiessuch as LASI provide important information aboutphysical inactivity and its correlates, but they cannotfully explain the experiences of women living in Manipur's diverse communities.

Research on women and sport in Manipur provides useful information about social and cultural influences, but much of the available evidence concerns younger women. The Powdel (2025) study provides regionally relevant evidence concerning olderwomen but focuseson institutional settingsrather than the wider community. The 2026 systematic review by Ezeokoli et al. provides valuable South Asian evidence but does not provide state-specific evidence concerning Manipur.

An important researchgap therefore concernsthe everyday physical-activity experiences of community-dwelling older womenin Manipur. Futureresearch should investigate the types and frequency of activities undertaken by older women and examine how health status,functional ability, familysupport, household responsibilities, social participation, cultural expectations, safety, transportation, and access to facilities influence participation.

Comparisons between urban, rural, valley, and hill communities could provide valuable evidence about geographical differences. Quantitative assessment of physical activityshould ideally be combined with qualitative interviews so that older women can describe their own experiences, preferences, motivations, and barriers.

Implications for Active Ageing in Manipur

The literature suggests that promoting physical activity among older women requires a multilevel approach. Individual health education is unlikely to be sufficient when women lack social support, safe environments, or accessible facilities. Community walking groups, supervised low- to moderate-intensity exercise, balance and strengthening sessions, yoga, and recreational activities could provide practical opportunities for participation.

Family involvement should also be considered because family membersmay either facilitate or unintentionally restrict participation. Health workers and community organisations can help families understand that physical activity is an important component of healthy ageing rather than an unnecessary leisure activity.

Programmes should be culturally and geographically sensitive. The needs of older women in urban Imphal may differ from those of women living in rural and hill areas. Local women should thereforebe involved in determining suitable activities, locations, schedules, and forms of social support.

The evidence also suggests that programmes should move beyond a purely competitive sports model. A successful active-ageing programmeshould prioritise regularparticipation, safety, enjoyment, social interaction, functional independence, and quality of life. Such an approach could complement Manipur's existing sporting culture while extending the benefits of physical activity to older women.

Conclusion

Participation in physical activity among older women in Manipur is influenced by an interaction of health, functional ability, social relationships, cultural expectations, gender roles, and environmental conditions. Evidence from systematic reviews and Indian studies indicates that physical activity can contribute to healthier ageing, functional independence, cognitive health, psychological well-being, and reduced risk of several adverse outcomes. At the same time,health limitations, fear of falling,lack of motivation, family responsibilities, limitedsocial support, cultural expectations, and inaccessible environments can restrict participation.

The 2026 systematic review of older South Asians provides particularly relevant evidence by demonstrating that physical-activity participation is shaped by interconnected individual, family, social, cultural, and environmental circumstances (Ezeokoli et al., 2026).However, South Asianevidence should not be treatedas direct evidenceof the experiences of older women in Manipur. Locally specific research remains necessary.

Physical activity among older women should not be defined narrowly through competitive sport. Walking, yoga, recreational movement, strengthening, balance exercises, and other culturally appropriate forms of movement can provide meaningful opportunities for active ageing. Community-based

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approaches may be particularly useful because they can combine accessibility, social interaction, family support, and culturally appropriate activity.The majorresearch gap is the limitedamount of community-based evidence concerning olderwomen in Manipur. Future research should document their actual activity patterns and examine how social, cultural, health-related, and environmental conditions influence participation. Such evidence couldsupport the development of affordable, safe, accessible, and women-friendly programmes and contribute to a more inclusive understanding of healthy ageing in Manipur and Northeast India.

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BOOK REVIEW

THE MANY LIVES OF RANI GAIDINLIU SOM KAMEI'S METICULOUSLY RESEARCHED BIOGRAPHY RESTORES RANI GAIDINLIU TO INDIA'S FREEDOM NARRATIVE WHILE EXAMINING TRIBAL IDENTITY, HERAKA, AND UNRESOLVED ZELIANGRONG ASPIRATIONS

by Sanjeev Chopra

Let me, at the very outset, disclose four clear connections with the author Som Kamei. These include JNU, our common alma mater, and then LBSNAA where he did his foundation course in 1998 when I was the Deputy Director of this apex civil services training institution. The third link emerged at the VoW–Auroville Literature Festival, where Som's book on Rani Gaidinliu provided the base material for Aashisha Chakraborty's featured historical fiction novel The 13-Year-Old Queen and Her Inherited Destiny. Last, but not the least, the North Eastern Council (NEC) Secretariat, where Som is Planning Advisor, is taking care of logistics for my research on Bob Khathing, who like him is a Manipuri Naga. But while Khathing was a Tangkhul Naga, Kamei, like the eponymous protagonist of this book, is a Zeliangrong Naga - an amalgamation of the Zeme, Liangmei, and Rongmei Naga sub-tribes in the contiguous hill areas of Manipur, Nagaland, and Assam. The Zeliangrong have been asking for an autonomous region/council within India's constitutional framework. However, as their numbers are scattered across three states, a realistic framework in which their cultural, social and indigenous faith traditions can be protected and preserved has not (yet) seen the light of the day.

This review is about Som's well-researched monograph Rani Gaidinliu: Legendary Freedom Fighter from the North East published by Niyogi Books, as part of their Pioneers of Modern India series. It offers a balanced perspective on of the most remarkable yet frequently misconstrued figures of the Indian freedom struggle. Unfortunately, the resurrection of her memory is often juxtaposed against the majoritarian Naga narrative which considers Heraka – the back to the roots, socio-religious reform and indigenous faith movement of the 1920s – as anti-missionary and anti-Christian. Thus, the portrayal of Rani Gaidinliu (1915-1993) as a valiant anti-Imperialist freedom fighter who deserves national recognition is opposed by elements which owe their affiliation to one or the other underground factions of the Nationalist Socialist Council of Nagaland (NSCN).

Trained as a sociologist and an administrator, Kamei approaches his subject not merely through the lens of a standard chronological history of India's freedom movement, but also within the structural context of tribal identity, colonial policy, and internal community dynamics. He traces her trajectory from being a young girl in a remote village to becoming a formidable leader of the Zeliangrong Naga community.

The book begins with her cousin brother, Haipou Jadonang, who in 1926 established a religious reform movement aimed at consolidating the Zeliangrong identity to resist British colonial exactions of pothang bekari and pothang senkhai. The former was the enforced house tax of Rs. 3 per month, even if one was unemployed; the latter mandated villagers to provide visiting officials with food and lodging and transport logistics.

Following her brother-mentor's execution by the British in 1931, the teenage Gaindinilu assumed both the spiritual and military mantle of Haipou Jadonang's Makam Gwangdi (Naga Raj) movement. Kamei captures the intensity of her guerrilla resistance against the British, her eventual capture in 1932, and her subsequent fourteen-year incarceration. A significant highlight is her intersection with mainstream nationalist politics, specifically when Jawaharlal Nehru met her in Shillong jail in 1937. It was he who first addressed her as the 'Rani' of her people, and attempted to secure her release. During his visit to Sylhet in December 1937, he wrote: "… six years ago, when the civil disobedience movement blazed over the length and breadth of the country, news of Gandhi and the Congress reached her in her hill abode, and found an echo in her heart. She dreamt of freedom for her people and the ending of all restrictions they suffer from, she raised the banner of independence,

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and called her people to rally around it… and now she lies in some prison in Assam, wasting her bright young womanhood in dark cells and solitude… and India does not even know of this brave child of her hills, with pride. A day will come when India will remember her and cherish her, and bring her out of her prison cell."

Although by 1938, Assam had a Congress government under Gopinath Bordoloi, the Excluded Areas (to which Giandinliu belonged) were not under the jurisdiction of the provincial government. Nehru therefore wrote to an influential member of the British parliament, Lady Nancy Astor, to secure Rani's release. The Manipur Mahasabha (a Congress affiliate) also petitioned their Maharaja for the same – Rani had been born in Manipur – but to no avail.
Her jail term made her a polyglot: she could speak Manipuri, Assamese, Khasi, Hindustani, Kachari (Bodo), Mizo and of course her own Naga language. Nehru was finally able to secure her release from the Tura jail in Assam in 1947, but as Manipur would not agree to have her back in the state for the next five years, she settled in Mokokchung (then part of the Naga Hills district) with several restrictions on her movement. She did, however, start receiving recognition as a freedom fighter, a monthly pension of Rs 15 and security from Nagaland Police. Finally, when restrictions on her movement were lifted, she settled in Tamenglong in Manipur, which had a substantial Zeliangrong population, and then began her quest for a homeland movement.

According to Prof. Gangmumei Kamei, the decade from mid-fifties to mid-sixties marked three distinct, interrelated and to some extent, conflicting political pathways for the Rani and her followers. First, unlike the extreme radical Naga groups, the Rani participated in the national political process as it was necessary for the social and economic development of her people. She was also actively engaged in seeking a Zeliangrong homeland for strengthening the Zeliang identity (which was resisting the overarching trend of missionary proselytization), and she also identified herself as a proud Naga who supported a pan-Naga movement (with the caveat that the Zeliangrong would retain its distinct identity within the larger Naga spectrum). However, differences surfaced between the Zeliangrong supporters and members of the NNC when her Heraka movement was criticised as anti-Christian.

After Nagaland achieved statehood, in 1963, CM Shilu Ao sought to bring her out of hiding. This task was entrusted to a young IAS officer Subodh Chandra Dev, then posted as the ADC in the Zohenoboto subdivision. Rani wanted to meet Dev without his security contingent: he agreed, and thus began a relationship of trust and affection in which he addressed her as mother. She told him, 'For my people, I want no state, no country, but only a Zeliangrong district within any state of the Indian Union.' She also clarified that she was not against Christianity, or for that matter any other faith, but as she said, 'We are Nagas, and should live like Nagas. We have beautiful folklore and folk songs, colourful dresses and culture.

When we see these new converts copying western ways in a cheap manner, it pains me.' Dev also recalls her meeting with Prime Minister Indira Gandhi: 'The PM stood draped all over with the colourful Zeliang(rong) attire and jewelry presented to her by the Rani' and 'assured her that she would do everything possible to develop the Zeliangrong area as quickly as possible'. However, even though the Rani was given the Tamra Patra Freedom Fighter Award in 1972, the Padma Bhushan in 1982 and the Vivekananda Seva Award in 1983 for her role in community service and the revival of indigenous tribal culture, alongside several assurances by Prime Ministers India Gandhi, Rajiv Gandhi, VP Singh and Narasimha Rao, her quest for the Zeliangrong homeland remains unfulfilled. In her centenary year, Prime Minister Modi and Home Minister Rajnath Singh launched a one-hundred-rupee commemorative and a five-rupee circulation coin in honour of Rani Gaidinliu. Her legend grows, but the hope for a Zeliangrong Council continues to be a quest in the present continuous.

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FIELD-BASED ASSESSMENT OF VULNERABILITY, IMPACTS AND DISASTER GOVERNANCE DURING THE 2026 FLOOD IN SIVASAGAR, ASSAM

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Abstract

This paper presents a field-based qualitative assessment of the 2026 flood in Sivasagar, Assam. Drawing on direct observations from Nazira, Santak, Bihubar and Nepali-Khuti, together with contemporary reports and official documents, it examines flood-related damage to houses, livelihoods and infrastructure, displacement, mobility, relief and recovery. The paper aims to understand how the flood affected communities at the local level and how disaster governance operated during and after the event. It argues that the flood exposed significant physical and livelihood vulnerabilities and revealed difficulties in implementing existing disaster-governance arrangements under severe flood conditions. The study further highlights that recovery extends beyond immediate relief, as affected households continue to face challenges in rebuilding homes, restoring livelihoods and preparing for future floods. It therefore emphasises the importance of timely response, livelihood protection and sustained recovery support within disaster governance.

Keywords : Flood; Disaster Governance; Sivasagar; Assam

1.0 Introduction and Background

Flooding is an established hazard in Assam, historically associated with the Brahmaputra and its tributaries. Historical records, including references in Ahom history, document the long history of major floods in the region. However, flood impacts are not uniform across the State, and their severity varies according to local geographical and hydrological conditions (GoI, 2005). The 2026 flood was particularly unusual in Upper Assam, as Sivasagar, Charaideo, Jorhat and Golaghat experienced severe inundation in areas described by The Assam Tribune as not normally affected by floods of this magnitude (The Assam Tribune, 8 August 2026).

Sivasagar nevertheless has officially identified flood-prone areas. The Sivasagar Flood Contingency Plan classifies 25.51% of the district's geographical area as flood prone. The district forms part of the Brahmaputra River system, with the Brahmaputra along its northern boundary and rivers including the Dikhow, Desang, Jhanji, Demow, Darika, Diroi and Mitong flowing through the district. The plan records earlier flood-related events, including embankment breaches at Dolopa and Deogharia in 2012 and flash floods affecting villages in the Amguri and Nazira Revenue Circles in 2017. The Sivasagar District Disaster Management Plan also identifies vulnerable locations along the Dikhow, Desang and other river systems (FCP, Sivasagar, 2026; DDMP, Sivasagar, 2026).

However, the 2026 flood was experienced differently in several communities. During field visits to affected areas, elderly residents reported that they had never witnessed flooding of such magnitude during their lifetime. Contemporary reporting similarly described the Upper Assam situation as an unprecedented crisis and highlighted exceptionally high levels in the Disang, Dikhow and Jhanji river systems (The Assam Tribune, 29 July 2026). The event also differed from the conventional image of the Brahmaputra gradually overflowing its banks. An Assam Tribune analysis

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described the flooding as involving flash floods, hill runoff and overflowing tributaries, with intense rainfall in neighbouring Nagaland contributing to the rapid movement of water into the plains (The Assam Tribune, 23 July 2026). A subsequent report emphasised the interconnected drainage catchments of the region rather than administrative boundaries alone (The Assam Tribune, 29 July 2026).

The rapid development of the flood created significant challenges for response. Sivasagar's District Commissioner stated that the administration had only about three hours to react on 19 July as water levels in the Jhanji and Dikhow rose rapidly. Access to some affected areas was subsequently restricted by damaged roads and strong currents; a rescue team attempting to reach Santak became stranded after the road became impassable (The Assam Tribune, 1 August 2026). By 21 July, more than 64,000 people in 189 villages of Sivasagar had reportedly been affected and 9,180 acres of cropland submerged. In Nazira and surrounding areas, houses, roads, markets, educational institutions, agricultural fields and tea estates were inundated, while livestock and household belongings were also lost (The Assam Tribune, 26 July 2026).

The above circumstances provide an important context for examining disaster governance. The Assam State Disaster Management Plan treats disaster management as a continuous process encompassing preparedness, response, rescue, relief, rehabilitation and reconstruction, while emphasising coordination among institutions and community participation (GoA, 2022). The Sivasagar plans similarly provide for preparedness, emergency response, relief, recovery and rehabilitation (FCP, Sivasagar, 2026; DDMP, Sivasagar, 2026). Against this background, this paper presents a field-based qualitative assessment of the 2026 Sivasagar flood, drawing primarily on observations from Nazira, Santak, Bihubar and Nepali-Khuti, supplemented by the supplied contemporary reports and official documents. It examines the observed effects on houses, livelihoods, livestock, mobility and everyday life, alongside the institutional response and subsequent recovery.

2.0 Field Observations

Field visits were conducted on 2–3 August 2026 in flood-affected areas of Sivasagar, particularly Nazira, Santak, Bihubar and Nepali-Khuti. The visits were undertaken after the peak of the July flood and provided an opportunity to observe conditions that remained after the floodwaters had receded. The observations focused on residential settlements, agricultural land, livestock, livelihood assets, roads and accessibility, as well as the difficulties faced by households in returning to normal life. Contemporary reports from The Assam Tribune are used to supplement and corroborate these field observations, particularly for conditions during the peak of the flood.

One of the most visible impacts was damage to houses and residential settlements. In the areas visited, houses and their surroundings showed clear evidence of inundation, with mud and silt remaining after the water had receded. Household belongings had also been damaged or lost, while the accumulation of silt made cleaning and returning to normal domestic activities difficult. The condition observed during the visit indicated that the effects of the flood continued even after the immediate danger from the water had passed.



Figure 1. Flood-affected residential settlement observed.

The Assam Tribune reported that more than 200 kutcha houses had been washed away in Nepali-Khuti, while hundreds of cattle were also lost (The Assam Tribune, 4 August 2026). Earlier reporting from Nazira identified Santak, Bihubar and surrounding areas among the worst-affected locations, with houses inundated and residents struggling to remove mud and silt from their homes (The Assam Tribune, 25 July 2026).



Figure 2. Mud and silt deposited in a flood-affected residential area observed.

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In Figure 2, water was observed to have flowed above an Assam-type house during the flood. The flood also affected the productive resources of households. Agricultural fields in the affected areas were covered with water and subsequently with mud and silt. This was particularly significant because the flood occurred during the cultivation season. Reporting from Nazira noted that paddy fields and seedbeds were buried under thick layers of mud and silt, leaving farmers concerned about their agricultural activities (The Assam Tribune, 25 July 2026).

Livestock losses were particularly important in Nepali-Khuti and Bihubar, where cattle and dairy activities formed an important part of local livelihoods. The Assam Tribune reported that cattle sheds had disappeared and agricultural land remained covered with silt, while residents of Nepali-Khuti estimated that more than 1,000 cows had been swept away (The Assam Tribune, 31 July 2026). The loss of livestock, crops, household goods, vehicles and other productive assets meant that the flood affected not only physical property but also the economic resources required for household recovery.



Figure 3. Road and access conditions observed during the field visit.

Roads and accessibility constituted another important dimension of the observed impact. During the field visit, mud, silt and damaged road sections continued to affect movement. The significance of this disruption was particularly evident during the flood itself. On 24 July, the Chief Minister stated that around 30% of affected areas in Nazira and 20% in Sivasagar remained inaccessible because road communication had been disrupted, while country boats were being used to support relief operations (The Assam Tribune, 25 July 2026). A rescue team attempting to reach Santak also became stranded after the road became impassable, while strong currents prevented immediate boat access (The Assam Tribune, 1 August 2026). Railway connectivity through Nazira was additionally disrupted following damage to railway tracks between Bortal and Banhgarh (The Assam Tribune, 25 July 2026).The field visit ultimately showed that the recession of floodwater did not mean an immediate return to normal life. Damaged houses, accumulated silt, affected agricultural land, and lost livestock and household assets continued to shape the conditions of affected families. The physical evidence observed on 2–3 August therefore connects the immediate impacts of the flood with the longer process of household recovery.

The displacement of households was also visible during the field visit to Santak. Some families whose houses had been severely damaged were staying in temporary tents placed in an area covered with stone debris. The presence of temporary shelters in such surroundings reflected the immediate housing difficulties faced by affected households. During the visit to the village, several dumpers and JCB machines were observed buried in mud. However, the precise purpose and source of the stone material could not be established from field observation alone.



Figure 4. Temporary shelter of a flood-affected family in Santak, located on an area covered with stone debris observed.

The Assam Tribune reported that more than 200 kutcha houses had been washed away in Nepali-Khuti, while hundreds of cattle were also lost (The Assam Tribune, 4 August 2026). Earlier reporting from Nazira identified Santak, Bihubar and surrounding areas among the worst-affected locations, with houses inundated and residents struggling to remove mud and silt from their homes (The Assam Tribune, 25 July 2026).

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3.0 Disaster Governance Response

The response to the 2026 flood in Sivasagar was organised through the district disaster-governance structure involving the District Disaster Management Authority (DDMA), district administration and relevant line departments. The Sivasagar District Disaster Management Plan identifies the DDMA as the nodal authority for coordinating with State and Central government departments and other agencies during disasters. It provides for relief camps, search and rescue, emergency communication, medical assistance, food and essential supplies, transportation and other emergency services.

During the flood, the district administration undertook field inspections, coordinated rescue and relief operations, and monitored conditions in affected areas. In Nazira, officials visited relief camps, reviewed the distribution of essential items and arranged medical services for affected residents. Medical teams conducted health check-ups and distributed medicines at relief camps in several locations (The Assam Tribune, 25 July 2026). The Indian Army, NDRF and SDRF were also deployed for rescue and relief operations. The Army's Operation Jal Rahat provided food, drinking water and medical assistance and rescued more than 1,000 flood-affected people in Upper Assam, including Sivasagar and Charaideo (The Assam Tribune, 23 July 2026).

The administration also faced considerable operational difficulties. Rapidly rising water and damaged communication routes restricted access to some affected locations. In Santak, a rescue team became stranded after the road became impassable, while strong currents prevented immediate boat access. These conditions demonstrate the practical difficulties of implementing an institutional response during a rapidly developing flood.

Relief camps were an important component of the formal response. The district plan provides for designated relief camps, registration of affected families, distribution of food and relief materials, medical facilities, communication facilities and special attention to vulnerable groups, including children, elderly persons, pregnant women and persons with disabilities. It also allows the DDMA to requisition vehicles, premises and other resources required for rescue and relief.

Government assistance subsequently included financial support for affected families and damaged institutions. The State Government released the first tranche of ₹112 crore for flood victims, including assistance to affected families, schools and other community institutions, while the Chief Minister visited severely affected areas of Sivasagar and assured residents of relief and rehabilitation support (The Assam Tribune, 4 August 2026). Therefore, the response involved administrative coordination, rescue, relief camps, medical assistance, emergency supplies and financial assistance. At the same time, the difficulties encountered in reaching some severely affected locations show that formal disaster-governance arrangements had to operate under significant physical and logistical constraints.

4.0 Recovery, Rehabilitation and Assistance

The recession of floodwaters did not mark the end of the disaster for affected households. During the field visit on 2–3 August, mud and silt, damaged houses, affected agricultural land and loss of livelihood assets showed that recovery was still underway. Many families were engaged in cleaning their homes, salvaging belongings and assessing whether their houses were safe to reoccupy. Contemporary reports similarly documented families living along roadsides and in lodges because their homes remained filled with mud and silt, while some households in Bihubar had little or nothing left to return to.



Figure 5. Paddy field covered with approximately four inches of silt observed.

Recovery was supported by community, voluntary and institutional actors. People and organisations from across Assam contributed food, medicines, clothing and other essential materials, while volunteers provided direct relief and rehabilitation support.

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Around 40 volunteers associated with nearly 10 Sikh organisations travelled more than 3,000 km to affected areas, bringing boats and medical supplies (The Assam Tribune, 4 August 2026). Local organisations also played an important role. Asom Sahitya Sabha distributed drinking water, ORS, food, medicines and hygiene materials in affected areas of Sivasagar and Charaideo (The Assam Tribune, 27 July 2026). The Assam College Teachers' Association distributed drinking water, food, clothing, mosquito repellents, bleaching powder, phenyl, candles and sanitary pads, with logistical support from the NGO Social Development Forum (The Assam Tribune, 29 July 2026). Student organisations also mobilised essential supplies, including cattle fodder, for flood-affected families in Sivasagar and Charaideo (The Assam Tribune, 23 July 2026).



Figure 6. Relief distribution to flood-affected households.

The disaster also had a substantial animal-welfare dimension. Livestock and poultry, which are important household livelihood assets in rural Sivasagar, suffered extensive losses. In Nepali-Khuti, residents reported that more than 1,000 cattle were swept away, while losses of poultry and other animals were also reported in Bihubar and Betbari (The Assam Tribune, 1 August 2026). Government veterinary teams and voluntary animal-rescue groups such as PARVAH – Help Them Survive participated in feeding, rescuing and treating stranded and injured animals. Veterinary assistance included the deployment of experts and the establishment of 40 veterinary camps, including 17 in Sivasagar; reports indicated that 725 livestock had died and 28,457 affected animals were receiving treatment (The Assam Tribune, 6 August 2026).



Figure 7. Flood-affected school in Bihubar remaining closed due to deposited silt observed.

Across the affected area, particularly along the roadsides, plastic bottles, food packets and other plastic waste were observed in considerable quantities. The accumulation appeared to be associated with the movement of several teams and groups involved in flood-relief activities. This indicates that post-flood recovery also involved challenges of waste management and sanitation alongside the restoration of essential public facilities.
Government assistance gradually shifted from emergency relief towards rehabilitation and recovery. The Chief Minister visited several affected villages and assured households of assistance, while the State released the first tranche of ₹112 crore, including ₹15,000 for each affected family and additional support for affected households, schools and Namghars (The Assam Tribune, 4 August 2026). The FCP, Sivasagar also emphasises post-disaster needs assessment, damage and loss assessment, rehabilitation planning and community participation as key components of recovery (DDMA, Sivasagar, 2026).

Overall, the Sivasagar experience demonstrates that the end of inundation did not mean the end of the disaster. Recovery required sustained cooperation among government agencies, local communities, NGOs, student and cultural organisations, veterinary services and volunteers. Damaged houses, silt-covered agricultural land, livestock losses and disrupted livelihoods show that relief was only the initial stage of a longer process of rehabilitation and livelihood restoration.

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5.0 Conclusion

The 2026 flood in Sivasagar demonstrates that a severe flood can extend far beyond the period of inundation. Field observations from Nazira, Santak, Bihubar and Nepali-Khuti showed damage to houses, agricultural land, livestock, roads and household assets, while the continued presence of silt, damaged homes and disrupted livelihoods after the recession of floodwater indicated that recovery remained a prolonged process. These observations were consistent with contemporary reports of extensive displacement, infrastructure disruption and livelihood losses across the district (The Assam Tribune, 25 July 2026; 31 July 2026).

The experience also demonstrates that disaster governance in Sivasagar involved more than formal government response. District authorities, emergency-response agencies, health and veterinary departments, voluntary organisations and local communities all contributed to relief and recovery. The Sivasagar DDMP itself provides for coordination among government departments, NGOs, volunteers and communities during response, recovery and rehabilitation.

At the same time, the difficulties experienced in reaching rapidly affected areas indicate the importance of strengthening preparedness, communication, evacuation capacity and local response arrangements. Future disaster governance therefore needs to connect early preparedness with accessible emergency response and sustained recovery, particularly for households whose homes, agricultural resources and livestock have been damaged. The Sivasagar experience ultimately shows that effective disaster governance cannot end with rescue and relief; it must continue until affected communities can rebuild their homes, livelihoods and everyday lives.

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RE-CONCEPTUALISING MEDIA EDUCATION THROUGH INDIGENOUS COMMUNICATION PATTERNS AND FUNCTIONS

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Abstract

Media education has largely evolved around technological and institutional developments, often ignoring the diverse communication systems through which indigenous societies have produced, transmitted and preserved knowledge for ages. In this vein, Arunachal Pradesh, rich in indigenous knowledge traditions, provides an important platform for rethinking communication and media education from a culturally grounded perspective. The study broadly tries to understand the relevance of indigenous communication traditions in contemporary media education and examines how their integration, supported by AI, can contribute to decolonising the curriculum. The study adopts a qualitative approach with document analysis and semi-structured interviews to examine indigenous communication practices, limitations in their curricular integration and possibilities for AI integration. The findings indicate that indigenous communication systems continue to perform important functions including information dissemination, emergency alerts, social coordination and knowledge transmission. However, conventional media education predominantly privileges Western and technology-oriented epistemologies, positioning indigenous practices as peripheral or regressive. The study argues that decolonising the curriculum does not mean rejecting Western knowledge but rather creating an ecology of knowledges where indigenous and established media scholarship interact. Additionally, the study finds that AI offers potential for documenting, preserving, translating and integrating indigenous knowledge into curricula. Such integration requires community participation guided by the principles of respect, relevance, reciprocity and responsibility.

Keywords : Media Education, Indigenous Communication Practices, Decolonisation, Westernised Education, Artificial Intelligence

Introduction

Throughout human history, education and skills have been considered central to human and economic development, social fabric and democratic participation (Sayed et al., 2016). With the industrial revolution in the West and the advent of colonialism, education systems gradually became Eurocentric (Baker, 2012). After independence, many countries across the globe continued to follow the same education system, designed within and deeply rooted in colonial epistemologies, structures and knowledge. This continued system tends to marginalise rich tribal and indigenous knowledge and prioritise a 'one-size-fits-all' standard for measuring knowledge, resulting in the loss of intergenerational, diverse, cultural, linguistic and intellectual knowledge that education should include (Yesmin & Peter, 2023) and leading to 'epistemicide' (Santos, 2014). In Orientalism, Edward Said (1978/1995) critiques the Western scholarly and cultural representations that constructed the cultures of the East as inferior, a critique that has since informed challenges to Eurocentric knowledge in education. The call for decolonisation of education across the globe started in the mid-twentieth century, when third-world countries started gaining independence and policymakers and scholars started questioning the Eurocentric epistemologies (Sua, 2013). The concept of decolonisation focuses on mitigating the intertwined structures, processes and outcomes resulting from colonisation so that indigenous people can reclaim their own subjectivity and seek an alternative and inclusive future (Woldegiorgis, 2021). Decolonisation raises the question of whose ways of knowing are privileged in existing histories, policies, practices and theories, and seeks to answer it anew within the education system (Shahjahan et al., 2021). Despite a successful nationalist movement in India, the education system carried forward the

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same colonial curriculum, which left almost no space for indigenous cultures and knowledge systems (Kumar, 2005). Decolonising the curriculum is not about replacing Western content but about broadening it and showing that Western epistemologies are incomplete when presented as universal; its essence lies in establishing a more inclusive and diverse curriculum (Longkumer, 2024).

The quest for decolonisation of education also scrutinises the existing media and communication curriculum in the country, but the voice of educators from the domain is largely missing from the debate (Srinivas, 2013). The history of media education is rooted in colonialism, where Western ideologies are dominant and shape both media structures and narratives across the globe (Dias-Fonseca & Potter, 2016). In the past few decades, Western scholars have focused on curricula that prepare students for industry (Straw, 1985) and on neo-liberal education (Benedetti & Compton, 2014). Some scholars have tried to focus on the plurality of education, society and democracy (Martindale, 1993). Moreover, media curricula emphasise technological developments such as the printing press, radio, television and the internet as turning points in communication development (Srinivas, 2013), which reduces media to a mere follower of technological determinism (Pavlik, 2013), rather than questioning the broader aspects of indigenous communication: what types of communication systems existed before the industrial revolution? The scholars mentioned above argue that both media students and audiences are from culturally diverse backgrounds and the purpose of education cannot be served through a homogeneous curriculum. Media curricula should be diverse, inclusive and culturally grounded by including indigenous and non-Western topics instead of treating Western theories as normative and universal (Todorova, 2016). Media are not limited to technologies but extend to the different communication patterns and functions in which meaning lies. A functional approach considers media in terms of the social purposes they fulfil, such as informing, warning, educating and mobilising, through various forms, including oral narratives, songs, performances, rituals and community-based communication networks (Valbuena, 1988). For example, indigenous communication systems are employed as mechanisms in development programmes across the globe, and their effectiveness increases their relevance in contemporary times (Tham-Agyekum & Loggoh, 2011). Indigenous warning systems are very effective during floods and other natural calamities in the absence of modern technologies (Haokip, 2022). Such reconceptualisation also has implications for journalism education. Recent scholarship on decolonising education calls for establishing indigenous communication knowledge within journalism curricula rather than treating it as a peripheral subject (Patrick et al., 2024).

Arunachal Pradesh is the largest state in Northeast India, inhabited by 26 major tribes and more than 100 sub-tribes with distinct cultures and traditions. Owing to its exceptional cultural, linguistic and ecological diversity, the state provides a substantial context for examining indigenous knowledge and its communicative dimensions. Situated in the Eastern Himalayas and sharing international borders with several countries, it occupies a distinctive geographical and cultural position connecting different transnational cultural zones (IGNCA, n.d.). These characteristics present the state as particularly relevant for rethinking media history beyond print-centric and technologically determined narratives. Further, advanced technologies like Artificial Intelligence (AI) can be employed to blend indigenous knowledge and modern technologies to design curricula (Bihari, 2023; Nicholas, 2022). In such cases, technology has proven to be a vital tool in safeguarding, upholding and advancing the intellectual and cultural richness of indigenous peoples (Grant & Söderbergh, 2020; Dada, 2024).

However, despite the richness of these indigenous communication traditions, the history and pedagogy of media education in India have largely been organised around the development of technologies, completely ignoring the systems that existed before technological development. Also, indigenous communication is frequently regarded as folk media or cultural heritage, which narrows its scope and hinders its development, further limiting attention to how indigenous communication systems can be incorporated into media education. This study focuses on integrating indigenous communication systems into media education, which can contribute to the decolonisation of media curricula by expanding the conceptual boundaries of media, recognising indigenous epistemologies and situating media education within the historical and cultural context of Northeast India. It also examines how advanced technologies such as AI can be blended with indigenous knowledge to enhance its relevance in the present context.

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Research Objectives

1. To examine the continued relevance of indigenous communication traditions of Arunachal Pradesh in the present context.
2. To analyse the limitations of conventional media education in representing indigenous communication practices.
3. To explore the potential applications of AI in integrating indigenous communication systems into media curricula.

Conceptual Framework

Decolonising the education system requires critical thinking and perspectives that shed light on how knowledge, identity and power are being reshaped in contemporary times. The study draws on decolonial theory, which deconstructs the Western-dominated media education system and highlights the relevance of indigenous communication systems in evaluating media education in Northeast India. Complementing this, Foucault (1997/2003) propounded a 'genealogy of knowledge' approach, which holds that knowledge and discourse are shaped by underlying historical circumstances and power relations that determine the boundaries and possibilities of that knowledge. Genealogy of knowledge revives local and subordinate knowledge against dominant discourses. This idea builds on scholarly works about indigenous media and indigenous communication practices across the globe.

Methodology

The study adopted a qualitative approach, using document analysis to examine the pedagogies of media education in the state of Arunachal Pradesh, India, maintaining a critical lens that tries to identify the colonial footprint and systemic barriers to decolonising media education. A qualitative approach is appropriate because the study seeks to understand the meaning, cultural contexts, communicative functions and educational significance of indigenous practices rather than quantifying their prevalence. Further, the study used a semi-structured interview schedule and purposive sampling to select 35 participants, including media and communication educators, indigenous knowledge practitioners, cultural practitioners, journalists, tech experts and researchers, in order to design a framework that assists in decolonising the curricula. The collected data were analysed thematically following Braun and Clarke's (2006) six-step thematic analysis. The analysis was guided by decolonial and genealogical perspectives, with particular attention to the relationship between knowledge, power, representation and educational structures.

Findings and Discussion

The study extensively engaged with the literature to develop an understanding of the topic. Beginning with an account of how indigenous communication practices persist in the present context, the discussion maps the silences and omissions in curricula of various universities and colleges to develop ideas on how conventional media education represents (or fails to represent) the indigenous perspective. The section then examines AI as a potential tool for bridging these gaps and fostering inclusion, and proposes a framework for a decolonised approach to media education. The findings are discussed under the following themes:

i.Relevance of indigenous communication practices in contemporary times

Indigenous communication traditions in Arunachal Pradesh can be understood more meaningfully through their communication functions rather than through the technological forms associated with contemporary media. From a decolonial perspective, it is important to challenge the hierarchy by raising concerns over whose knowledge has been historically recognised as legitimate and whose communication practices have been excluded from formal knowledge structures (De Albuquerque, 2024). In this light, indigenous communication traditions of Arunachal Pradesh should not be treated merely as folk media, but rather as communication infrastructure through which communities gathered, transmitted, interpreted and preserved information. The relevance of these traditions becomes evident when their communicative functions are compared with those of contemporary media. Indigenous societies also developed mechanisms for performing tasks such as information dissemination, social mobilisation and emergency communication. For instance, among the Wancho, distinctive drum beats vary with the situation and convey information about particular events, gatherings, celebrations or emergencies. From a communication perspective, the significance lies not simply in the instrument itself but in the relationship between the sender, the encoded messages (the beats) and the community as the receiver. Similarly, oral networks involving elders, messengers, community representatives and

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customary institutions like Kebang in the Adi tribe perform important knowledge-transmission and fact-verification functions. Among the Bokar, the arrival of a beetle called 'Barbi' signals the time for harvesting. Likewise, festivals such as Nyokum, Syi-Donyi and Solung are not mere celebrations but communicative spaces where knowledge is practised and performed, and where sustainable ecological knowledge is passed down through generations. These institutions should not be interpreted as outdated versions of modern media; rather, they demonstrate that societies can develop different organisational structures for fulfilling comparable communication needs. Indigenous communication prioritises continuity and inter-generational transmission, which demonstrates that communication can serve temporal and social functions that extend beyond the immediate dissemination of news. This perspective is particularly compatible with Foucault's conception of genealogy of knowledge, which questions how particular forms of knowledge become authorised while others are marginalised through historically situated relations (Foucault, 1997/2003). Indigenous oral and community-based systems have frequently remained outside the structures of knowledge production. A genealogical approach therefore enables the recovery of such subordinated forms of knowledge and asks how they have been excluded from formal understandings of media and communication. There is a need to acknowledge that indigenous communication practices of Arunachal Pradesh have their own structures, codes, audiences and functions.

ii.Current media curricula and lack of indigenous communication representation

The current state of media education is highly Western-dominated. Through document analysis of the curricula currently in use in various universities and colleges of Arunachal Pradesh, the study found that indigenous communication practices are largely absent. Rather than presenting communication as a historically plural and culturally situated process, the dominant curriculum tends to privilege a universalised, Western-dominant understanding of media in which the development of communication is commonly organised around technological development. Such linear progression positions technologically mediated communication as the normative trajectory of media while relegating community-based communication traditions to the margins of formal media knowledge. From a decolonial perspective, this is more than a curricular omission; rather, it reflects the greater legitimacy of a particular type of knowledge (Cajete, 2019).

Although the introduction of 'Media in Northeast India' as a subject in some universities in the region is a positive development, the history of communication in these courses begins with the advent of missionaries and the printing press. Indigenous media are included in the form of dance and festivals, which are termed 'folk media', diminishing the very essence of the meaning these practices carry, which aligns with the idea of epistemicide, the systematic destruction of non-Western knowledge (Santos, 2014). Similarly, although news values are not universal but depend on the social and cultural context (Joye et al., 2016), the curricula continue to teach the same Westernised concept of news values, instead of developing society- or culture-specific news values. These limitations also have implications for epistemic representation and student learning. When students are exposed to media studies derived from dominant knowledge traditions, they may come to see indigenous communities as objects of study rather than as producers and custodians of knowledge. This mismatch can further exacerbate the gap. By contrast, a decolonial perspective recognises indigenous communities as knowledge holders, which is consistent with the idea of critical pedagogy propounded by Freire (1970), which rejects the passive transmission of knowledge. Overall, the current curricula further fail to integrate indigenous knowledge systems, which are local, place-based and culturally grounded, and have been refined by communities throughout generations of ecological interactions and epistemologies to create a sustainable knowledge system.

iii.Recognising indigenous communication through critically grounded research

This section argues that decolonising media education should not be confused with the rejection of Western epistemologies; rather, it advocates the expansion of epistemological boundaries of the curriculum by recognising historically marginalised indigenous ways of knowing and placing them in dialogue with Western knowledge. In the context of Arunachal Pradesh, decolonising requires documenting and understanding indigenous communication before attempting to theorise it. Oral narratives, songs, storytelling and ritual communication should be investigated through indigenous lenses instead of immediately interpreting them through Western media theories. Such an approach can provide an empirical foundation for developing indigenous concepts and models of communication. Consequently, media curricula should provide dedicated space for fieldwork, documentation, oral history and study of verbal

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and non-verbal communication practices across diverse communities of Arunachal Pradesh. Further, there is a need to shift from treating indigenous knowledge as content to recognising it as a method of knowing and communicating. Students should be encouraged to investigate indigenous communication through critically grounded research rather than simply memorising descriptions of folklore. Courses on cultural communication, indigenous media, oral traditions and community knowledge systems could enable students to examine how different communities construct meaning, preserve collective memory, transmit ecological knowledge and organise social communication. This approach is consistent with Freire's (1970) emphasis on contextual and dialogical education where learners engage critically with their lived realities. The National Education Policy (NEP) 2020 promotes a similar vision of education, in which Indian Knowledge Systems (IKS) are to be revived and integrated into education.

iv.AI-mediated strategies towards decolonising media education

Within this decolonising framework, advanced technologies like Artificial Intelligence (AI) can provide an important technological possibility for curriculum development. Datasets built in local languages, and models trained on them, can support transcription and preservation of oral narratives through AI-assisted speech recognition and natural language processing technologies. AI-supported knowledge graphs can also help map relationships among narratives, cultural practices, places and people, allowing scholars to explore the complexities and interconnectedness of indigenous communication. AI can further support the restructuring of media curricula by connecting indigenous communication practices with existing communication education. AI can assist in creating comparative and contextual learning environments in which students can examine different communication systems according to their functions, structures and cultural context. Thus, the objective is not for AI to theorise indigenous knowledge but to help create conditions in which indigenous communication practices can be documented, accessed, compared and eventually theorised through the collaboration of researchers and knowledge communities. This idea aligns with Santos's (2007) idea of an ecology of knowledges in which different epistemologies coexist without one being treated as universally authoritative. In a similar vein, Abdi (2012) proposes the idea of 'co-created schooling' where diverse knowledge systems contribute to educational arrangements capable of producing meaningful and equitable outcomes. Applied to media education in Arunachal Pradesh, this points towards creating curricular spaces where indigenous communication traditions are not treated as supplementary cultural content but as a legitimate source of understanding communication, media and knowledge production. Drawing on Kirkness and Barnhardt's (1991) 'four Rs', the study therefore adopts respect, relevance, reciprocity and responsibility as foundational principles for AI-enabled indigenous curriculum development for media education in Arunachal Pradesh. These principles are consistent with decolonial approaches that emphasise indigenous agency in knowledge production.

Conclusion

The study concludes that indigenous communication traditions of Arunachal Pradesh constitute a substantial and continuing communication system that remains relevant beyond the technological boundaries of contemporary media. Their functions of information dissemination, emergency communication, knowledge transmission, social mobilisation and collective memory demonstrate that communication existed before the institutionalisation of modern media. However, analysis of media curricula reveals a substantial epistemic gap, as indigenous communication practices remain largely absent or labelled as 'folk media', which erodes the essence of the indigenous communication system and marginalises the communities as knowledge producers, reinforcing existing hierarchies of legitimate knowledge.

Therefore, decolonising media education should not simply reject Western concepts but expand the curriculum to accommodate indigenous epistemologies and culturally grounded communication practices. The study further suggests that AI can provide opportunities for documenting, preserving, mapping and integrating indigenous communication through locally developed datasets, speech recognition and natural language processing. However, technological integration must remain community-centred and guided by the principles of respect, relevance, reciprocity and responsibility (Kirkness & Barnhardt, 1991). Ultimately, an AI-enabled decolonial media curriculum can create an ecology of knowledges (Santos, 2007) in which indigenous and established communication traditions interact, contributing to more plural, contextual and culturally responsive media education in Arunachal Pradesh.

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ROAD CONNECTIVITY AND SOCIO-ECONOMIC DEVELOPMENT IN THE BORDER REGIONS OF ARUNACHAL PRADESH

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Abstract

Roads in the Himalayan border areas of India serve two purposes at once. They help local people improve their lives, and they help the state extend its administrative and military presence into difficult frontier land. Arunachal Pradesh is a special case in this picture. It shares a long and largely undefined boundary with China, along with borders with Bhutan and Myanmar. Most studies on road-building in the state have looked at the subject mainly through geopolitics, defence needs, and the wider India-China rivalry. Far less attention has gone to how the people living along these roads actually experience them in daily life. This paper looks beyond security and strategy to ask a simpler question: what has road connectivity meant for the everyday lives of border communities in Arunachal Pradesh? It examines how roads have shaped socio-economic conditions in these regions, using a descriptive research design based on both primary and secondary sources. For primary data, the study relied on purposive sampling. Scheduled Interview (mostly telephonic) were done with permanent residents of border villages, most of them students from these districts now studying in the Itanagar Capital Region. The results show that major road programmes, including the Special Accelerated Road Development Programme for the North East, the Trans-Arunachal Highway, and the Arunachal Frontier Highway, have reduced the isolation of many frontier villages. However, the pace and quality of construction remain uneven across districts. The paper argues that lasting development in border areas depends on planning that brings together strategic infrastructure goals and the actual needs and priorities of the people who live there. Connectivity, in other words, should not be treated only as a matter of national security, but as a matter of everyday life for border communities.

Keywords : Border connectivity, Arunachal Pradesh, socio-economic development, frontier communities, road infrastructure.

Introduction

Road connectivity is widely recognised as a critical factor for regional development, particularly in mountainous and geographically remote areas where distance and challenging conditions restrict access to markets, education, health care, and other public services (World Bank, 2009; Calderón & Servén, 2008). In such contexts, roads serve not only as transportation routes but also as networks shaping arrangements of mobility, livelihoods, institutional access, and engagement with the broader economy. This importance is especially evident in Arunachal Pradesh, where scattered settlements, rugged topography, and limited alternative transportation options makes road connectivity essential to daily life (Department of Economics & Statistics, 2024).

The strategic geopolitical significance of Arunachal Pradesh, given its borders with China, Bhutan, and Myanmar, has significantly shaped discussions on road development in the state. As a result, regional security, border management, and geopolitical competition often take precedence in decisions regarding road infrastructure. Although these considerations are important, this focus may overlook a crucial issue: identifying beneficiaries of improved connectivity.

Infrastructure development in the border areas of Arunachal Pradesh is closely associated with India's evolving border management policy. Following the Sino-Indian War in 1962, several frontier regions remained underdeveloped, partly due to security concerns that improved infrastructure might facilitate the movement of Chinese troops into Indian territory

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(Rahman, 2020). Since the late 1990s, however, the Government of India has increasingly prioritised enhancing infrastructure and connectivity in these border areas. Roads have come to be regarded not only as strategic assets for defence but also as vital links connecting remote settlements to administrative, economic, and social systems (Ziipao, 2018; Bhattacharya & Deka, 2021).

Several government initiatives, including the Border Roads Organisation, Border Area Development Programme, The Special Accelerated Road Development Programme for North East (SARDP-NE), Pradhan Mantri Gram Sadak Yojana, and Vibrant Villages Programme, have facilitated road development in Arunachal Pradesh (Bose & Singh, 2026). Major projects such as the Trans-Arunachal Highway (NH-13), and Arunachal Frontier Highway (NH-913), Sela and Nechiphu tunnels along the Balipara-Chariduar-Tawang road are designed to enhance connectivity across the state (Pattnaik & Panda, 2023). Additionally, feeder roads under the Vibrant Villages Programme aim to connect border villages with the existing road network (Ministry of Home Affairs, Government of India, 2026, July 28). These initiatives serve significant strategic purposes, particularly by improving access to various locations along the Line of Actual Control (LAC) and linking remote areas to district headquarters. Nevertheless, these roads do not always effectively communicate their broader significance to local communities within the strategic framework.

This paper shifts the focus from roads as strategic infrastructure to roads as social infrastructure. It examines the effects of improved road connectivity on mobility, access to essential services, livelihoods, markets, and engagement with public institutions among communities in selected border regions of Arunachal Pradesh. The central research question is: What impact has road connectivity had on the daily socio-economic life of communities in the border areas of Arunachal Pradesh? The significance of road connectivity extends beyond strategic and geopolitical objectives; roads can reduce geographical isolation and transform the daily socio-economic opportunities and experiences of border communities.

Review of Literature

The literature available on road and infrastructure development in Arunachal Pradesh broadly falls into three thematic areas: strategic and geopolitical importance of the road and infrastructure along the borders, developmental and economic costs of connectivity, and experiences of the local communities in the frontier areas. The first two dimensions have garnered most of the scholarship, with the lived implications of connectivity comparatively under explored.

There is considerable literature on the topic of road construction from a border security and state security perspective. In his research on infrastructure development along the Sino-Indian border, (Rahman M. Z., 2018) argues that roads in Arunachal Pradesh have always been tied to the military needs and, recently, to the developmental and strategic goals. The study also highlights perceptions of local infrastructure projects and the need for community backing in the development of a frontier. Similarly, (Ajin, 2022) looks at the process of making roads in Tawang, and argues that road construction is both developmental and strategic. His study also highlights the challenges facing the local population due to the landslides, poor connectivity and limited medical facilities. (Pattnaik & Panda, 2023) also situate the phenomenon of road construction in the broader context of infrastructural rivalry between India and China and the growing ‘securitisation’ of the border region. In the aggregate these studies suggest that roads cannot be divorced from issues of territory, sovereignty and border management in Arunachal Pradesh. But their main concern is not the systematic analysis of the impact of connectivity on the daily socio-economic conditions, it is the strategic and political value of infrastructure.

A second body of literature relates connectivity to economic development and regional integration. (Ziipao, 2018) holds that better road and market infrastructure is needed to connect the Northeast with the rest of the country and the rest of Southeast Asia and that Arunachal Pradesh’s roads are inadequate and unreliable. Similarly, (Bhattacharya & Deka, 2021) look at post-liberalisation road projects in the North East and how the programmes like SARDP-NE have tried to integrate far-flung remote areas with the broader economic network. Their work acknowledges that infrastructure development is not just a strategic interest of the state, but also an impact on the lives of local peoples. While examining railway infrastructure, (Shrivastva et al., 2023) also emphasize that connectivity has a dual nature in the Sino-Indian border region in terms of development and strategy.
It is thus established from the literature that infrastructure in Arunachal Pradesh serves various purposes;

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(i) it enables territorial administration and security, (ii) facilitates economic integration and (iii) can enhance the situation of remote communities.

However, it is still not possible to match the musings on infrastructure as a strategic/developmental project with a more detailed examination of connectivity as a feature of everyday life. There is little systematic evidence from existing studies that exists about the experiences of residents of the changes in their mobility, access to education and healthcare, market access, employment and interactions with public institutions as a result of improved road connectivity. In the event of local communities being mentioned, there is a strong focus on reactions to strategic projects or the overall borders development goals. The present study fills this void as it focuses its analysis on the impact of road on the day-to-day socio-economic well-being of communities in selected border regions of Arunachal Pradesh, instead of the strategic objective of the road.

Methodology

The study is of qualitative descriptive research design and both primary and secondary data sources are used. For the purpose of primary data collection, 30 respondents were selected from local inhabitants of selected border villages of Tawang, Upper Subansiri and Anjaw district, with ten respondents from each district, and scheduled semi-structured interviews were conducted. The respondents were purposefully sampled and snowball sampling was then employed to locate and make contact with other eligible people living in the selected villages along the border.

The respondents were the permanent and original inhabitants of the selected villages but some of them were temporarily residing in the Itanagar Capital Region for educational purpose and were having close social and familial relation with their respective home villages. Due to the geographical remoteness, difficult terrain and accessibility constraints of the study areas, most of the interviews were conducted telephonically. Secondary data was gathered from Government of Arunachal Pradesh Reports, Census of India Publications, Economic Surveys, Reports from various ministries and departments, official road and connectivity documents, academic literature and published research. Data was analysed using descriptive interpretation.

Findings

The results show that the road connectivity has somewhat positively affected in varying degrees the different aspects of everyday access in the three selected border districts. This was especially noticeable for health services, schools, markets, government services and livelihood. The responses from Upper Subansiri and Anjaw suggest connectivity benefits are smaller in certain parts, though Tawang continues to have a high level of perceived improvement. The results are organized into themes below.

Healthcare Access

Road connectivity is seen to have enhanced access to healthcare, but there is a wide variation in the level of improvement in the various districts. The percentage of perceived improvement in Tawang is the highest at 63%, followed by Upper Subansiri at 47% and Anjaw at 40%. The improvement in healthcare access for a relatively large proportion of respondents in Tawang is evident, while the lower figures for Upper Subansiri and Anjaw indicate that improved roads may not provide the same level of access to healthcare facilities in geographically challenging areas.

Education Access

The percentage of people having better access to education is Tawang has 67%, Upper Subansiri has 53% and Anjaw has 47%. The data in figure 1 show that, educational access has improved due to the connectivity of the roads, and the improvement is highest at Tawang. While the benefits of connectivity to education are evident, they are not felt equally across the districts.

Market Access

The percentage of people having better access to the market is 70% in Tawang, 60% in Upper Subansiri and 53% in Anjaw. Data shows that over half of the respondents in all three districts felt their access to markets had improved.

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Access to Government Services

The perception of access improvement to government services is relatively less than education and markets. Tawang shows 57% while Upper Subansiri shows 47% and Anjaw shows 37% respectively. While access to the road seems to have improved access to government services for a significant proportion of the respondents, however, data suggest that access to road does not necessarily imply access to public institutions and services.

Livelihood Opportunities

The results for livelihood opportunities are less consistent. In Tawang it account for 57% while in Upper Subansiri it accounts for 43% and in Anjaw 37%. This distinction is significant because it implies that better market access does not always go hand-in-hand with a greater sense of better livelihood opportunities. Thus, roads can contribute to increased access to markets but not necessarily provide employment or other livelihood activities.

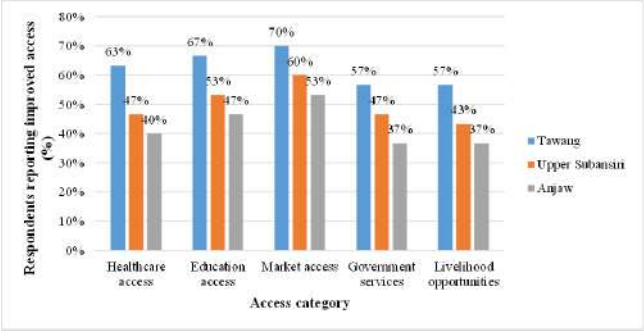


Figure 1: Perceived Improvements in Access Following Road Connectivity

Discussion

The data suggest that road connectivity has produced noticeable changes in the daily lives of residents in the selected border areas, although these changes vary across the three districts. Market access was perceived as the most improved dimension of road connectivity, in Tawang (70%), Upper Subansiri (60%), and Anjaw (53%) according to surveys. Education and healthcare also showed perceived improvements. These findings indicate that the primary benefit of roads lies not in their intended functions, but in their capacity to reduce the practical challenges posed by distance. This observation is dependable with broader assessments of rural roads, which emphasise that key socio-economic impacts of road connectivity include increased mobility and improved access to markets, healthcare, education, and employment opportunities in rural regions. Interviews further highlight the transformation in healthcare access due to improved connectivity. During medical emergencies, reaching the district hospital via roads to Tinsukia and Dibrugarh became more feasible, although the district hospital continued to lack certain specialised facilities, as noted by a respondent from Sung Village, Anjaw (personal communication, [10th August 2026]). Similarly, a respondent from Taksing Circle in Upper Subansiri linked improved roads with greater ease of access to both the primary health centre and the district hospital (Taksing respondent, personal communication, [11th August 2026]). The significance of these interpretations lies not in the provision of new healthcare facilities, but in the increased accessibility of existing ones. This is particularly important in a geographically dispersed state such as Arunachal Pradesh. These experiences are consistent with national evidence indicating that the introduction of all-weather roads enhances access to health facilities and facilitates movement during medical emergencies (Ministry of Rural Development, Government of India, 2026).

A similar correlation is evident within the educational sector. Quantitative data show that 67% of respondents in Tawang, 53% in Upper Subansiri, and 47% in Anjaw reported a positive perception of improved access to education. Interview data indicate that this benefit is especially significant for students who must travel outside their villages to pursue higher education. According to a Lampung village representative from Anjaw, despite improved road access, students remain unable to pursue further education within the district due to the absence of degree-level education providers (Lampung respondent, personal communication, [10th August 2026]). A respondent from Limeking Circle stated that enhanced road connectivity has enabled youths to attend college in Itanagar and other locations. Similarly, a respondent from Zemithang in Tawang observed that improved connectivity has increased educational mobility among the youth (Limeking and Zemithang respondents, personal communication, [8th August 2026]). While roads do not establish schools, they facilitate access to existing educational institutions. The association between improved rural road

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transport and increased school attendance and access to higher education is further substantiated by PMGSY assessments (Ministry of Rural Development, Government of India, 2026).

The most significant benefits of connectivity pertain to market access. Respondents from Chenguinty, Anjaw highlighted the ease of transporting agricultural produce to local markets, while those from Taksing emphasised the transport of crops such as kiwi and dragon fruit. Farmers from Yuthumbu and Dungse in Tawang also associated improved roads with the movement of agricultural, horticultural, fisheries, and livestock products to markets (Chenguinty, Taksing, Yuthumbu and Dungse respondents, personal communication, [10th August 2026]). These interpretations help explain why market access demonstrates the highest percentage in the quantitative findings. Improved roads have facilitated the movement of goods and brought remote producers into closer contact with market centres. National assessments have reported that enhancements in rural roads have led to increased transport of agricultural produce, improved market access, and the growth of small economic activities (Ministry of Rural Development, Government of India, 2026).

The variation in livelihood opportunities is evident in the survey results: 57% of respondents in Tawang, 43% in Upper Subansiri, and 37% in Anjaw reported improvements in this area. Interview responses suggest that road development has facilitated existing economic activities by improving access to raw materials and enabling the shipment of finished products. However, these changes have not translated into significant employment growth. Respondents described reduced difficulties in sourcing raw materials and distributing products, but did not attribute substantial job creation to road construction.

In access to government services, in Tawang, 57% of respondents reported improvement, compared to 47% in Upper Subansiri and 37% in Anjaw. Respondents linked improved road infrastructure with increased participation in government programmes and service delivery interventions, such as Sarkar Aapke Dwar and Seva Aapke Dwar. Nevertheless, some respondents observed that attending service camps did not always complete the administrative process, as additional travel to government offices was often necessary (respondents from Tawang, Upper Subansiri and Anjaw, personal communication, [12th August 2026]). These findings indicate a distinction between physical access to state infrastructure and effective access to services. Although improved roads reduce geographical distances between villages and administrative institutions, they do not fully address procedural or institutional barriers.

The findings present an overview of rural road infrastructure in Arunachal Pradesh. Existing studies on border regions has primarily examined border infrastructure through the lenses of national security, geopolitics, and state-building. While these strategic functions remain significant, the present study highlights that roads serve both as strategic infrastructure and as essential social infrastructure for daily life. However, disparities among the three districts suggest that improved connectivity alone does not resolve deficiencies in healthcare, education, employment, or administration. The significance of roads is therefore linked to the opportunities they create for border communities to access institutions, markets, and services beyond their settlements. The extent to which these opportunities foster socio-economic development depends on the availability of complementary facilities and livelihood options.

Conclusion

While road connectivity in the border areas of Arunachal Pradesh is often emphasised for its strategic and national security significance, its importance extends beyond these roles. The study's findings demonstrate that improved road conditions have mitigated several challenges associated with geographical isolation, particularly by enhancing access to markets, education, and healthcare. Respondent (s) experiences further indicate that roads have facilitated the transportation of agricultural and horticultural produce, enabled access to educational institutions, supported visits to medical facilities, and improved contact with government services. However, these advantages are not uniformly experienced across the selected districts, and enhanced connectivity has not consistently led to improved livelihoods or adequate public services. The study therefore suggests for a conceptual shift, viewing roads as essential social infrastructure rather than solely as strategic assets. While roads are crucial for providing access and opportunities, the extent and quality of these opportunities depend on the availability of complementary facilities, employment prospects, public services, and ongoing maintenance. For

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border communities, connectivity not only links remote villages to the national road network but also reduces the effective distance to markets, institutions, and services essential for daily life.

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SUSTAINABLE DEVELOPMENT OF UNDERUTILIZED NATURAL FIBRES IN NORTH EAST INDIA: ADVANCES IN PRODUCTION, FIBRE BLENDING, VALUE ADDITION AND MARKET PROSPECTS

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Abstract

North East India possesses unique agro-climatic conditions that are highly conducive for cultivation of various natural fibre crops such as pineapple (Ananas comosus), banana (Musa spp.), roselle (Hibiscus sabdariffa L.), ramie (Boehmeria nivea), and okra (Abelmoschus esculentus). The extracted fibres are eco-friendly, renewable, biodegradable, and lightweight and possess good mechanical properties that make them suitable for application in textiles, composites, packaging, and various technical applications. Though they are abundantly available, a huge quantity of agro-wastes from these crops remains underutilized or burned in open fields. Consequently, valuable biomass resources are wasted, leading to increase environmental pollution. The scientific process of fibre extraction, processing, blending with conventional fibres, and value addition provides significant potential to enhance the circular bioeconomy and improve rural livelihoods in the North Eastern Region (NER). However, North Eastern Region faces challenges in terms of commercialization due to limited production system, mechanical extraction, inadequate fibre grading, lack of regional blending facilities and poor market linkage. This review examines the potential for production, agro-climatic adaptability, fibre properties, chemical compositions and utilization of underutilized natural fibres from North East India.The paper also highlights recent technological advancements in fibre processing, blending, diversification of value-added products, and export prospects. This approach can generate rural livelihood, encourage sustainable textile manufacturing, decrease environmental pollution, and establish North East India as a leading provider of eco-friendly natural fibres in both domestic and international markets.

Keywords : Natural fibres; North East India; Pineapple leaf fibre; Banana fibre; Roselle fibre

1.0 Introduction

Emerging concerns towards climate change, the depletion of petroleum-based resources and escalating environmental pollution have accelerated the worldwide shift towards sustainable and biodegradable materials. The textile sector, a major user of synthetic fibres, contributes approximately to 2-8% of global greenhouse emission. The increasing use of renewable natural fibres as eco-friendly substitutes can enhance the biodegradability of developed products, reduced carbon emissions, renewability, and alignment with circular economy principles (Mohanty et al., 2018; Joshi et al., 2023). North East India (NER), which includes Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Tripura, and Sikkim, boasts exceptional biodiversity, plentiful rainfall throughout the year, fertile quality soils, and favorable climate conditions that facilitate the growth of various fibre producing crops. Major Horticulture crops are grown in the areas and after harvesting of crops large amounts of agricultural biomass from the cultivation of pineapple, banana, roselle, ramie, okra etc are remain underutilized in the fields. Despite containing

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fibres with significant industrial potential, much of this biomass is discarded every season (Singha et al., 2022).

The North Eastern states play a central role in India's minor fiber production. Tripura, Assam, and Meghalaya are important states for pineapple cultivation, while Assam, Tripura, Mizoram, and Meghalaya are known for producing considerable amounts of bananas. Similarly, roselle is widely grown in Assam, Nagaland, and Meghalaya for its edible calyces, and ramie has been cultivated in Assam for a long time due to the suitable climate. Okra a high source of high-quality lingo cellulosic fibres. is grown throughout the region, resulting in a large amount of underutilized stem residue. The fiber posses low density, high specific strength, excellent moisture absorption, biodegradability, renewability, required for textile fiber and requires low production costs. The utilization are found in clothing, home furnishings, automotive composites, geotextiles, agro-textiles, medical textiles, and packaging materials that proves the need of fiber as industrial importance an increasing industrial interest in sustainable raw materials (Faruk et al., 2012; Satyanarayana et al., 2009). Unprocessed fiber contain high level of lignin and gummy substances that tend to make the fiber coarse and rigid, o which can be enhanced through fiber pretreatment that increases flexibility and spinning capabilities. The variability in fibre quality arises due to manual extraction techniques pose as a challenge for their adoption in contemporary textile industries (Reddy & Yang, 2005).

Fiber blending has emerged as a key strategy for achieving new sustainable fiber with different blend proportion. This approach combines the beneficial properties of various fibres while reducing their individual drawbacks. For example, combining pineapple leaf fibre with cotton enhances yarn strength without compromising softness; blending banana fibre with viscose improves moisture management and comfort; integrating roselle with cotton boosts durability; and blending ramie with silk or wool increases tensile strength and dimensional stability. These blends create opportunities for crafting high-quality, eco-friendly textiles that are suitable for both National and International markets. Besides promoting sustainable industrial growth, using agricultural residues directly supports the United Nations Sustainable Development Goals (SDGs), intended to consumption and production (SDG 12), climate action (SDG 13), decent work and economic growth (SDG 8), and industry, innovation, and infrastructure (SDG 9). Developing diverse value chains for underutilized natural fibres can thus strengthen regional bio economics while mitigating the environmental impact of agricultural waste disposal.

2.0 Agro-climatic advantage of North East India

North East India offers a congenial agro-climatic setting for growing natural fibre crops, because of its humid tropical to subtropical climate, annual rainfall between roughly 1,800 and over 4,000 mm, fertile alluvial and acidic soils, abundant organic matter, and moderate temperatures. These factors facilitate year-round biomass production and allow for the cultivation of a variety of fibre producing crops under rain-fed conditions with relatively low chemical usage (Baruah et al., 2021). The vast forest cover, rich biodiversity, and traditional agricultural systems of the region further encourage sustainable farming practices, making it ideal for producing eco-friendly lingo-cellulosic fibres.

Pineapple is widely grown on well-drained sandy loam soils with a pH of 4.5-6.5. Each hectare of pineapple cultivation after harvesting is able to yields about 50-70 tonnes of leaf biomass, (Cherian et al., 2010). Banana farming is prevalent due to the fertile loamy soils rich in organic content, which promote robust plant growth in the North Eastern region. After harvesting, the pseudostem is left as a plentiful agricultural byproduct, containing long fibres ideal for use in textiles and composites and also the pseudostem liquor can produce fire retardant fabrics (Basak, S.,et.al., 2015). Roselle (Hibiscus sabdariffa L.), an annual crop known for its bast fibres, thrives in warm, humid climates on sandy loam to clay loam soils with pH levels ranging from 5.5 to 7.5. This crop is widely grown mainly for its edible calyces, while its stems yield strong bast fibres suitable for spinning and technical textiles. Similarly, ramie (Boehmeria nivea), recognized as one of the strongest natural bast fibres, trappings in the high rainfall and humid subtropical climates found in Assam and nearby regions. Okra, a commonly grown vegetable known for its antidiabetic property, provides an additional source of biodegradable cellulose fibres that are largely underutilized. Such agro-climatic advantages position the region as an emerging hub for sustainable fibre production capable of supporting both domestic industries and international markets (Ahmad, N., et al.,2025).

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3.0 Production potential and physicochemical characteristics of underutilized natural fibres

The Agricultural biomass residues are rich in cellulose and have excellent mechanical properties, making them ideal for use in textiles, composites, packaging, and technical applications. For fruitful extraction of good fiber, proper fibre extraction, retting, degumming, and quality standardization are crucial. Recent research highlights that optimizing the conditions for fibre extraction not only enhances the quality of the fibres but also boosts spinning efficiency and commercial value (Faruk et al., 2012; Reddy & Yang, 2005).

3.1 Pineapple Leaf Fibre (PALF)

Pineapple stands out as a particularly promising source of leaf fibre where 50 to 70 tonnes of leaves per hectare can be harvested, from which 2 to 3 tonnes of high-quality fibre, depending on the variety and extraction technique used. Pineapple leaf fibre is recognized as a multicellular lingo cellulosic fibre with remarkable tensile strength. PALF is composed of approximately 70 to 82% cellulose, 5 to 12% hemi cellulose, 5 to 12% lignin, 1 to 3% pectin, along with minor amounts of waxes and ash. The substantial cellulose content is responsible for its excellent tensile strength (400-1627 MPa), Young's modulus (34-82 GPa), and relatively low density (1.44-1.56 g cm^{-3}), positioning it among the strongest natural leaf fibres known (Asim et al., 2015; Cherian et al., 2010).

Mechanical decortication is the favored method for extraction as it yields more fibre in less processing time.Chemical retting utilizing 2-5% sodium hydroxide at temperatures of 80-90°C for duration of 1-2 hours effectively eliminates non-cellulosic materials and enhances flexibility, dye absorption, and spinning characteristics (George et al., 2014).

3.2 Banana fibre

After harvested, each banana plant pseudostem weighing about 25-40 kg and one hectare of banana farming produces approximately 60-80 tonnes of pseudostem biomass, contribution significant potential for fibre extraction and can boosts rural incomes. Banana fibre is mainly composed 60-65% cellulose, 6-19% hemi cellulose, 5-10% lignin, 3-5% pectin, along with small amounts of waxes and ash.

The properties of these fibres vary based on the cultivar, maturity, and extraction technique. They have tensile strengths between 350-600 MPa, elongation at break from 1.5-3.5%, and a density of around 1.35 g cm^{-3}, making them alternatives for synthetic reinforcement fibres (Elanthikkal et al., 2010). Water retting process takes 10-20 days, enzymatic retting with pectinase and cellulase cuts processing time down to 24-72 hours. Chemical degumming, involving 4-6% sodium hydroxide at 90°C for about 60-90 minutes, efficiently eliminates lignin, hemicellulose, and gummy substances, leading to softer fibres with enhanced spinning and dyeing capabilities.

3.3 Roselle fibre

Roselle (Hibiscus sabdariffa L.) is a key annual bast fibre crop grown in Assam, Meghalaya, Nagaland, and various other regions of North East India. The plant can thrives in warm, humid climates and performs well under rainfed conditions, making it ideal for diverse farming systems. Roselle fiber comprises about 62-74% cellulose, 15-18% hemicellulose, 8-13% lignin, 2-4% pectin along with small amounts of waxes and ash. These fibres possess tensile strengths between 350-550 MPa, exhibit good flexibility, and have a relatively low density, making them suitable for textile yarns, technical textiles, and composite materials.

Water retting is the most prevalent extraction technique, typically taking 12-18 days, depending on temperature and microbial activity. Chemical retting significantly lowers the retting period to 7-10 days. In contrast, enzymatic retting with commercial pectinase enzyme can reduce the process to just 24-48 hours, yielding cleaner fibres with enhanced fineness and less environmental impact. After retting, treating the fibres with a mild alkali solution of 4-5% sodium hydroxide at around 80°C for an hour efficiently eliminates remaining gums, improving both fibre softness and dye uptake.

3.4 Ramie fibre

Ramie (Boehmeria nivea L.), commonly known as "China grass," is one of the strongest natural bast fibres available and has been cultivated in humid subtropical climate of Assam for a long time. Unlike annual bast fibres, ramie is a perennial plant that can be harvested multiple times a year, ensuring a steady fibre supply. Ramie have very high cellulose content, typically between 68-76%, along with 13-16% hemicellulose, 0.6-1.2% lignin, 4-7% pectin, and minor quantities of waxes and gums. Its low lignin content enhances its remarkable whiteness, high tensile strength (400-938 MPa), excellent lustre, and superior moisture absorption.

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These characteristics make ramie ideal for high-quality clothing, industrial textiles, and blended yarns. Water retting typically takes between 5 and 10 days, while enzymatic degumming with pectinase and xylanase significantly enhances fibre quality and minimizes environmental impact. Optimized chemical degumming usually employs 5-8% sodium hydroxide at temperatures of 95–100°C for about 1-2 hours, followed by neutralization and rinsing.

3.5 Okra Fibre

Okra fibre is composed of about 57-67% cellulose, 15-20% hemicellulose, 7-12% lignin, and 3-6% pectin. These fibres are lightweight, biodegradable, and possess moderate tensile strength, making them ideal for applications such as nonwoven materials, handmade paper, biodegradable composites, and packaging. Water retting takes 8-15 days, whereas enzymatic retting significantly shortens the process and yields cleaner fibres. Treating the fibres with a mild alkali solution of 4-5% sodium hydroxide at 80-90°C for around an hour effectively removes gummy substances and increases fibre flexibility. The comparative analysis of chemical composition and retting condition of the selected natural fibres were presented in Table 1.

Fibre	Cellulose (%)	Hemicellulose (%)	Lignin (%)	Pectin (%)	Conventional retting	Optimized process	References
Pineapple leaf	70-82	5-12	5-12	1-3	7-14 days	Enzymatic retting 18-48 h; 2-5% NaOH, 80-90°C, 1-2 h	Eleuterio et al., (2025)
Banana	60-65	6-19	5-10	3-5	10-20 days	Enzymatic retting 24-72 h; 4-6% NaOH, 90°C, 60-90 min	Bharali.P,2018
Roselle	62-74	15-18	8-13	2-4	12-18 days	Ribbon retting 7-10 days or enzymatic 24-48 h; 4-5% NaOH, 80°C, 1 h	Song et al., (2024)
Ramie	68-76	13-16	0.6-1.2	4-7	5-10 days	Enzymatic degumming 5-8% NaOH, 95-100°C, 1-2 h	Hindi et al., (2025)
Okra	57-67	15-20	7-12	3-6	8-15 days	Enzymatic retting; 4-5% NaOH, 80-90°C, ~1 h	Soraisham et al., (2022)

Table 1: Comparative chemical composition and optimized retting conditions

4. Fibre blending technologies for sustainable textile development

Fibre blending is an effective step to overcome each fiber limitation by combining fibres with fiber having complementary properties. Blending is commonly carried out during fibre opening, carding, drawing, or spinning, with ring spinning being the most widely used technique. Pineapple, banana, roselle, ramie, and okra fibres blended with cotton, silk, viscose, bamboo, or other regenerated cellulosic fibres produce yarns and fabrics with enhanced mechanical performance, moisture management, dyeability, and durability(Reddy & Yang, 2005; Faruk et al., 2012). Such blends also promote the sustainable utilization of agricultural residues while meeting the increasing demand for eco-friendly and high-performance textile products as stated in Table 2 and Figure 1.

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Fig 1. Fiber Blending: From Minor Fiber to Sustainable Textiles

Underutilized fibre	Blending fibre	Suggested ratio	Major applications
Pineapple leaf fibre	Cotton	30:70	Apparel fabrics, shirts, sarees, dress materials
Pineapple leaf fibre	Eri silk	40:60	Premium handloom textiles, scarves, stoles
Banana fibre	Cotton	50:50	Apparel, denim, casual wear
Banana fibre	Viscose	40:60	Fashion garments, knitted fabrics
Banana fibre	Wool	30:70	Winter wear, blankets
Roselle fibre	Cotton	40:60	Home textiles, upholstery
Roselle fibre	Viscose	50:50	Apparel, decorative fabrics
Ramie	Cotton	50:50	Fine shirting, trousers
Ramie	Silk	40:60	Luxury apparel
Ramie	Wool	30:70	Winter fabrics
Okra fibre	Cotton	20:80	Eco-friendly woven fabrics
Okra fibre	Bamboo	30:70	Medical textiles, sustainable packaging

Table 2 Recommended fibre blends and potential applications

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5 Opportunities and value added products from Blended fibers

The commercial possible of utilization of the underutilized natural fibres by converting raw biomass into high-value products through scientific processing, will able to produce innovative products and can be commercialized through branding, and market integration. Fibres such as pineapple, banana, roselle, ramie, and okra can be utilized in textiles, home furnishings, technical textiles, natural fibre composites, biodegradable packaging, and paper products shown in Figure 2. Blending these fibres with cotton, silk, or regenerated cellulosic fibres enhances product quality while supporting sustainable fashion and traditional handloom industries. They also have applications in geo textiles, agro-textiles, filtration materials, automotive components, construction boards, and eco-friendly packaging. Cellulose-rich agricultural residues can be converted into handmade paper, biodegradable disposables, and advanced biomaterials for biomedical applications. Establishing decentralized fibre processing and product development clusters can further enhance value addition, generate rural employment, and strengthen livelihood opportunities for farmers, women, self-help groups (SHGs), and farmer producer organizations (FPOs).

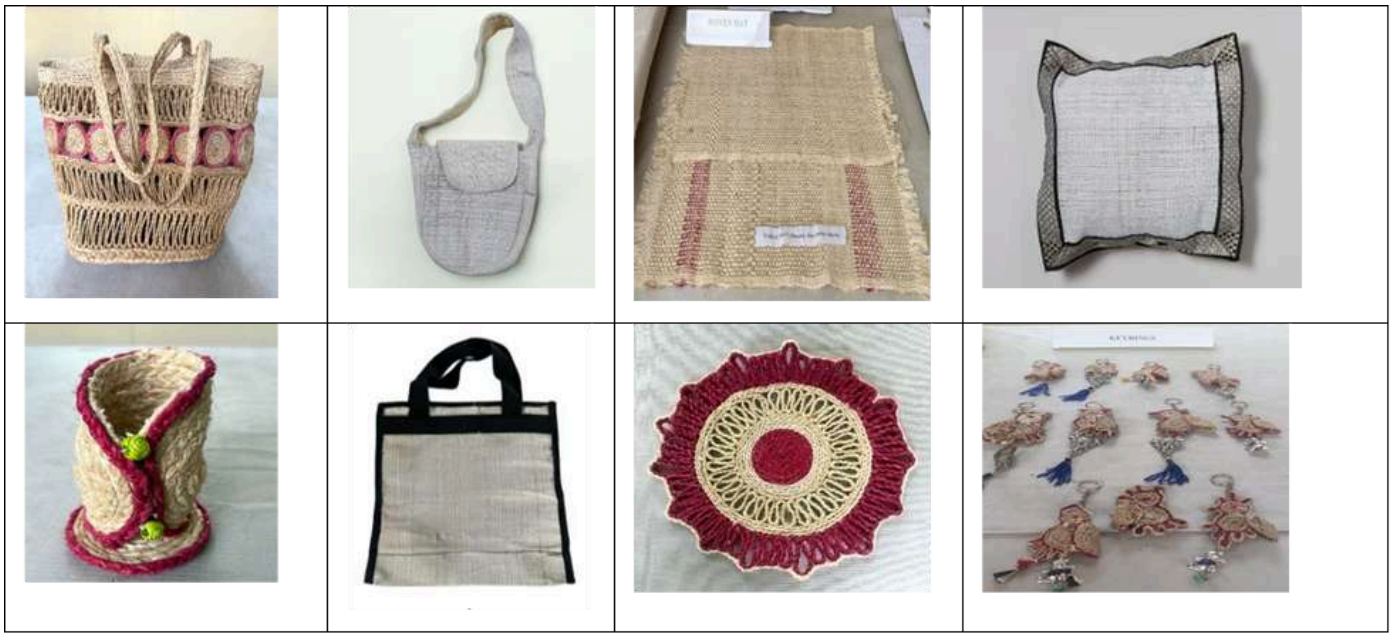


Fig.2. Value added products developed from Minor fiber

6 Export Potential and Market Opportunities

The global demand for sustainable natural fibres is ever-increasing rapidly due to growing environmental awareness, stricter regulations to environmental protocol, and the shift towards renewable materials in textiles, automotive, furniture, and packaging industries. Fibres such as pineapple, banana, and ramie have already gained commercial importance in countries including the Philippines, Japan, China, and other Southeast Asian nations. North East India has strong export potential because of its abundant agricultural biomass, organic farming practices, rich handloom heritage, and strategic proximity to neighbouring countries.

New strategies should focus on establishing integrated fibre processing centres equipped with modern extraction, spinning, and testing facilities, while strengthening Farmer Producer Organizations (FPOs), Self-Help Groups (SHGs), and rural enterprises. Greater collaboration among government, academia, and industry, along with research on eco-friendly processing technologies, advanced fibre blends, and functional textiles, will enhance product quality and market competitiveness. The implementation of digital traceability, life cycle assessment (LCA), and circular economy principles will prop up the sustainable growth of the natural minor fibre sector in North East India. To access international markets, importance should be laid on standardized fibre processing, quality testing, traceability, sustainability certifications (e.g., GOTS and OEKO-TEX), and branding, which will increase the global competitiveness of natural fibre-based products.

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Conclusion

Underutilized fibers represent a vital renewable resource with the potential to transform the rural economy of the North Eastern region. The scientific use of agricultural residues through mechanical extraction, optimized retting, fibre blending, and product diversification can greatly boosts Nation economy. Fibre blending technologies allow for the development of high-quality yarns and fabrics by combining the excellent mechanical properties of these fibres with the comfort and processability. Establishing integrated fibre processing and blending centers, supported by quality testing laboratories, research institutions, and industrial partnerships, will aid in the commercialization of sustainable natural fibre. Product innovation, quality certification, branding and export promotion can position North East India as a globally recognized supplier of environmentally sustainable textile materials from minor fibers.

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REFLECTIONS: THE GAIDINLIU COLLECTION AT THE PITT RIVERS MUSEUM

by Som Kamei

I have been told by a very good friend of mine who recently visited the Pitt Rivers Museum in Oxford that one was immediately struck by the density of objects, each carrying fragments of histories, cultures, and memories. And for every object on display, there are many more that remain in museum storage. And even though it has never been exhibited publicly, the Rani Gaidinliu collection stands out among them—not only for its historical significance but also for the way it embodies the collective memory of the Zeliangrong community. For me, reflecting on this collection is not just about the objects themselves, but about the layered meanings they carry and the responsibilities museums hold in shaping narratives of identity and heritage.

Rani Gaidinliu: A Living Memory

Rani Gaidinliu, often recognised and remembered as a freedom fighter and spiritual leader, occupies a unique place in the history of the North East. Her resistance against colonial rule and her advocacy for the cultural and spiritual revival of the Zeliangrong people made her more than a political figure—she became a symbol of resilience. The collection at Pitt Rivers, consisting of shawls, undeciphered scripts in notebooks, and other personal artifacts, is not merely a set of objects; it is a repository of lived experiences and cultural continuity. Indeed, many of her personal associates, close followers, and former soldiers in her guerilla army are still living today. They have played an important role in keeping alive the memory of Rani Gaidinliu and her life's work. The sharing of the digitised Gaidinliu Collection with the community was an opportunity for these memories to be brought to life and shared with the community, especially the younger generations.

Role of Museums

Museums like Pitt Rivers play a dual role. On one hand, they preserve fragile histories, ensuring that objects survive the passage of time. On the other, they inevitably shape how those histories are told and remembered. For instance, It was surprising to learn that, even today, most of the information about the artefacts in the Gaidinliu Collection comes from the notes made by the colonial officers who captured her. They tend to represent Gaidinliu, her activities, and her followers in a somewhat negative light, and through the textual descriptions, this perspective shapes how the history of Gaidinliu is told to museum visitors. There is a need to revisit the language through which the artefacts in the collection become meaningful to viewers. For that to happen, we need to illuminate for the viewer the multilayered nature of Gaidinliu's activities—her life and story must be retold from the Zeliangrong Naga perspective. Museums must also recognise that they have a responsibility to preserve these collections, but also to give voice to what they mean for the community. For the Zeliangrong community, the presence of Rani Gaidinliu's collection in Oxford is both a source of pride and a reminder of displacement. The objects are safeguarded, yet they are far from the land and people whose stories they embody.

This distance raises questions about ownership, representation, and the ethics of care. One must consider what it means to care for the collection. Is it sufficient to protect it from physical damage, or do museums also need to care for the cultural well-being of the object and its relationships with the community?

Collective Memories and Community

The Zeliangrong community's collective memory is deeply tied to Rani Gaidinliu's legacy. Her shawls, for instance, are not just textiles; they are woven with meanings of identity, resistance, and belonging. The undeciphered scripts she left behind are tantalizing

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fragments of thought— unfinished, yet powerful in their mystery. For the community, these objects are touchstones of memory, connecting generations to a shared past. Yet when housed in a museum thousands of miles away, they risk becoming detached from the living practices and oral traditions that give them meaning. The undeciphered scripts, for example, are more than archival curiosities; they are invitations to engage with the intellectual and spiritual world of Rani Gaidinliu.

The care of such collections is not only about conservation but also about contextualization. Preserving shawls in controlled environments ensures their physical survival, but what about the intangible heritage they represent? One might even say that their historicity lies not only in their age but in their potential to spark dialogue, research, and renewed cultural pride. I was very happy to learn that one of the important forms of community engagement undertaken as part of the DiMuse project was the collaboration with community weavers to produce replicas of the original handlooms in the Gaidinliu Collection. These efforts showcased the work of community weavers and reactivated traditional weaving knowledge about rare designs and techniques. More such efforts ought to be undertaken, as they help in revitalising intangible cultural heritage of the community. The research-oriented objectives of museum projects provide a conducive space for close study and discussion.

Revitalising such traditional cultural practices is an important way in which museums can move beyond being custodians of objects to becoming facilitators of memory. This means collaborating with communities, allowing them to interpret and narrate their own histories. Without this, collections risk being frozen in time—beautiful but silent.
Another aspect of this is the scope for the pedagogical uses of the digitised Gaidinliu Collection. The digital copies shared with the community are being used to tell audiences about Zeliangrong culture and Rani Gaidinliu's life in an engaging manner. The digital space offers a lot of scope to use new technologies to create visualisations, narratives, and online communities through which people can share and learn.

My personal reflections

My friend and renowned academic, Arkotong Longkumer was kind enough to send me the digital copies of the Rani Gaidinliu collection from PRM.

When I received it finally, even though it was just a replicas I felt a tension between admiration and longing. Admiration for the meticulous care with which the museum preserves these artifacts, and longing for them to be closer to the people whose stories they embody. The shawls seemed to whisper of journeys, rituals, and resistance. The undeciphered scripts felt like unfinished conversations, waiting for the community to reclaim and interpret them. The collection is not just about the past—it is about the continuity of memory, the resilience of identity, and the responsibility of institutions to honour living cultures.

The Rani Gaidinliu collection at Pitt Rivers Museum is more than a set of historical objects—it is a mirror of collective memory, a reminder of resilience, and a challenge to rethink the role of museums. For the Zeliangrong community, these artifacts are not relics but living symbols. As museums continue to grapple with questions of representation and care, the collection calls for a more inclusive approach—one that bridges the gap between preservation and participation, between Oxford and the hills of the North East. Are there ways to bring museum collections closer to communities? How can communities and museums work together to enrich what we know about artefacts? The use of digital technologies may help to bridge this gap in some sense, but one must remember that ultimately it is a matter of living, evolving relationships and not just technology.

The shawls, the undeciphered scripts, and the entire collection remind us that memory is not static. It is woven, spoken, and lived. And museums, if they are to truly honour heritage, must ensure that these memories remain alive—not only within their walls but within the communities to whom they belong. Even as endeavours such as the digitisation and return of museum artefacts can help to further the task of bridging the distance between museums and communities, much more remains to be done. Most importantly, there is a need to think about museum-community engagement in a long-term perspective. How can we establish strong relationships built on trust, collaboration, and a recognition of mutual interests but also difference? In this sense, I see the DiMuse project as a first step in this direction. And I am hopeful that the relationships built over the course of this project will develop into an enduring relationship that reconnects the Zeliangrong Naga people with their cultural heritage and memory.

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