

History, Habitat, Ecosystem Services, and Sustainable Tourism Revealed through Geoinformatics Techniques and Field Visit: Comprehensive Study on Khonoma Heritage Village, Nagaland

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Abstract

Khonoma Heritage Village, located in Nagaland, India, symbolizes sustainable practices and cultural significance. The village, situated in the hilly terrain of Nagaland, is a paradise for nature lovers, offering serene escapes into the region's natural beauty. Khonoma holds the title of the first green village in India, a testament to its community's commitment to conservation. The village is home to the Angami tribe, known for its warrior traditions, and played a crucial role in resisting British colonial forces during the Battle of Khonoma in 1879. The village was part of the undivided Assam province, and the British aimed to build a road through it to reach Manipur. The village has a community-driven approach to development and conservation, with local councils playing a pivotal role in decision-making. Robust initiatives are in place to educate locals and visitors about sustainable living and cultural heritage preservation. Khonoma village, established over 500 years ago, relies on cultivation for its livelihood, focusing on cash crops. The village uses jhum cultivation and wet rice cultivation, promoting sustainable agriculture through terrace farming. The village has various plants, trees, flowers, and wild fruits, including cane, bamboo, and colorful orchids. The rich green environment supports biodiversity, with reptiles, butterflies, animals, and birds, including "Blyth's Tragopan", found in the area. Khonoma villagers avoid chemical pesticides and fertilizers for farming. Every home in the village has an organic kitchen garden, and the villagers are skilled in traditional crafts like weaving and bamboo work. The village hosts traditional festivals, including Sekrenyi, a significant festival

for the Angami tribe. The villagers produce intricate handloom products and bamboo artifacts. Khonoma aims to become a sustainable heritage tourism destination, showcasing historical sites, traditional heritage gardens, and archaeological societies. However, challenges such as maintaining ecological balance, ensuring sustainable tourism, and preserving cultural heritage remain. The study on Khonoma Heritage Village investigates sustainable practices, cultural heritage preservation, community engagement, and challenges using qualitative methods like interviews, focus groups, documentary analysis, and field visits. The study examines how ecological conservation efforts, such as terrace farming and biodiversity preservation, align with cultural traditions like the Sekrenyi festival and traditional crafts. The study also addresses challenges like ecological balance and sustainable tourism promotions while identifying opportunities for heritage tourism. It aims to propose policies for sustainable development and cultural preservation and potentially serve as a global model. The study assessed ecosystem services through remote sensing data, which has been utilized and interpreted by indices mapping like NDVI, LST, and NDWI. Landscape mapping has been done using Google Earth images and topographical maps.

Keywords

Ecological, Conservation, Sustainable, Community-Driven, Tourism

1. Introduction

An ecosystem is a group of living things that includes microorganisms, plants, and animals. An ecosystem is the interaction of living and non-living environmental physical and chemical components. Ecosystem services help to benefit by providing environment or biodiversity to humans, such as water, fresh air, and food. It controls the environment's capacity to provide ecosystem services (Balvanera et al., 2016). Scientific understanding helps to improve ecosystem production, but it remains a limited factor in incorporating the natural components into decisions through national accounting systems and other mechanisms (Daily et al., 2009). Several initiatives to conserve the totality of forest ecosystems have been taken up across the world, many of which are led by the government, NGOs, and local communities themselves (Chase & Singh, 2012). Habitats are primarily classified based on the climate. Habitat is used as a concept of space or place, having suitable conditions where life can dwell and the occurrence of every living organism in such places and spaces. Habitat loss has been the most significant threat to biodiversity (Brooks et al., 2002; Hanski, 2005). Because of the growing human population and the rising demand for resources, efforts to conserve natural ecosystems on agricultural land, pastures, plantations, developed areas, and infrastructure are ongoing (Alinger, 2024; Hanski, 2005). Forests' provisions of tangible and intangible benefits are fundamental for the survival of human beings. (Chase & Singh, 2013). Headhunting has a profound social and cultural significance for the Khonoma

village in northeastern India Nagaland (Aiyadurai & Banerjee, 2022). It has some complex traditional values. The residents of this village believed that spiritual power is associated with the head of a human. They thought that if they took the head of any enemy, they could capture their life force or soul, which would help bring blessings to their village. However, the ban on logging and headhunting helped to enrich the forest. It declared a vast area of its forest as Tragopan Sanctuary, and Khonoma village became the first green village in India (Chase & Singh, 2014). This village is a study center and an important tourist destination.

1.1. Research Gap and Question

After interviewing the villagers and conservation with a local guide and reviewing all kinds of literature, we aim to report in this paper how the local community conserves their rich forest resources, manages the ecosystem, spends their livelihood, and improves their village as a sustainable tourist destination based on their history. After reviewing existing literature, various research gaps have been pinpointed that could direct future investigations in ecology, conservation, and community management. An analysis can focus on the integration of ecosystem services into policy development. Scientific research can be conducted to comprehend ecosystem services better and enhance ecological productivity. A qualitative investigation is needed to uncover the non-tangible contributions of biodiversity to human well-being and societal progress. Studies can be initiated to explore how these advantages can be quantified and assessed, which is essential for implementing effective conservation measures. Research could explore innovative strategies to mitigate habitat loss, focusing on the roles of urban planning, agricultural methods, and infrastructure development in habitat preservation. Research should aim to understand the village's historical background, cultural importance, threats, and the conservation of its culture and heritage.

It is essential to recognize the role of Local Communities in Ecosystem Management. What cultural beliefs and practices shape conservation efforts and biodiversity management within indigenous populations should be investigated. Understanding their traditional ecological knowledge is crucial and may offer valuable perspectives. A key research question is to assess and examine the effects of tourism on local ecosystems and communities, as well as to pinpoint practices that encourage sustainable tourism while maintaining ecological integrity. Longitudinal studies on ecological transformations should be carried out in the village of Khonoma. These studies could shed light on the long-term effects of conservation methods and shifts in land-use practices. Cross-disciplinary research methodologies should be employed in Khonoma village. Future research may benefit from interdisciplinary approaches integrating insights from ecology, anthropology, economics, and sociology to develop a comprehensive understanding and solutions for ecosystem management. Comparative studies could also be conducted across various ecosystems and cultures to explore how diverse ecological and cultural contexts affect conservation strategies and their results.

1.2. Aims and Objectives

The research conducted on Khonoma Heritage Village offers a comprehensive exploration of sustainable practices, cultural heritage preservation, and community engagement while addressing various challenges the village faces. Utilizing qualitative methodologies such as in-depth interviews, engaging focus group discussions, meticulous documentary analysis, and insightful field visits, the study paints a detailed picture of life in Khonoma. It delves into the harmonious relationship between ecological conservation efforts—specifically, the traditional terrace farming methods and biodiversity preservation initiatives—and the rich cultural traditions that define the community, including the vibrant Sekrenyi festival and the intricate craftsmanship passed down through generations. By examining these connections, the study reveals how cultural practices and environmental stewardship can complement and enhance one another.

1.3. Significance of the Study

The Ecosystem Services Assessment of Khonoma Village can guide local policy and conservation actions, ensuring that ecosystem services are recognized and safeguarded.

The research results may offer valuable insights to local stakeholders for creating sustainable tourism initiatives that benefit both the community and tourists. This study can produce essential data that supports ecological and biodiversity conservation efforts. The findings could tackle intricate issues such as conservation and sustainable development by providing more integrated solutions. The outcomes of this comprehensive study could impact local and regional policies, empowering stakeholders to achieve a balance between development and environmental conservation.

2. The Study Area

Khonoma Village is located in the western part of Kohima, Nagaland. This village is 20 kilometers away from the capital of the Nagaland state, Kohima (**Figure 1**). This village spans between 94degree 02'00"E and 25degree 39'00"N. This village is under the Sechu-Zubza block of Kohima. Khonoma is perched on the top of the hill at an altitude of 1200 meters, surrounded by hills as high as 3000 meters (**Figure 2**). Its alternate name is Khwunoma (an Angami term, and the term is used for a local plant, *Glouthera fragreantisima*). This village is around 700 years old (Kalpavriksh Environmental Action Group). The village's topography comprises 58.53% hilly terrain, with the remaining 41.47% of the land mainly used for agriculture (Ozukum et al., 2023). This village is spread over 123 sq. km (Kalpavriksh Environmental Action Group). This village is located on the Indo-Myanmar border and got the "Green Village" tag because of the conservation of natural resources and the ecosystem (**Figure 3**). As per the recent survey of the 2011 census, the total population of this village is nearly 1943, of which 1024 are females, while 919 are males. According to 2011 census data, the village is considered to have a high literacy rate in overall Nagaland. The literacy rate is 83.41%, compared to the

79.55% of Nagaland. The male literacy rate is higher (93.72%) than the female (74.19%). This village's maximum number of people is under the scheduled Tribe category. There is no Schedule Caste class in the village. In the village, 1227 people were engaged in work activities (2011 census data). The Khonoma village was often described as a “warrior village” for the fierce resistance during the colonial period when the British attacked their hill (Figure 4). The village is covered with lush green forest, and many rare and endangered plant and animal species live there. This village is also known as the first green village in Asia. The village has 580 households (Figure 5). The village has a traditional gate at the entry point, and visitors are toured around the village through the cobblestone footpath. Villagers have mainly cultivated paddy by following Terrace farming (Agarwal & Narain, 1992) (Figure 6). This village is where the Naga warriors battled against the British. Apart from the main fort, several small forts exist around the village's alleys. Nature has gifted lush green abundance to the village (Figure 7). Women are making wooden crafts—baskets and weaving clothes. Alder-based jhum cultivation is mainly practiced by the local Angami tribal community. This jhum cultivation is helpful for nutrients and FYM (Farmyard manure) in the soil from the hill slope.

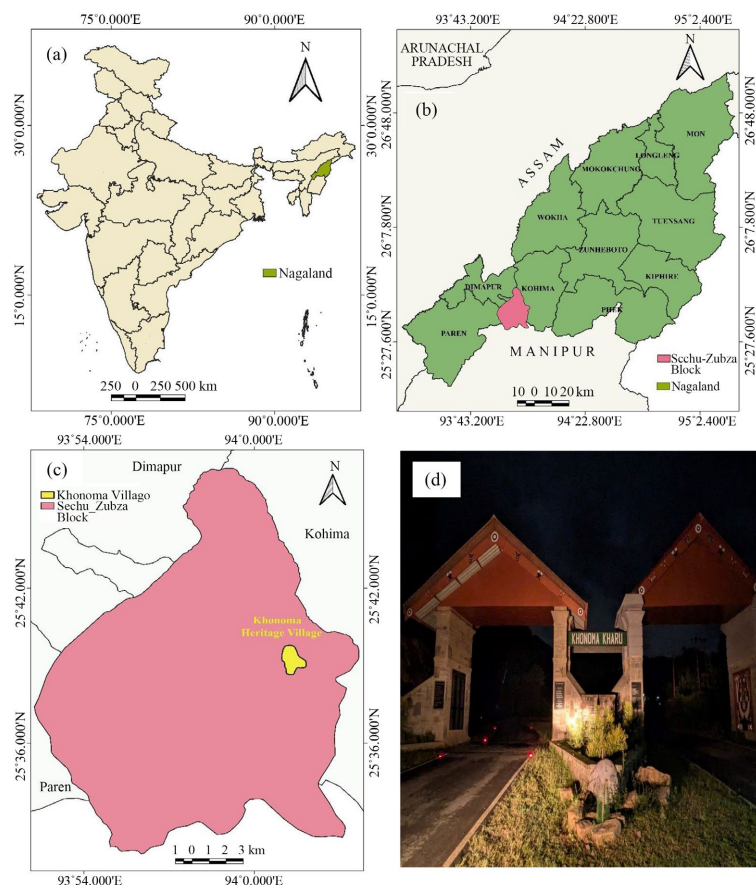


Figure 1. Location of Khonoma Village. This is a heritage village located in the North-eastern part of India. Khonoma village is situated in the hilly terrain of Nagaland. It is under the Sechu-Zubza block of Kohima district. Khonoma village is a paradise for nature lovers, offering serene escapes into the region's natural beauty.

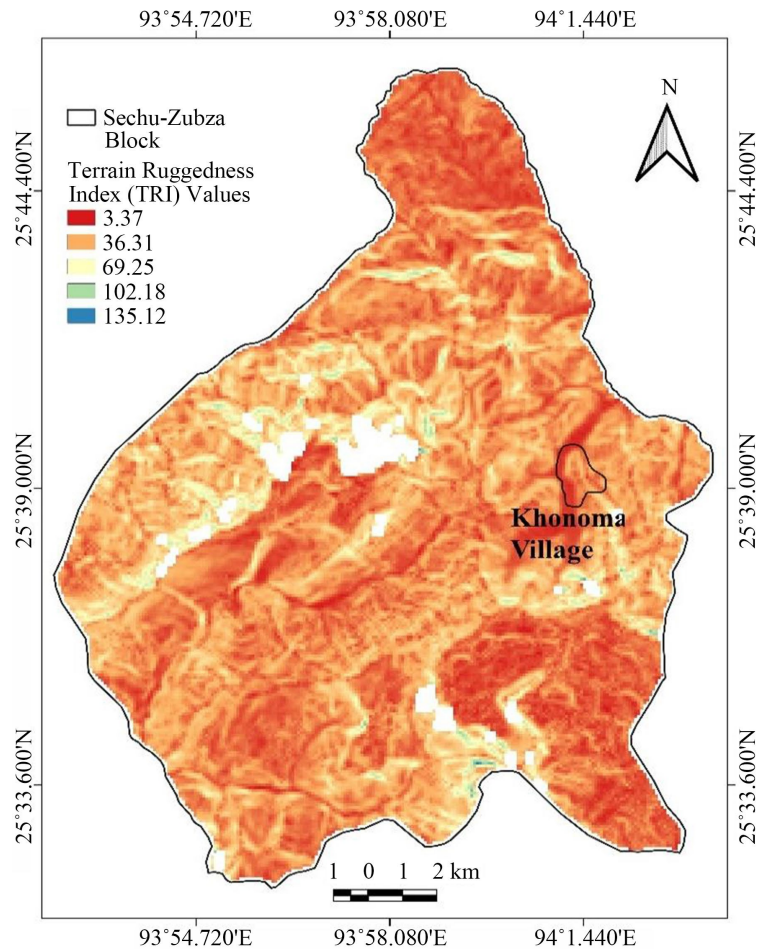


Figure 2. The Terrain Ruggedness Index map, which represents the terrain heterogeneity of the Sechu-Zubza block and Khonoma Village. The TRI is strongly dependent on the local slope. Positive TRI values indicate that the area is higher than its surroundings.



Figure 3. Khonoma received the prestigious title of being India's First Green village, for its natural blessed resources. The hills are covered with lush forests. The whole forest area now managed and protected by the local communities. It's all about the conservation of biodiversity and ecosystem.



Figure 4. (a) A memorial commemorating residents of Khonoma village who died during the fighting (1956-1992) for an independent Naga nation; (b) A tomb commemorates the death of Major C. R. COCK, Mr. G. H. Damant, and Subedar Nubir Sahi. These all men were among the first to be killed in Nagaland during British Colonisation. It was erected in 1879, and marble was brought from Calcutta.

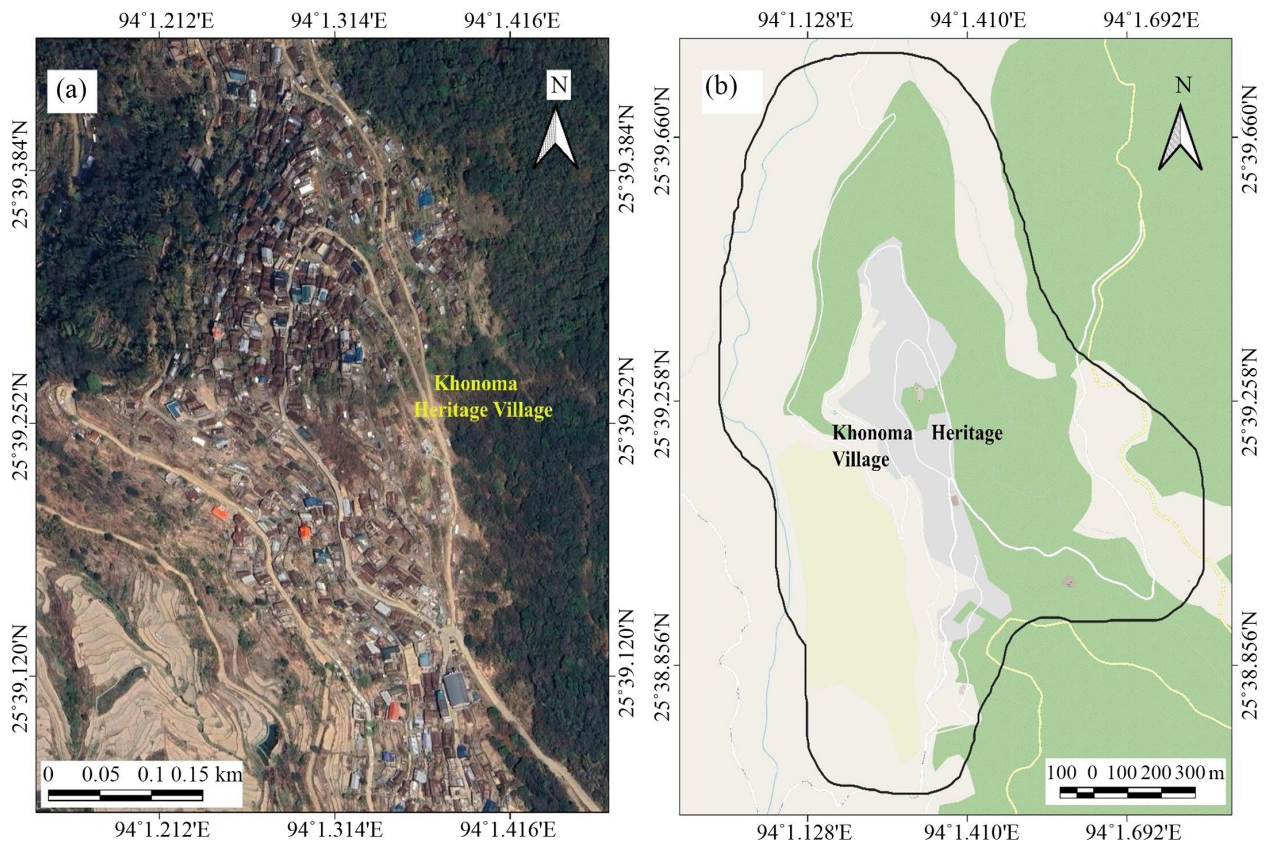


Figure 5. (a) Layout of Khonoma village prepared from Google earth and configuration of settlement area along with topography (b) from OSM.



Figure 6. Paddy Agriculture in Khonoma Village, Nagaland, India, is a form of irrigated agriculture that uses a terrace cultivation process to grow crops and prevent soil erosion. More than 20 varieties of rice are grown in the fields surrounding the village.

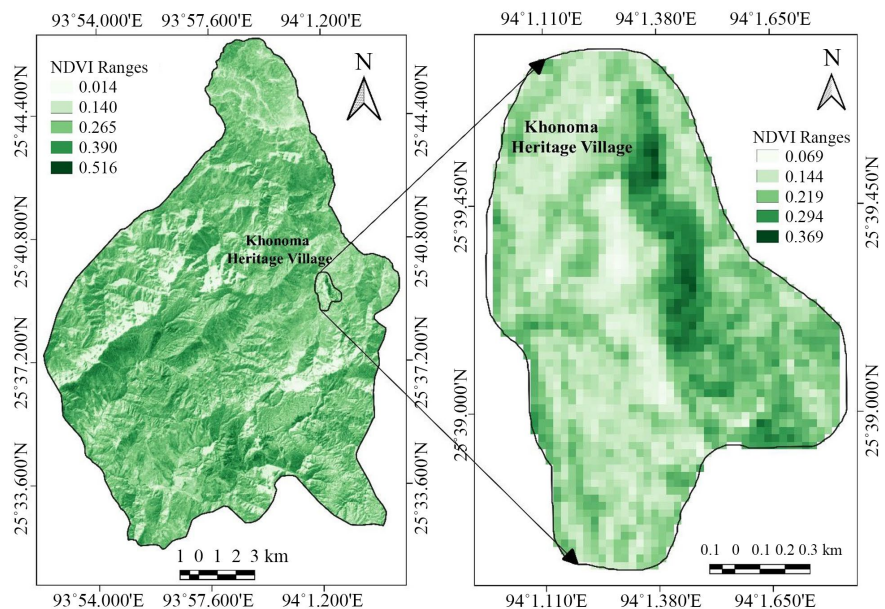


Figure 7. Quantification of health and density of vegetation of Sechu Zubza block and Khonoma Village through Landsat Satellite Image. According to the Normalized Difference Vegetation Index (NDVI), values 0 - 0.33 denotes as unhealthy vegetation.

3. Data and Methodology

In the preliminary phase, an intensive review of books, articles, government reports, and previous studies related to Khonoma and similar heritage villages has been conducted to identify key themes and gaps in the literature. This helps us to accumulate knowledge of Khonoma, focusing on its history, habitat, ecosystem services, and sustainable tourism practices. Multispectral and elevation data ob-

tained from Remote sensing technology have been analyzed to prepare a map of its geographical and ecological aspects. Multispectral satellite (Landsat 8 and Landsat 5) data (LOI, TIRS, TM) (Table 1) has been used to assess land use, vegetation cover, and changes in the habitat over time. Landscape mapping was done using Google Earth. Qualitative and quantitative data have been combined for the comprehensive analysis. An intensive field survey was successfully conducted to collect primary data through direct observation and community engagement. Conduct structured interviews with residents, community leaders, and stakeholders involved in tourism. Use focus groups to gather diverse perspectives on the impact of tourism on heritage and ecosystems. Distribute questionnaires to tourists and locals to assess perceptions of sustainable tourism, ecosystem services, and community involvement in preservation efforts. Data integration and analysis have been done by comparing and contrasting data from different sources (literature, geoinformatics, field surveys) to validate findings and ensure a comprehensive understanding of the dynamics in Khonoma. This methodology combines advanced geoinformatics techniques with community-based fieldwork, guaranteeing an extensive study of Khonoma. The mixed-methods approach allows for robust data collection and analysis, facilitating a deeper understanding of the interactions between history, habitat, ecosystem services, and sustainable tourism in this unique heritage village. The comprehensive nature of this research reassures the audience about the thoroughness of the study and the reliability of its findings.

Table 1. Details of Satellite data, date of acquisition, and spatial resolution of bands.

Satellite and Sensor	Date of Acquisition	Path/Row	The band used	Spatial Resolution
Landsat 8 "OLI-TIRS"	11/03/2024 16/03/2024	135/42		30 m
Landsat 5 "MSS-TM"	29/02/2020 22/08/2020	135/42		30 m
SRTM	10/01/2012			30 m

4. Result and Discussion

4.1. History

4.1.1. Tribe

The Nagas, a group of Indo-Mongoloid people, have a rich and diverse cultural background. Residing in the northeastern hills of India, they are divided into over a dozen minor tribes, each with its unique language and dialect, exceeding the number of tribes by more than double (NIO, 1970). The origin of the name "naga" has led to considerable speculation, resulting in several theories, each with its foundation but lacking unanimous agreement. In the region of Kohima, Dimapur, and surrounding villages, the Angami tribe, one of the largest ethnic groups, holds significant cultural and historical importance. The *Zembi* coined

the word “*Angami*” from their word “Gami”. Their language is Gnamei, Ngami, Tsoghami, Monr, Tsanglo, Tenyidie, Tsugumi, etc. This tribe community also consisted of ferocious warriors and fighters. The Angami Nagas, the first Naga tribe, encountered British colonial expansion. Nagas are predominantly Christian (Chandola, 2012). The tradition of Naga is older than Christianity (Chandola, 2012). The Naga people are very much connected with the Church and are Close to Christianity (Chasie, 2021). One of the ritual practices back in the day was headhunting (Aijmer, 2017). The tribal community of this village was not ready to take these hands down, and they fiercely defended their territory (Bhattacharyya et al., 2022). The people of the Angami tribe live on the hill, which was established over 500 years ago and is divided into three classes, namely “*Merhu-Ma*” (M-Khel), “*Semo-Ma*” (S-Khel), and “*Thevo-Ma*” (T-Khel). When the British attempted to establish complete dominance over the Indian sub-continent in the middle of the 19th century, they also made their way to Khonoma (Figure 8).



Figure 8. A stone door with a Naga painting that was to be installed at the gate leading to the upper part of Khonoma. There used to be a wooden curved door, but that was replaced with this stone door, which was so heavy that it could not be moved. So, the stone door has been kept aside.

4.1.2. Society

The village is set up as the head of government and administration. In contrast,

the village development Board looks after all developmental works and projects sanctioned or authorized by the state and central governmental agencies. The “*Khels*” were the most critical platform of governance. The “*Khels*” of the village also appoint their *Gaon-Burah* as their headmen or leader for advice and to represent their “*Khels*”. Traditionally, this group of clans was the most important platform of governance, where the veto power of the purest form of democracy of the village came into play. The village also fulfils many traditional and local unions and organizations to govern and guide social and local activities relating to women, youth, students, etc. (Bhattacharjee, 1990). The “*Morung*” (boy’s dormitory) is the first educational institution for boys in this village. In a *Morung*, the elders must inculcate moral values of life, respect, obedience, and social obligations (Figure 9). Every form sits around a big bonfire, and a standard wooden bed is in the interior room. The village boys spent their mornings and evenings occupying the corner—the smallest space—leaving the center space to their elders to listen to their great adventures, heroic deeds, hunting trips, etc. During festival season, they bring their little bamboo cups of rice beer and sit around the fire listening to tell tales during their head-hunting period and their adventurous journeys into the mainland of India. Young boys bring their raw materials of bamboo and cane to learn weaving in these *morung’s*. The emergence of Khonoma into a village settlement, since the Naga community/indigenous organization depended by the large on hunting for their subsistence, although affords were also made to supplement it by agriculture.



Figure 9. One of the traditional “Morungs” (boy’s dormitory), serves as a learning institute where young boys are passed on the traditional beliefs and customs from the one generation to another generation. This convention is now going into background and at present it is used more like a recreational club.

4.1.3. Regional

The village was India’s first green village in 2005. Its name refers to a local aromatic plant called *Khwuno*. The hills in Khonoma are surrounded by lush green-

ery, forest, land, and various species of fauna and flora. The terrain is hilly, and its rugged slopes are gentle and steep. This village and its surrounding fields, where paddy is mainly cultivated, are bound by clear, long-lived flowing streams. Some main rivers flow through the village—Dzuza, Khunodzukhuru, Khuru, and Dzulrudi on the southwest side. A tributary part of the Barak River also flows through Khonoma in the upper reaches along the border with Manipur. This hilly village is covered by many green forests full of wildflowers, colorful orchids, ferns of different varieties, aromatic plants, thick bamboo groves, etc. Besides the trees and plants, a variety of insects, butterflies, frogs, reptiles, and different species of birds make this Khonoma village like a colorful carpet in full bloom. The people of this village followed a unique form of agriculture known as shifting cultivation (Giri et al., 2018; Kalidas-Singh et al., 2021; Kehie et al., 2017). Many houses in the village are made of wood and bamboo, and the floors of those houses are plastered with mud. For farming activity, they avoid chemical pesticides and fertilizers, and instead, they prefer the organic composition, which is actively sourced from composting that is done using kitchen waste. Khonoma is not only the first “green village of India”, but it is also said to be the first green village in Asia (Figure 10).

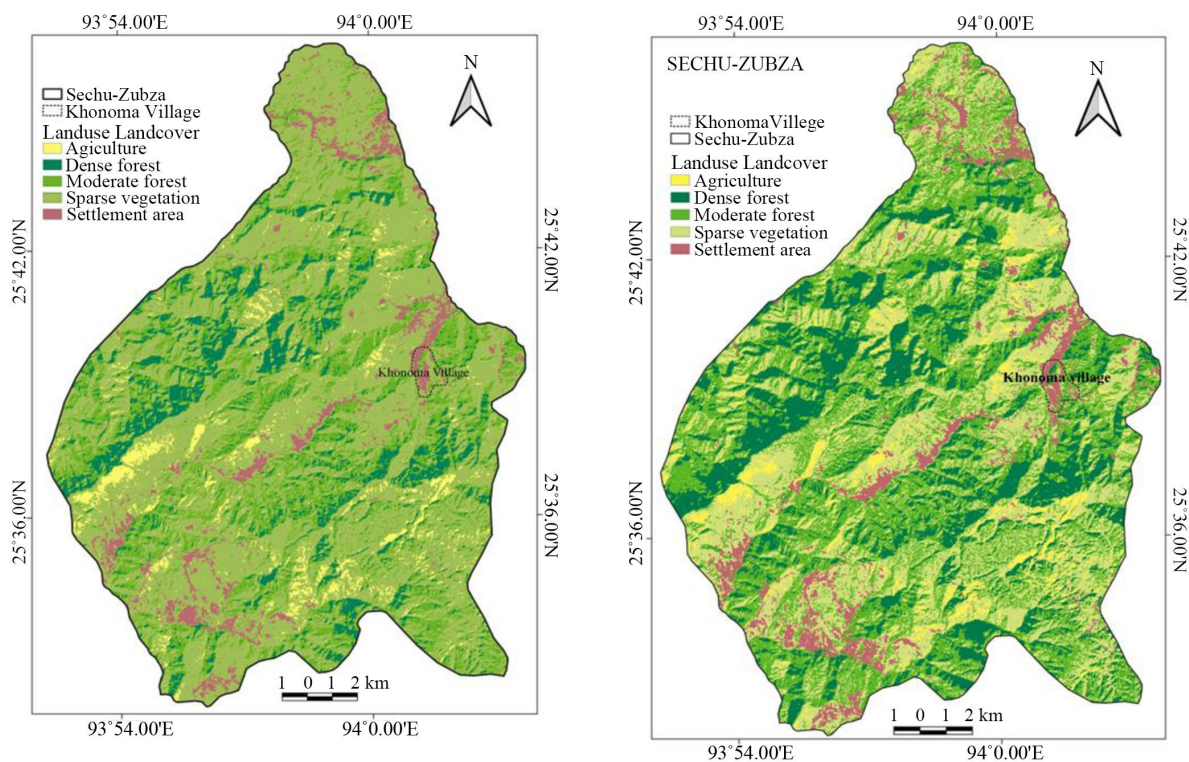


Figure 10. Change of Forest, Settlement area, Agricultural Land, and Vegetation identified during 2020-2024 in the study area using Landsat Images (TM, OLI, and TIRS sensors) in open-source software.

4.1.4. Nagaland and Indian Independence

The Nagas have a unique history (Sebu, 2013). During the 19th century, British colonialism ruled various parts of India. British rulers made significant progress in northwestern India by submerging the Sikh rule of Punjab and Kashmir in

1816. They are trying to establish their residency near Gilgit, which borders China. The northeastern part was divided into various numbers of Monarchy and village states. The Nagas were peaceful and independent until they encountered the outside world (Elwin, 1969). The Naga hills were either tribal chiefs or managed by the tribal council, which was left untouched by Indians. The British rulers had the advantage in the northeastern region part of their empire. Khonoma stands as a warrior village and is brave in warfare. Besides protecting many other villages from the war and enemies in the past days, this village also put up a violent resistance during the British rule. The first British Francis Jenkins and R.B. Pemberton's contact with the Nagas was established in 1832. They traveled through the Angami territory on the route between Manipur and Assam. Thus, the regions are inhabited by the Nagas. The well-organized British rulers with the latest and higher fighting weapons finally pointed through Naga country. The British began preparations for another punitive expedition to Khonoma (Chasie, 2017). They surrounded the village on three sides: to the east (towards Kohima), to the west (from the Mezoma side), and the north (along the Dimapur-Imphal road) before launching their attack on the village (Blankenship et al., 1993; Chasie, 2017). In the 1880s march, a peaceful contract was signed with the Britishers. This agreement led to a culmination of the conflicts. This display of valor against the British invasion/foray has made the Khonoma story of Indian History. The chiefs of Khonoma village create an immensely indifferent outlook towards their neighbour's village and the clan chiefs of *Mezoma* when British officers are present. One year after this incident, when the British sent their officers under the supervision of collecting commendations, the tribal Angami community not only rejected them but even went to the extent of killing most of the soldiers who were posted there. John Butler took a conciliating task for the tribes in 1845, but he succeeded only to a limited extent in carrying out British policy. For this, to the Angamis, he was popularly known as "*Zieni Shaha*". Before he reappeared, the chiefs were selected to gratify in intra-tribal warfare. This was enough excuse to give the British for the establishment of a permanent out give the British for the establishment of a permanent outpost in the Naga Hills. Although many Naga hills were covered mainly by unknown jungles, and unknown jungles primarily covered British rulers, the British rulers decided to track down a land route through this jungle. At first, they had access to trace the route Manipur through Cochar, which is in Assam, then from Imphal to Nagaon, which is in Assam, and established their headquarters in Assam. Captains Francis Jenkins and R.B. Pemberton conducted the first expedition with 700 soldiers and 800 labourers across the Angami-Naga region. After reaching the Naga hills, they were continuously attacked along the route by the Naga villagers. In those days, this route to cross over the Barak River was taken by Japanese soldiers and their INA guides. This route on the Nagaland side is called "*Pherica*" by Angamis, which means "the mountain pass at *pheri*" and is not far from *Yangkhullen* village. Moreover, this village on the Manipur side had close relations with the Khonoma village. Dzuleke, Poilwa, and Mezoma lay along the

route to *Chumoukedima*, where the British party was headed. The Nagas fiercely protected their lands and were profoundly offended by the British attempt to encroach on the Naga homeland's geographical borders to trace the eastern frontiers of their Indian empire. Khonoma was attacked 3 times—the first in 1841, the second in 1845, and the third in 1850, where 334 men, 23 23-pounder guns, and 4-inch mortars were against Khonoma. As a result, Khonoma was destroyed; its lands were confiscated and redistributed to neighboring villages, and the residents of Khonoma were dispersed to other areas (Chasie, 2017). The villagers of Khonoma became refugees after the battle (Chasie, 2017). Nevertheless, during the night of 1850, villagers evacuated their village and moved higher up in the snowy mountains under cover of darkness to hide in the shelter from invading British troops.

4.2. Habitat and Rural Society

4.2.1. Habitat Factors or Abiotic Components of Habitat

Khonoma village's terrain is hilly, with gentle slopes to steep slopes and rugged hillsides. These hills are covered with much forestland and are rich in various flora and fauna. Cane, bamboo, and many colourful orchids are part of most of the vegetation. The village name also referred to a local aromatic plant called "*Khwuno*". A little part of this "*khwunoria*", hundreds of different plants, trees, flowers, various wild fruits, and medicine plants are found in this region. This flourishing green environment provides a subsidiary habitat for biodiversity. Various ferns, aromatic plants, thick bamboo groves, and rhododendrons are also present here, making a forest appear like a green and colourful carpet in full bloom (Chauhan & Singh, 2023; Jing et al., 2015). A preliminary ecological survey done so far records the use of about 250 - 300 plant species, including more than 70 which are used for medical purposes; 84 types of wild fruits; 120 kinds of wild vegetables; 9 - 10 variations of mushrooms; and five types of natural dyes are located/present the surrounding forests in the village. The local tour guide said about 204 species of trees, including 45 kinds of arid orchids, 11 types of cane, and 19 varieties of bamboo. The local villagers recorded 25 types of snakes, six kinds of lizards; 11 types of amphibians, and 196 - 200 types of birds (87 have been identified), including Blyth's Tragopan—a threatened bird (which is mentioned in the Red Data Book of IUCN); 72 kinds of wild animals where include leopard, serow, sloth bear, Asiatic black bear, tiger, etc. (Table 2 and Table 3). The Kohima district is occupied by a forest of approximately 39.2601 sq. km, and Khonoma is included there, which covers 20 sq. km of forest area. This region provides habitat for various endangered flora and fauna, including various reptiles such as Barking Deer (*Muntiacus Muntjak*), Leopard (*Panthera Pardus*), Hoolock Gibbon (*Hylobates Hoolock*), and other kinds of birds and insects, which are also abundantly found.

Some important trees include *Alnus Nepalensis*, *Bauhinia Variegata*, *Betula Alnoides*, *Castanopsis Indica*, *Juglans Regia*, *Phoebe Goalpareagesis*, and *Schima Wallachi*. Village forests conserve the rich natural resources and benefits that attract the local people to them, which was possible through the active participation of the local people.

Table 2. Account of living species (biodiversity) of Khonoma Village, Nagaland.

Serial No.	Fauna	Number of Species
1	Mammals	72
2	Birds	196
3	Reptiles	31
4	Amphibians	11
5	Edible Fish and Aquatic Insects	35
6	Edible Terrestrial Insects	31
7	Honeybee	7

Source: EIA report, Khonoma tourism development board, 2004 and household survey.

Table 3. Account of flora diversity of Khonoma Village, Nagaland.

Serial No.	Flora	Number of Species
1	Timber	68
2	Fuel Wood	72
3	Edible Plant Products (Wild Fruit and Vegetables)	118
4	Mushrooms	9
5	Medicinal Plants	64
6	Bamboos	23
7	Canes	16
8	Natural Gum Extracts	7
9	Dye and Colour Yielding Plants	4
10	Colourful Orchids	11
11	Other Forest Products	6

Source: EIA report, Khonoma tourism development board, 2004 and household survey.

4.2.2. Human Ecology, Habitat, and Geospatial Technology Rural Morphology and Landscaping

The Khonoma village structure is unique and identified using local materials and community-based design. Every house in the village is built with locally available materials like bamboo, wood, stone, etc. The village is covered with paddy fields. The village's design includes foot pathways from every house that lead to the farmland. The streets of this village are constructed tidily along the slopes, and both sides are adorned with flowers and plants. The roads are flared up by streetlights powered by solar energy. People in Khonoma village set up a living space on the left side, with dormitories on the right side, while the right has workshop areas. Every designed structure has a staircase that leads to the farmland. The road to Khonoma village winds uphill. The village has two main roads: the lower and upper circulation roads. These two roads meet near the church of Khonoma. The whole village is covered with stairs. Climb the stairs opposite this church to get here (Figure 11).



Figure 11. The Baptist Church in Khonoma Village which was founded in 1839 by the missionaries of American. The church is located at the junction where the only two roads in the village meet.

1) Rural Household Architecture and Building Materials



Figure 12. House Gardening is a very popular practice. Almost every home has an organic kitchen garden in the front yard. Villagers grow many fruits and vegetables for their daily needs. They use organic kitchen waste products and avoid chemical pesticides and fertilizers. Sometimes, they also plant some medicinal plants based on their needs.

The houses in Khonoma village were constructed with bamboo and wood. The floor of every house is plastered with mud. Bamboo products are used significantly in daily life for building and household essentials. Plants are potted, and different colors of flowers can be seen hanging on balconies and decorating the yards of

most of the houses in the village (**Figure 12**). Every house in this village has an organic kitchen garden in their backyard or front yard. Various colourful fruits and vegetables are studied in the garden. The family of every house in this village practices cooking their food in the centre of the house so that the originating smoke during cooking time helps to kill the insects. These practices also help them keep the house warm during the cold season. Bamboo and stones are sometimes used for infrastructure developments such as steps and staircases.

2) Rural Development

This village is not only India's first green village but is also said to be the first green village in Asia. Since it is called a "*Warrior Village*", Khonoma village is famous for its steadfast resistance during the British colonial war. For this, it has an assortment of historical significance. The town is appropriately connected to electric power, and to save this power, they have been using electricity-resuming elements like LED bulbs. Students of Khonoma play a significant part in maintaining the cleanliness of this village. The garbage bin is maintained in this village, and the residents properly do sanitation. Central governments provide them with toilets under the "Swachh Bharat" Scheme, and most of the time, the Indian army has helped to construct community benefits, including public toilets and irrigation facilities. Every house has facilities for fresh potable water (**Figure 13**). Every house is connected through pipelines provided under government schemes like MGNREGA. Khonoma is a popular tourist spot where visitors get many opportunities. The traditional dry cultivation method is known as "Jhum" (Das, 2024). They also learned about the cultivation process and how it helps the soil with N₂.



Figure 13. Community Water tanks constructed in different locations to supply water to the village's homes. Each house is connected to a fresh potable water pipeline through a government scheme like MGNREGA.

3) Rural Natural Resource Management

People of Khonoma pollard trees, which means cutting off the top and branches of a tree, which provides wood for fuel and material for construction. They established the Khonoma's natural conservation and Tragopan Sanctuary (K.N.C.T.S) with many rules and regulations and declared about 96 km² forest area as a Sanctuary. They conserve the rare Blyth's Tragopan, the state bird of Nagaland. This

is funded by Gerared Duran Trust, U.K., for the unique type of community for environment and wildlife protection. The government of India mainly acknowledged this effort by awarding the village. The government provided a three-core project 2005 for this village's development, conservation, and management and declared it the first green village in India. Many NGOs like the CEE (Central for Environment Education) help to spread awareness among them about conservation. The initial stage of the conservation policy banning hunting and exploitation of the forest area of Khonoma was fully conserved on 15th February 2001 after persistently persuading the public despite accusations and strong alternatives. The village council act which is deputed and authorizes the Khonoma Young Organization to monitor and regulate the whole system. The village proudly celebrated its decennial celebration on the successful conservation of 15th February 2011.

4) Rural Health

Ninety percent of the villages are covered with trees, providing fresh air, essential for human health. For the hardworking, the town records a meaner death rate from male diseases. Comparatively, their health is better because of their simple lifestyle. They are involved in many sports which keep them healthy. They produce local organic crops like tomato, potato, cabbage, garlic, rice, millet, soybean, and squash, which helps them live a healthy lifestyle. A primary health care facility is available in the village.

5) Rural Education

The "*Morung*" is the first educational institute for boys in this village, popularly known as a Centre of Learning. It is a boy's dormitory, famous as a house of decision-making. Khonoma has the highest literacy rate, at approximately 70%. Currently, two high schools are run by the Baptist and Catholic communities. The village has good educational infrastructure, including a government middle school and three primary schools. However, no colleges and institutions exist, so many students go to towns to pursue higher education. As a result of the educational migration, the people have faced economic and social advantages and disadvantages. The government must be concerned about setting up any college or institution to create a perfect study environment. They also must provide a plan for developing the facility for the village's children by getting them desired vocational training and skills development in various trades, especially in some critical skills. The village will be more developed when they can raise a generation of young people who solve their pr the help of their blended modern technologies. The literacy rate has increased by 91% in the present living population.

6) Disaster Management, Mitigation, and Resilience

In Khonoma, the primary vulnerable disaster is Soil erosion. To reduce soil erosion, the alder trees are restored in the field, which increases soil fertility through natural processes. Moreover, being a fast-growing plant, alder trees provide timber and fodder to every villager during the following years. The villagers conserve much firewood, which is required for household purposes. As a result, soil erosion can be prevented. The villagers plant alder trees, also known as Nepalese alder

trees, along the crops to reduce soil erosion and fill N₂. The composition level of the soil is unique because, during farming, they do not use synthetic fertilizers or chemical pesticides; they use organic manure, which is actively sourced from kitchen waste. The villagers have banned tree cutting. Deforestation is a significant problem for the forest around this village. Contractors were logging the forest of Khonoma to create transport timber by using elephants. As a result, trees are affected, and poaching threatens the wildlife in the area. They have instituted plant checks and balances to ensure renewal and conservation. Naturally, the village has a closed canopy, created by the presence of lots of vegetation in the form of leaf litter, which helps to reduce soil erosion. The people of Khonoma use terrace farming as their main crop to mitigate soil erosion. To protect the forest, the people of the village took some actions:

i) **Logging Banned:** In 1998, the villagers created a council and banned logging in the forest community after realizing the contractors' timber transport plan.

ii) **Sanctuary Establishment:** In the 1990s, this village council created a sanctuary to ban hunting, the name of which is "Khonoma Nature Conservation and Tragopan Sanctuary".

iii) **Community Conservation:** To protect the area's biodiversity, they created a system of conservation communities. The youth generation works as forest guards, ensuring the rules are followed, and women and students help clean the village.

7) Impact of Climate Change

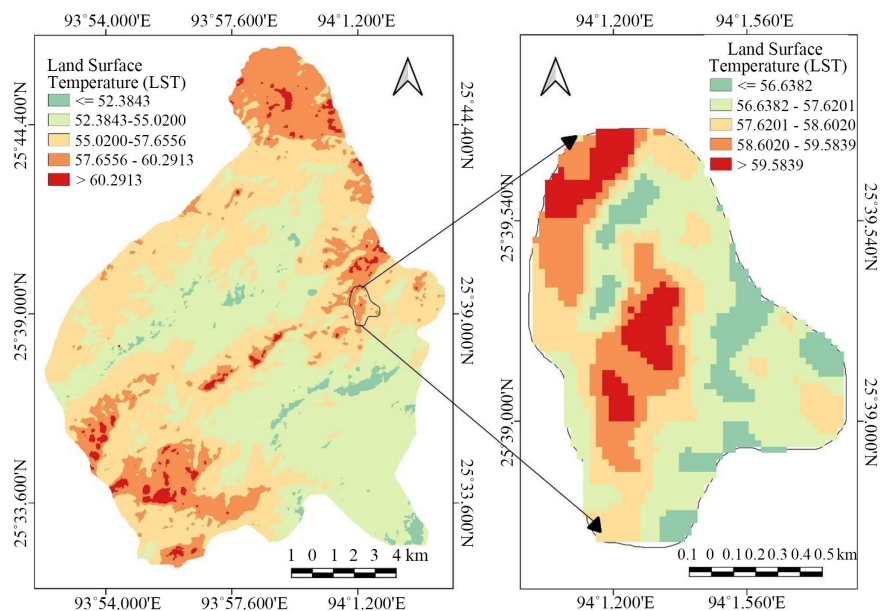


Figure 14. Temperature distribution in the land surface area. Land Surface Temperature (LST) is used to identify the temperature range at the land surface area through Landsat satellite sensors. LST provides a reliable way to track the temperature changes of Sechu-Zubza block and Khonoma Village. It is a valuable tool for monitoring the temperature changes related to environmental changes.

Khonoma enjoys the monsoon season with a considerable number of heavy tor-

rents of rain from June to September. Winter starts in November, and at that time, the temperature becomes cold and chilly. The snowfall period starts from November to February. The maximum temperature is 31 °C in summertime and minimum 16 °C. During winter, the maximum is 16 °C, and the minimum is 4 °C. 36.67% of people think that climate is an environmental phenomenon; 6.67% of people in villages think that it is god's work (Figure 14). The climate had an impact in several ways, including:

i) **Impact on Agriculture:** All agricultural practices are dependent on climate. Climate change can affect the cultivation process. There are two kinds of cultivation: Jhum cultivation and wet rice cultivation. Due to the increase in cash crop planting, agricultural biodiversity has decreased.

ii) **Impact on Hunting:** Climate can impact the villagers' hunting time when they occasionally go out to hunt outside. Due to the climatic phenomena, crops are damaged. As a result, various wild pigs and other animals are affected by their hunting time.

iii) **Impact on Environment:** Climate also affects forests. Deforestation causes many animals to lose shelter and erodes soil during heavy rainfall.

4.3. Ecosystem Service

4.3.1. Provisioning Services

1) Fresh Water

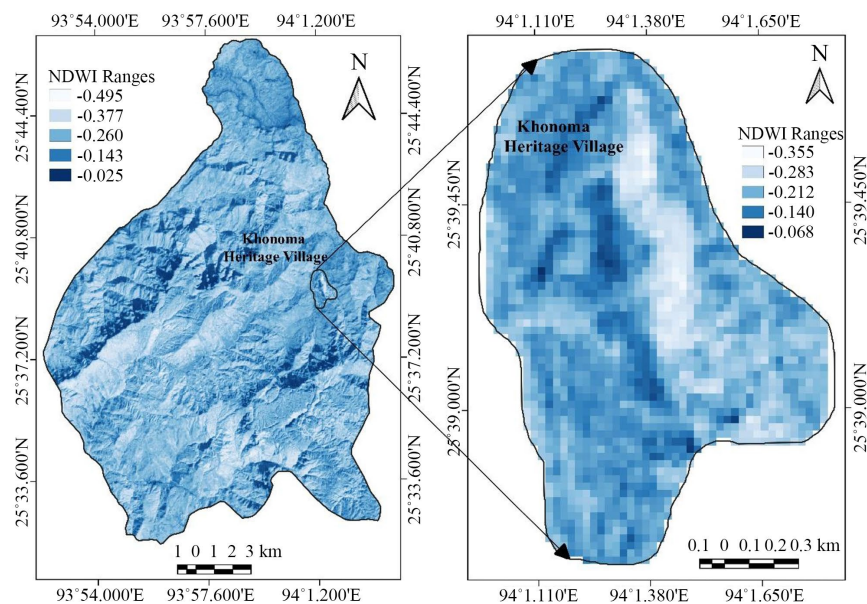


Figure 15. Water content distribution in the water body, leaf, and land surface. Normalized Difference Water Index (NDWI) is used to quantify the occurrence of liquid water at the surface from space through Landsat satellite sensors. NDWI provides a reliable way to track the changes in the water content in the water bodies of Sechu-Zubza block and Khonoma Village.

Khonoma, an enriched ecosystem village in the northeastern state of Manipur, India, has lots of freshwater. It is the primary source of the ecosystem that presents

various ecosystem services to the local community and surrounding environment or area (Figure 15). This freshwater is used for drinking purposes and household activities. This potable freshwater pipeline is connected to every house through government schemes. The villagers sometimes collect spring water for agricultural activities like irrigation. They also practice the rainwater harvesting process to re-use this water and recharge the underground water through ponds and wells.

2) Food Production

i) **Agriculture:** Khonoma is very popular for its cultivation techniques. Farmers are using a different cultivation process known as shifting cultivation, where they change their farming land for two years and use Nepal alder trees "*Alnusnepalensis*" planted with the crops and cut down their branches during the occasion to get back the nitrogen, which helps to bind the soil. The dwellers still practice it. This pollarding system is very sustainable and has spread into other regions. The Naga people are engaged in terrace cultivation (Elwin, 1969). They also practice terraced cultivation, which is mainly shown in paddy fields (Kithan, 2014). Over 30 different types of paddies are grown using this cultivation method. This method helped to solve the soil erosion problem and enriched the ecosystem services in the environment.

ii) **Community Kitchen Garden:** They produce many vegetables like potatoes, garlic, pumpkin, carrots, radish, tomato, millet, cardamom, and chili in their garden. Almost every home in the village has an organic kitchen garden in their backyard, front yard, or some proximity. At maximum time, they adorn half of the vegetables needed for their daily life. For farming, they avoid chemical pesticides and fertilizers and use organic manure, which is preferred and actively sourced from the composition of kitchen waste products. Sometimes, they planted medicinal plants needed to make the household self-sufficient.

iii) **Livestock Grazing:** During different times of the year, they celebrated many festivals at various intervals. They are non-vegetarian. During the celebration of the festival, they share good pieces of chicken or buffalo meat, such as the upper leg or the fleshy portion of the chest. The people of the village also rear pigs and cats. The pigs roam freely in the public area and help sanitize the town. This area is good grazing land for the availability of a large forest area. They also reared "Mithun" (*Bros Frontaila*), an economy-boosting animal (Jamir & Khare, 2018). They belt out yearly to specific locations to avoid crop destruction caused by grazing animals.

iv) **Cooking in the Center of the House:** Families practice cooking their food in the center so that the smoke and gases kill harmful insects, and the wooden structure can remain active to keep the house inside.

3) Fuel

Khonoma village is well known for its environmental maintenance efforts, sustainability practices, and conservation. The people of the village use natural materials for their fuel needs, including the collected wood for fire, which is in their local forests. They always conserve their natural forest resources through commu-

nity conservation-based practices. They used firewood as their primary fuel for cooking and heating (Figure 16). However, nowadays, this village has taken steps to reduce deforestation and promote eco-friendly practices. Sometimes, they create bioenergy as fuel to fulfill their basic needs.



Figure 16. Timber practices in Khonoma village. Wood is collected from the local forest. People are familiar with alder cultivation, which is unique in modern civilization as well. They store various types of wood for winter. Wood is a primary raw material for living purposes.

4) Fibber

The villagers of Khonoma use fiber rooted in their traditional practices. These natural fibers mainly originate from different plants, which play a vital role in their village's handloom, handcrafts, and daily life practices. The villagers used many indigenous plants to dye yarns in various colors. Different types of plants are planted to die in different colours.

i) **Black Dye:** The “Nushunphangha” plant is cultivated near the garden of every house to get black dye, which is mainly used for making shawls, clothes, and dresses. On the first day, I plucked the leaves from the plants and boiled them in a big earthen pot for 2 - 3 hours. Then, they were taken out and dried in the sunlight, and this process was continuously repeated until the dye was completely black.

ii) **Red Dye:** “*Allawi*” and “*Achaque*” plant roots are used for red colour dye. These two types of plants are primarily grown in the riverbank area. At first, they cut the roots of these plants into many pieces, put them into a big pot, boil them for several hours, and repeat this process until they change their colour to red, then dry them in the sunlight. Again, it will be sucked in a large wooden vessel for two to three days and taken out from there, and again contents will be boiled and again dried. These two plant roots are the best components for red colour dyeing.

iii) **Yellow Dye:** Roots “*Khentsu*” and “*Ahicho*” are mainly used to get yellow dye. Here are some processes that are mainly followed in red and black dyeing. This practice has probably stopped due to the availability of ready-made yarns of different colours in the market.

5) Medicinal Plants and Biochemical Resources

Khonoma is a hilly or mountainous region with rich biodiversity and unique medicinal properties of plants. These medicinal plants grow in harsher climates and high altitudes (Figure 17). These all are very beneficial compounds. There are several medicinal plants found:

- **Rhododendron** (*Rhododendron arboreum*): Many rhododendron forests surround this village. These plants are mainly used for the treatment of headaches and inflammation. Its flowers are also used in herbal teas to relieve coughs and colds.
- **Paris Polyphylla**: This unique category of plants is grown in this village. These types of plants are used traditionally. They use the plant to recover healing fevers and as anti-floatation.
- **Sarsaparilla** (*Smilax Glabra*): These medicinal plants help detoxify the blood, cure skin ailments, and aid digestion. They are also used to treat inflammatory diseases.
- **Black Turmeric** (*Curcuma Caesia*): This unique type of black turmeric plant is mainly used for several skin problems, respiratory issues, and digestive disorders.
- **Nepalese Alder** (*Alnus Nepalensis*): The bark of these plants is mainly used to treat fevers and clean bruises. The leaves of this tree mainly help reduce skin infections and work as a natural remedy for rheumatic pain.
- **Mountain Pepper** (*Litsea Cubeba*): These wild plants are very popular for their antioxidant components. They are also used for stomach or inhalation issues.



Figure 17. Medicinal plants in Khonoma Village have been known to be used for various purposes, either for consumption or health care purposes, and certain areas were identified for their medicinal value.

6) Handcrafts, Handloom, and Ornaments

One of the most popular handicrafts is basket weaving. All these baskets have

woven designs and beautiful shapes. When visitors come across, they can suddenly see old men weaving baskets or polishing their raw materials. Interestingly, a significant percentage of the village's population knows the art of basketry very well. Five different types of baskets are woven by men using various patterns. This basket is called "*Khuophi*" or "*Khuoshie*", which is very special as a gift to a girl by her parents before her marriage or by her beloved person as a sign of love and attraction. It is the symbol of treasure for the girl throughout her life. Many baskets are used for carrying paddy during harvesting. They have many vegetables and firewood by this. Many local villagers are engaged in the work of making chairs, tables, etc.

The people of the village weave cloth, shawls, and other wearables for trade purposes. Women weave more than 16 different types of shawls in various colours and designs. Different age and gender categories can use these items. With shawl weaving, they create multiple bands, earrings, necklaces, wrist bands, key rings, designer bags, and many other decorative products (Kanungo, 2006) (Figure 18).



Figure 18. Shows a lady weaving a shawl in her house. Khonoma village in Nagaland is very popular for its intricate handlooms and handcrafts. Women weave more than 16 different types of shawls in different colors and designs. The fabrics are unique and known for their quality and durability.

4.3.2. Regulating Services

1) Erosion Control

The terrain of Khonoma village is hilly, from a gentle slope to a steep, rugged slope. Soil erosion is the leading environmental degradation problem in the village. Soil is one of the most critical ecological elements, and it is the habitat of many wild animals. However, due to the steep slope, the soil eroded rapidly. Khonoma village of Nagaland uses logs, bamboo, and stones in the hilly jhum fields to

control soil erosion. They practice jhum cultivation, which increases the amount of erosion and is very popular in this village because it is the main factor in losing soil fertility. To prevent erosion, they laid logs, bamboo, and stones across the slopes of jhum agricultural fields in rows at some distance of 10 to 20 feet. This distance depends on the degree of the slopes. The farmers have all the elements laid there for three years so that the erosion and the runoff in this field area are checked, and moisture is stored in the soil particles. They also follow some indigenous techniques to check the amount of soil erosion by using mechanical and vegetation barriers. Due to the heavy rainfall and wind, much soil is eroded in the slope area. For this, in the present day, many farmers use a unique method. They planted many crops and vegetables in rows along the slope so the soil would not be eroded during runoff. For example, they planted crops like millet and maize and vegetables like soybean and velvet beans along the contour. These vegetative barrier methods are cost-effective and have been practiced for the last 50 years by the farmers of this village.

2) Pest Control

The farmers of the Khonoma village of Nagaland use ash to control pest infestations in crops and vegetables. They dusted ash over the leaf in the early morning before the dew drops dried up over the leaf. Thus, the ashes are stuck over the leaf, which helps to prevent the insect pest from having direct access to the leaf. The ash acts as an expulsion for the insects. Typically, insects are attacked through the leaf of a plant. For this, they adopt this process to prevent damage, which is reported to have controlled the insect attack by up to 50% - 60%. They use one another method, known as deep ploughing, to kill the insects and pests in the soil and provide exposure to the sun. For farming, farmers of the village avoid chemical pesticides and fertilizers. Generally, organic components, preferable for crops and plants, are sourced from the composition of their kitchen waste.

3) Pollination

Pollination is an essential part of its agricultural practices and ecosystem services, especially in the context of farming. Khonoma villages have some sustainable conservation practices, and pollinators are mainly shown in bees, butterflies, and other insects. For the state of pollination, terraced fields are present there. This village also follows organic farming techniques. The villagers are wholly concerned about biodiversity conservation, and for this, they created the KNCTS to protect the forest and local wildlife. This Khonoma's sanctuary mainly focuses on natural farming without chemical pesticides and fertilizer and provides a better habitat for pollinators. This pollination is essential because it helps to support the village's food security and ecological balance.

4) Seed Dispersal

Seed dispersal is an essential component in Khonoma village because it helps to regulate the local ecology and agricultural systems, land management, and biodiversity conservation of this village. The dispersal of seeds is mainly practiced in traditional agriculture, which supports terraced farming fields and organic farm-

land through various methods, including wind, water, and animals. Sometimes, it happens by such local fauna as birds, mammals, and insects. As a result, natural reforestation and regeneration of the native plant category are achieved. The villagers collect seasonal indigenous crop seeds to promote agricultural diversity.

5) Disease Regulation

The regulation of disease service is prevalent in Khonoma village due to its traditional and sustainable farming practices and ecological conservation. This method is crucial to biodiversity by reducing disease risks between crops, livestock, and villagers. The villagers try to maintain a healthier soil composition and structure by using disease-regulate practices. The villagers cultivate different diversified crops and plants to avoid the lower risk of disease outbreaks, monoculture (when a particular single crop is grown highly), and to maintain the ecosystem balance. Natural pest services help reduce the demand for synthetic services and minimize the environmental and health risks mainly associated with chemical pesticides and fertilizers. Controlling the resilience against diseases in the agricultural system can create a better and healthier environment for the villagers and the local wildlife.

4.3.3. Supporting Services

1) Waste management

Based on some data and information, we know that the waste management system in Khnomona village started in 1990, and till now, it is still pragmatic. The student union of Khnomona village takes care of cleanliness and solid waste management. The student union has placed and maintained garbage bins for every portion of the village's use. Every house in the village also practices maintaining the use of dustbins. Once a month, the sanitation process is carried out. The local schoolchildren are trained to manage waste and clean their village and houses. Now, the generated waste of the village is being separated and disposed of by incineration. The villagers also constructed their community water tanks in different locations to get the proper water supply to every house. This village is tiny, but they maintain proper dustbins on the way of traffic and bus stands. The waste management practices in Khonoma village impact the natural environment and sustainable development. This village is famous as the first "green village" in Asia.

2) Soil formation

The soil formation of Khonoma village depends on its hilly terrain, variation of climate, and heavy monsoon. The soil of this village primarily originated from bedrock, which is created for compressing sedimentary and metamorphic rock. This village faces heavy rainfall in the monsoon season, and as a result, a high leaching process continues in the soil, which helps promote the formation of richer and darker topsoil. The village is fully covered with considerable vegetation, contributing organic matter to the soil. Their traditional agroforestry practices help to improve soil fertility by providing nitrogen fixation. The soil depth of this hilly village is different. Where steep slopes are located, the soil becomes thinner because of the high range of erosion. "Jhum Cultivation", a prevalent agricultural practice, helps to maintain soil fertility, minimize soil erosion, and prevent soil

structure. Many vegetables and crops are cultivated in this soil, such as millet, soybean, carrot, paddy, etc. The soil of this village is good for farming and organic fertilizer.

3) Nutrient Cycle and Decomposition

The nutrient cycle of this village is highly efficient, depending on traditional agroforestry and jhum cultivation practices. They are practicing alder cultivation practices to fix the amount of nitrogen. These cutting trees release nitrogen into the soil, supporting various crops' growth. When many parts of the tree, such as leaves, roots, branches, flowers, fruit, etc., are decomposed into the soil and enhance the soil fertility, this decomposition helps to return the necessary nutrients like phosphorus and potassium; nitrogen gets back into the soil. The villagers of Khonoma are very concerned about the rear of livestock, which contributes to nutrient cycling by adding organic material and nutrients to enhance soil fertility. During the time of Jhum practices, which are very popular there, the fallow land accumulated biomass to restore the soil fertility and nutrients into the soil, for the lands are eventually reused and replenished nutrient levels.

4.3.4. Cultural Services

1) Festivals

Khonoma Village celebrated several festivals. All the festivals are directly connected to the base of their agricultural cycle. During these festival days, some people prepare themselves physically and spiritually, which helps create a strong connection and belief in the spirit that controls their well-being and all their activities.

- **Sekrenyi Festival:** This festival is celebrated for 10 days in February. It is known for male purification and rejuvenation. People celebrate with complete festivity as their agricultural cycle, which is booming, ends with all their cultivation in a rich harvest. The main goal of this festival is to cleanse the soul and body.
- **Thekranyi Festival:** This festival is celebrated in late May. This festival announces that the plantation season is coming. This is a festival for the youth, where the two-age category of people, young and old, enjoy feasting and using their earnings from agricultural labour.
- **Ngonyi Festival:** The Ngonyi Festival starts in March. During this festival, men mainly collect firewood and fish for their women and hunt for men. During this time, men go to the forest in groups to celebrate their traditional hunting. In this festival, a man observing a piece of sliced wood directs the hunters towards the area to hunt or in a favorable direction, depending on his prediction.
- **Liekhwenyi Festival:** This festival is held between August and September. During this time, people go fishing because hunting and other activities are unfavourable. At that time, all women received particular attention, and cooked fish was offered. Women do not eat the delicacy fish until they go to bed in privacy.
- **Tiede Festival:** This festival is held in November. During this time, children

of every house shout happily with baskets and jars. All villagers contribute food, such as wine, potatoes, local vegetables, salt, rice, chilly, etc. On this festival day, children are trained in wrestling.

- **Suliede Festival:** This festival is celebrated after the harvesting of jhum crops such as millet, paddy, potatoes, chilly, etc. Many young boys and girls participate in baking cakes by extracting fresh millet.

2) Folk Culture

Angami, the central tribal community of Khonoma village, has a unique folk culture. Based on their beliefs and myths. Myths refer to beliefs about what happened and not reality. The Angami tribal community expressed their emotion and feelings through songs. Several songs are rhythmic and harmonious when they are songs by different notes of many numbers of people in a big group. The songs have several messages about wars, happiness, triumph, etc. There is another category of songs that mainly convey messages of beauty, love, joy, and youthfulness. The aged group forms a semi-circle and slowly works towards the other end by singing songs. At the end of the singing festival, two girls are chosen to sing to show their talent associated with the boys. At noon, the festival owners offer a grand menu and provide puffed sticky rice wrapped in banana leaves to every participant.

3) Cognitive Development

The reflection of blending environmental supervision, indigenous knowledge, and developed educational opportunities. Naga tribes are much more conservative and organized by traditional law (Hutton, 1928). Khonoma's cognitive growth and learning have been shaped by its traditional beliefs, values, awareness of ecology, concern about economic development, and exposure to modern education. Children, men, women, and young adults learn many essential activities, such as hunting, conservation, management, and farming. All these observational skills and thinking help improve cognitive development regarding real-world applications. They conserve their biodiversity (plants, animals, insects) and maintain ecological balance and sustainable agriculture practices. As a result, the villagers have developed a unique awareness of the ecosystem and conservational ethics, which directly impact human activities. Recently, the village has made many schools for their community to provide access to many subjects like mathematics, science, etc. They have a vast amount of traditional knowledge, which helps them to navigate many contemporary challenges. Based on extraordinary access to technology and information, the younger generation of the Khonoma village is expanding their cognitive horizons. The villagers created many garments and ornaments by hand to sell to the visitors and outside the market of Khonoma village so that they could improve their economic conditions.

4.4. Sustainable Tourism

Khonoma, the first green village in India and Asia, is also known as a sustainable eco-tourism for conserving the ecosystem and environment (Dutta, 2018). This village is a unique destination for eco-tourism based on its veritable travel experience (Figure 19). People visiting the village can stay in their traditional homestay

(Figure 20). They can walk around the village and participate in cultural performances. The visitors get excellent opportunities from the village, which helps teach them about the Naga way of life and its nature. The rich traditional culture of the Naga tribes in Nagaland signifies its status as a significant cultural heritage (Chophy & Chaudhuri, 2022; Chowdhury & Biswas, 2016). Visitors who want to explore the village are allowed to talk with the Angami local tribal community about how they live and try to make efforts to establish sustainable and environmentally deliberate ecosystems. Visitors can experience staying overnight in the local traditional homestays where the villagers manage everything. The village is trendy for its cleanliness and the practices of dustbin use and toilets. Tourists can also experience trekking and viewpoints, such as birdwatching and mountain viewpoints. Khonoma has preserved rare and vulnerable animal and plant species and Jhum or Terrace Cultivation practices. This village is described as a “Warrior Village” during the British colonial period. For the last two decades, the village has spent its whole days listening to the sounds of birds and various insects. Visitors can be educated about sustainable living and biodiversity conservation if they are gone. They can see how the villagers joyfully live their simple lives and initiatives for the ecosystem. Some portion of the economy of Khonoma village is developed based on tourism activity. Many villagers work there as local tourist guides and perform in some cultural dances or songs arranged for the visitors. Because of the presence of naturally blessed resources, agricultural practices, and conspired history, the village is the most sustainable place to visit in Nagaland, the northern, eastern part of India.

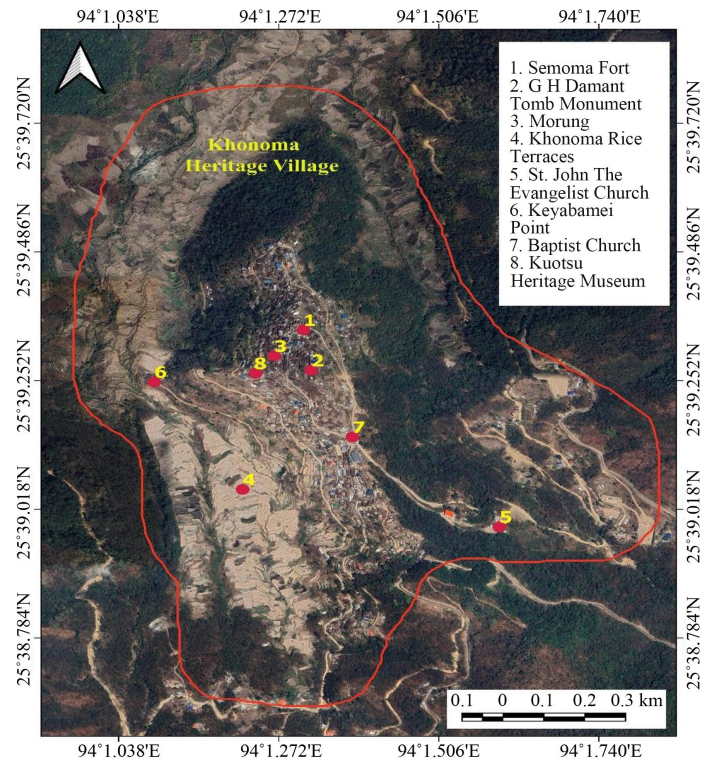


Figure 19. Landscape of Khonoma, the village of headhunters, the village of greenness, the village of culture.

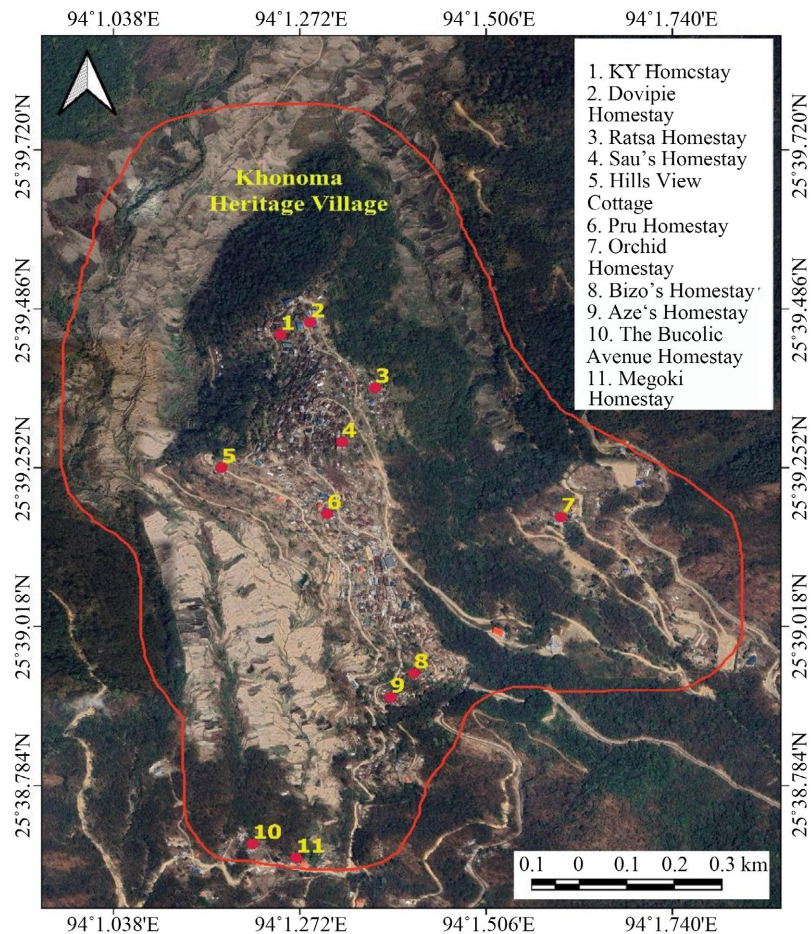


Figure 20. A Homestay located in Khonoma village. The village is significant for its historical significance, greenness, and unique tradition, which draws the attention of the contemporary world.

5. Major Findings

The Angami tribal communities are well-known for their resistance against the British and their reputation as fierce warriors defending their territory. This tribal community has inhabited the hills for over 500 years and is divided into three social classes: “*Merhu-Ma*”, “*Semo-Ma*”, and “*Thevo-Ma*”. They first encountered British colonial expansion in the Naga Hills during the 19th century, particularly in the Khonoma village, which resisted British rule. In 1832, the first contact between British rulers and the Nagas took place, during which the Nagas killed British officers and soldiers. The British faced continuous attacks from the Nagas as they established a permanent outpost in the Naga Hills. Eventually, the villagers evacuated and moved to higher mountains for protection. Khonoma village is recognized as the first “green village” in India and Asia, and it is celebrated for its local aromatic plants, lush forests, and diverse wildlife. The government and development boards oversee various projects in the village. The “*Khels*” community exemplifies a traditional democratic structure, while “*Morung*” was the village’s first educational institution for boys. The settlement’s economy was primarily

based on hunting and agriculture. Khonoma is rich in flora and fauna, with 250-300 species of plants, 84 types of wild fruits, 120 natural vegetable varieties, five natural dyes, and 72 wild animals. The village was established around a unique community structure utilizing local materials, surrounded by paddy fields.

Khonoma features footpaths, solar-powered streetlights, two main roads, and staircases. The village has received assistance from the Central Government and the Indian Army for electricity connections, maintenance, and traditional dry cultivation methods. The villagers established the Khonoma Natural Conservation and Tragopan Sanctuary (KNCTS), where they selectively harvest trees for fuel and construction. They are committed to conserving rare and endangered species, such as Blyth's Tragopan, the state bird of Nagaland. Approximately 90% of the area is covered with trees, ensuring a supply of fresh air that contributes to a healthy lifestyle and allows the villagers to produce organic crops. The community is actively involved in sports and has a low fertility rate and a minimal male mortality rate due to disease. While "*Morung*" was the first boys' educational institution, Khonoma boasts a literacy rate of 70% and has several primary, medium, and high schools, though it lacks colleges or vocational training institutes. The villagers have access to abundant fresh water for drinking and daily activities. They practice shifting cultivation, adhering to organic farming methods, and avoiding chemicals. They also rear Mithun for grazing purposes and cook their food in the center of their homes to deter harmful insects.

Khonoma is well-regarded for its environmental conservation, biodiversity sustainability, and the use of traditional natural materials, such as firewood and fiber, to create handcrafted items like sarees and handlooms, which are essential for their daily lives. The village is home to unique medicinal plants that thrive in harsh climates and high altitudes, providing beneficial compounds like *Paris Polyphylla* and *Sarsaparilla*. Additionally, basket weaving, predominantly crafted by men, is a popular activity in the village. In Khonoma village, women are weaving shawls, ornaments, and sarees. The abundant vegetation in the area contributes to the formation of organic matter in the soil. Traditional agroforestry practices enhance soil fertility, and livestock rearing plays a vital role in maintaining the nutrient cycle within the soil. One of the main challenges Khonoma village faces is soil erosion, exacerbated by the hilly terrain. To combat this issue, villagers have restored alder trees, banned tree cutting, and adopted terrace farming. To protect their forests and preserve rare species, they have implemented various conservation actions, including logging restrictions, tree preservation, and the establishment of sanctuaries for endangered species.

The village experiences heavy rainfall during the monsoon season and snowfall from November to February, significantly impacting agriculture, hunting, and the environment. Villagers use ash to manage crop and vegetable infections and incorporate organic kitchen waste into their practices. There is a strong emphasis on sustainable agriculture, pollination, and biodiversity conservation to ensure food security and ecological balance. Seed dispersal regulates the village's ecology,

agricultural systems, land management, and biodiversity conservation. This natural process aids in reforestation and the regeneration of native plants. The villagers employ traditional farming methods that involve diversified crops while minimizing the use of synthetic products to combat diseases and reduce risks to biodiversity and ecosystem stability.

Khonoma's waste management system was initiated in 1990 when student unions organized monthly sanitation efforts for public dustbins. The village also celebrates festivals rooted in physical and spiritual preparations, fostering a deep connection to their cultural beliefs. Notable festivals include *Sekrenyi*, *Thekranyi*, *Ngonyi*, *Liekhwenyi*, *Tiede*, and *Suliede*. The *Angami* tribal community has a rich folk culture that reflects its beliefs and myths, expressed through songs and dances performed in a semicircle. The village's cognitive growth is influenced by its belief systems, ecological awareness, economic development, and modern education. The community actively participates in various activities aimed at improving its financial conditions. Recognized as India's first green village, Khonoma is a sustainable ecotourism destination celebrated for its eco-friendly practices and environmental conservation. Visitors typically stay in traditional homestays and can enjoy cultural performances that showcase the Naga way of life.

6. Conclusion

In summary, Khonoma Heritage Village is a stunning representation of the perseverance and creativity of the Angami tribal community, whose deep-rooted history and cultural legacy have influenced their identity and practices throughout the ages. With a history of resisting colonial domination and a profound bond with their surroundings, the villagers have cultivated a distinct lifestyle that blends traditional wisdom with contemporary sustainable methods. The complex social system, represented by the "*Khels*" and "*Morung*", showcases a democratic spirit that encourages community participation in governance, education, and resource management. The village's dedication to environmental protection is highlighted by its status as India's inaugural "green village", where the abundant biodiversity, including medicinal plants and wildlife, is carefully maintained through sustainable approaches like agroforestry and selective tree harvesting. The focus on organic farming practices and community-led projects like the Khonoma Natural Conservation and Tragopan Sanctuary reflects the villagers' commitment to preserving ecological integrity and safeguarding their natural assets for future generations.

Additionally, the fusion of traditional crafts, like weaving and basket-making, not only bolsters the local economy but also reinforces the cultural identity of the Angami community. The focus on education and a high literacy rate position Khonoma as a center of knowledge and cultural preservation, ensuring that the younger generations are prepared to face modern challenges while staying connected to their heritage. Despite encountering environmental issues like soil erosion and the effects of changing seasonal weather, the community shows resilience

through innovative strategies and a united commitment to sustainability. Implementing waste management systems and hosting cultural festivals further emphasize the community's comprehensive strategy for environmental responsibility and social unity. As a growing eco-tourism spot, Khonoma provides visitors with a distinctive experience that merges cultural engagement with environmental consciousness, demonstrating the potential of sustainable tourism to drive economic growth while maintaining priceless heritage. Ultimately, Khonoma is a motivating example for other communities, illustrating how a deep respect for history, culture, and the environment can thrive alongside modernity.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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