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Indigenous Sacred Groves: Exploring Traditional Knowledge, Environmental Sustainability, and Conservation Practices at Ajodhya Hill region, Purulia District, W.B. India

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Abstract:

The sacred grove holds significant importance for indigenous communities as it serves as a place for them to engage in traditional natural worship practices. Through the utilization of indigenous knowledge and the preservation of holy groves, local environmental sustainability becomes attainable. Participant observation is used to determine how individuals implement their knowledge in everyday life, which indirectly benefits the environment. To examine the impact of a sacred culture in a sustainable environment, two clusters were formed of the vegetation areas as sacred groves and non-sacred groves. And tried to analyse the difference between the vegetation growths into two clusters for the NDVI technique used for the last 30 years and represent it in a line graph with the help of the Google Earth Engine (GEE) platform. And with this temporal analysis, spatial changes of the vegetation within sacred and non-sacred groves area were also done. 155 participants contributed their knowledge to the survey. In sacred groves, 24 plant families have been observed, along with numerous animals, birds, and invertebrates. The indigenous people residing in the area play a crucial role in protecting the sacred groves by placing their trust in oral traditions passed down through generations. The result shows that the consistency of vegetation growth is very high in sacred groves than in the area of the non-sacred grove. And has also been seen that deforestation and afforestation are very less in sacred groves whereas in the non-sacred cluster have very high deforestation happened last 30 years.

Keywords: Environment sustainability, NDVI, Traditional knowledge, sacred groves,

1. Introduction:

Sacred groves are areas of nature that indigenous people revere and observe strict taboos in honour of the spirits or deities of their ancestors (Rath, & Ormsby, 2020; Bhagwat, & Rutte, 2006; Devi et al., 2005). There are small areas of land with plants and animals in sacred groves that have been used by different groups of people for generations to worship with

faith, religious zeal, etc. and it's important to the people in that society spiritually and culturally (Kandari, et al., 2014; Ormsby, 2011; Devi et al., 2005). It is the last refuge forest where medicinal plants, endangered species, and other species are well-preserved (Gadgil, & Vartak, 1976; Devi et al., 2005). Throughout history, humans have established connections with nature through the utilisation of sacred groves, as well as through various social, environmental, and regulatory traditions. The enduring influence of taboos on holy groves within indigenous cultures has been a subject of considerable significance over an extended period (Barre, et al., 2009; Gadgil, & Vartak, 1976). Sacred Groves, known by several names including Fetish forest, Church forest, and sacred forest, are revered natural spaces where diverse indigenous communities across the globe, including those in Ghana, Nigeria, Ethiopia, Japan, and Turkey, have long practised the worship of various deities. These traditions have been upheld from ancient times within these respective countries (Kandari, et al., 2014; Gadgil, & Vartak, 1976). The sacred grove sites of indigenous tribal people are located in close proximity to villages in India, as well as in other nations (Rath, & Ormsby, 2020). The Western Ghats States, Himalayas States, and plateau region of India are known to possess extensive sacred groves. These groves are found throughout India, with their number exceeding 100,000 (Ormsby, 2011; Malhotra, et al., 2007). Since the Pre-Vedic period, various Tribal communities of India have practised rituals based on their religious beliefs and reverence for sacred Groves (Sharma, & Kumar, 2021). In the Santal language, the lexical items "Shanta" and "Ala" respectively denote the semantic concepts of "peaceful" and "people." (Ota, & Patnaik, 2020). Following the Bhils and Gonds, the Santals constitute the third biggest indigenous community in India. The individuals reside within the geographical regions of West Bengal, Odisha, Jharkhand, Bihar, and Assam (Mukhopadhyay, & Paul, 2022). The Santal people engage in the observance of many festivals throughout the year, wherein they partake in acts of nature worship as a means of paying homage to their deities and forebears. Significant Santal festivals encompass korek-sim, Sahrai, magha-sim, lri-gudi-sim, magha-sim, and Bandhna, which are observed in a traditional manner, passed down through successive generations (Hembram, 2017). Throughout the years, the Santal community has actively participated in the observance of diverse religious festivals. These religious rites have not only held significant cultural and spiritual value but have also played a crucial role in the preservation of biodiversity and the maintenance of material equilibrium (Wrenn, 2013). The sacred groves provide as habitats for a wide variety of plant and animal species, including many that are currently extinct. These groves are acknowledged as notable

regions for the conservation of biodiversity (Sing, H., et al. 2013). Traditional Ecological Knowledge (TEK) plays a significant role in establishing connections between the human and physical environment through the lens of practise and belief (Barre, et al., 2009). India is home to a total of 25 biodiversity hotspots, which are classified as threatened ecological regions on a global scale (Kandari, et al., 2014). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) have initiated the Man and Biosphere (MAB) programme with the aim of mitigating the decline in biodiversity. This programme seeks to enhance the scientific foundation for fostering harmonious interactions between human beings and the environment (Barre, et al., 2009). The biodiversity of sacred groves is influenced by the surrounding landscape forest, resulting in distinct differences in flora and fauna when compared to formal reserves. These variations include the presence of medicinal plants, endangered species, as well as variations in tree thickness and width (Bhagwat, et al., 2005). It is the informal organisations of indigenous people that use social taboos as weapons to control natural sites. These are also known as Resource and Habitat Taboos (RHTs) (Colding, & Folke, 2001). The regulation of individual interactions and behaviour inside Sacred Groves is facilitated by the presence of social taboos. These taboos, which hold significant cultural and religious importance, contribute to the enhancement of environmental conservation efforts (Barre, et al., 2009). The traditional ritual practise of Indigenous peoples in Sacred Groves has been observed to enhance social well-being, promote the replenishment of water supplies, and contribute to the protection of biodiversity since ancient times (Sharma, & Kumar, 2021). Voluntary co-operation and communal efforts of indigenous tribal communities managed Sacred Groves as environment sustainability (Rath, & Ormsby, 2020).

The Purulia district is home to a multitude of sacred groves, varying in size and scale. The indigenous communities in this region have distinct cultural characteristics. The primary goal of this study is to know the present scenario of Sacred Groves conservation practice at the Ajodhya hill region of Purulia District and change of vegetation cover with Sacred Groves and non-sacred Grove’s area. In addition to this, how the Santal tribes protect nature through traditional knowledge and sacred Groves for environmental sustainable development.

2. Methodology:

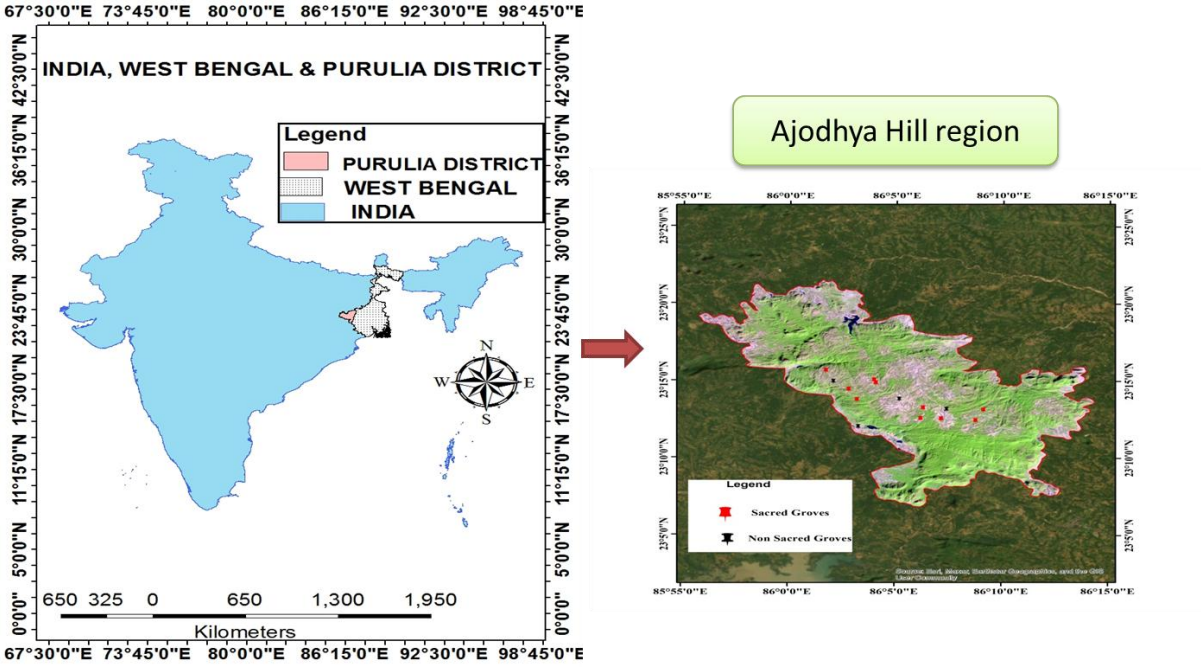
2.1. Location of the study

Santal is one of the most significant tribal communities in the Purialia District, which is home to numerous indigenous peoples. It is obvious to see how dense the forests are in the Ajodhya Hill region, which has the greatest forest cover in the district. Traditional management is evident in this location. The geographical coordinates of the Ajodhya hill region is 23°7'00"N to 23°22'00"N in terms of latitude, and from 85°56'00"E to 86°14'00"E in terms of longitude(Fig. 1). The Ajodhya hills are situated in the Purulia district, specifically within the administrative boundaries of five blocks, namely Bagmundi, Balrampur, Jhalda 1, Jhalda 2, and Arsha. 17 sacred groves of Ajodhya hills have been surveyed (Table 1). The Ajodhya hills are home to a diverse range of tribes, including the Santals, Birhors, Bhumijs, Lohars, and others. Among these tribes, the Santals are the most numerous. The Purulia district is geographically situated as an extension of the Chotanagpur plateau, while the Ajodhya hills are encompassed within the Dalma range. The location is regarded as having knowledge of how much the Santal tribe still uses their expertise to preserve nature.

Table 1: Location of sacred groves at Ajodhya hill region

Sl. No.	Name of the village at Ajodhya hill region	Extension of sacred groves	No. of big trees at sacred groves
1	BANDGHUTU	23°12'29.35"N 86° 6'10.65"E	23
2	BANSHARI	23°15'36.70"N 86° 1'42.80"E	63
3	CHARUBERA	23°14'59.10"N 86° 3'59.50"E	37
4	CHURING SARA	23°12'22.90"N 86° 8'45.40"E	64
5	GARDHAM	23°12'26.83"N 86° 7'10.04"E	108
6	HESADI	23°15'42.90"N 86° 5'10.00"E	37
7	JILLINGTAR	23°13'10.00"N 86° 6'17.00"E	59
8	KALHA	23°13'47.50"N 86° 6'45.80"E	15
9	KURUPAHAR	23°14'23.00"N 86° 2'47.50"E	13
10	KUSUMTIKARI	23°14'48.00"N 86° 4'5.30"E	96

11	LAHADUNGRI	23°13'5.56"N 86° 9'7.89"E	126
12	LIPSITARH	23°13'43.90"N 86° 3'10.40"E	24
13	PORADI	23°14'46.80"N 86° 2'20.00"E	64
14	SAHARJURI	23°15'33.20"N 86° 6'11.10"E	35
15	SAPAROMBERA	23°14'4.00"N 86° 7'47.70"E	102
16	SARAMCHAKI	23°15'2.80"N86° 2'0.96"E	14
17	SUSNIDI	23°15'17.60"N 86° 1'57.10"E	74
Total tree			954
Data source: Survey 2023 & 2024			



2.2. Data acquisition and method

The main objective of the study is to understand the impact of sacred groves culture on vegetation conservation. So to execute the objective, initially a remote sensing index has been applied as Normalized differential vegetation index (NDVI) (Eq. 1). NDVI or Normalized Difference Vegetation Index is a remote sensing method that uses the reflectance of light in the visible and near-infrared (NIR) wavelengths to determine the amount and health of

vegetation in a region (Tucker, 1979). NDVI is widely used in agriculture, forestry, and ecology to monitor the growth and health of vegetation and to identify areas of stress or damage (Thenkabail, 2012). NDVI values can also be used to map and classify vegetation types, and to detect changes in vegetation cover over time (Gitelson, 2003).

$$NDVI = \frac{(Red\ band - NIR\ band)}{(Red\ band + NIR\ band)} \quad \text{(Eq.1)}$$

So here NDVI has been used for detecting the vegetation cover status in a sacred grove area and trying to understand the consistency of vegetation conservation. The analysis was done from 1990 to 2023. The data processing and index formation result was holly done in the Google Earth Engine Platform (GEE). The GEE platform is very helpful to temporal analysis and also to get the average condition of vegetation for a particular year or time frame. The data types, Path-Row, Date, spatial resolution, and index, which have been taken for data processing mentioned (Table 2). The location of sacred groves are located in the study map and from them, one sacred grove with the maximum area covered was selected for vegetation analysis name is Gardham located on Ajodhya Hill is the height point of the Purulia district and is also an extension part of Chhota Nagpur plateau (Saha et al, 2022). Here four years have been selected with 10 years duration for analysis of the vegetation detection and also changes for Ajodhya hill range as well as Gardham sacred grove. The vegetation dynamicity of Gardham has been represented line graph that was generated in the GEE platform for the last three decades (1990-2022). The research employed the participant observation method to investigate several aspects of the Santal tribal community residing in the Ajodhya hills. This method facilitated the exploration of their traditional knowledge, religious norms, utilisation of acquired knowledge in their daily lives, as well as their perspectives on the natural world. Hence, surveys were conducted within the designated study region during the months of January and February 2023, as well as from March to July 2024. During the survey, information about the traditional knowledge of the local Santals and how they perceive nature has been gathered through interview, group discussion, etc. techniques. Data was obtained from a total of 155 respondents, with 114 men and 41 women (Table 3).

Table 2 data acquisition

Data set	Path & Row	Date	Spatial resolution	Band	Index
Landsat 5	139/44	01-01-1990 to 30-12-1990	90 mts	Red (B3) & NIR (B4)	NDVI

Landsat 5	139/44	01-01-2000 to 30-12-2000	90 mts	Red (B3) & NIR (B4)	NDVI
Landsat 5	139/44	01-01-2010 to 30-12-2010	90 mts	Red (B3) & NIR (B4)	NDVI
Landsat 8	139/44	01-01-2023 to 30-10-2023	30 mts	Red (B3) & NIR (B4)	NDVI

Table 3: respondents of the study area

Age group	Male	Female	Total no. of respondents
Below 25	28	13	41
25-50	53	11	64
Above 50	33	17	50
Total	114	41	155
Data source: Survey 2023 & 2024			

3. Results:

3.1. Vegetation covers of sacred groves and non-sacred grove

In the Ajodhya Hill Forest Range, the amount of forest is slowly going down, but the sacred forest area has not changed. The sacred site of Gordham holds a position of utmost significance within the Ajodhya highlands. A hunting festival is organized at this location on the occasion of Buddha Purnima. Here to understand the consistency of vegetation cover on Gardham Sacred Grove, line graph has been generated for 1990 to 2023 and the graph shows that the status of vegetation as per the area is very much consistence. This means there has not been any deforestation or low deforestation. On the other way, we can say there has seen high consistency as per the vegetation cover with in sacred grove (Fig. 2). The arboreal entity within the sacred forests has remained unchanged (Fig. 3), but the adjacent profane regions have experienced change.

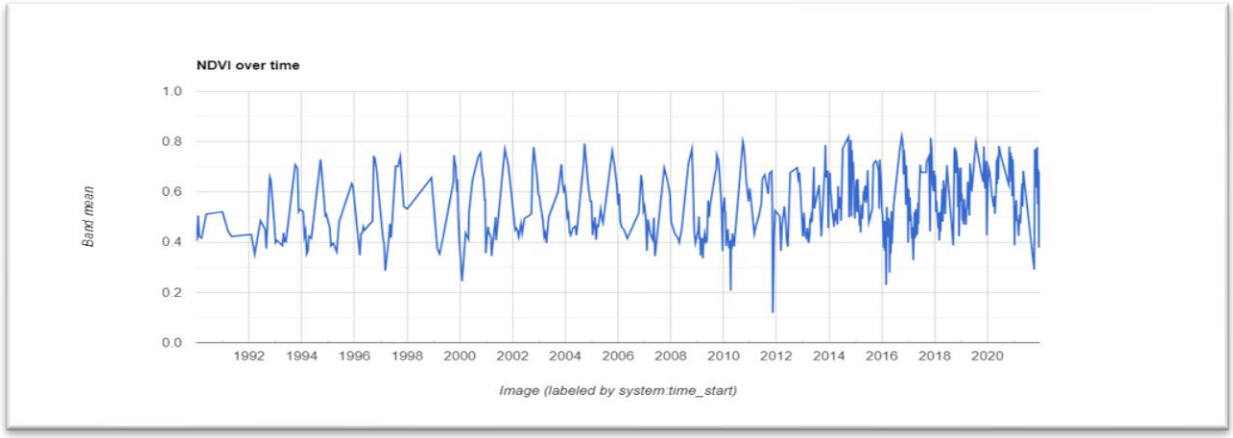


Fig. 2: Line graph of NDVI in Gardham sacred grove

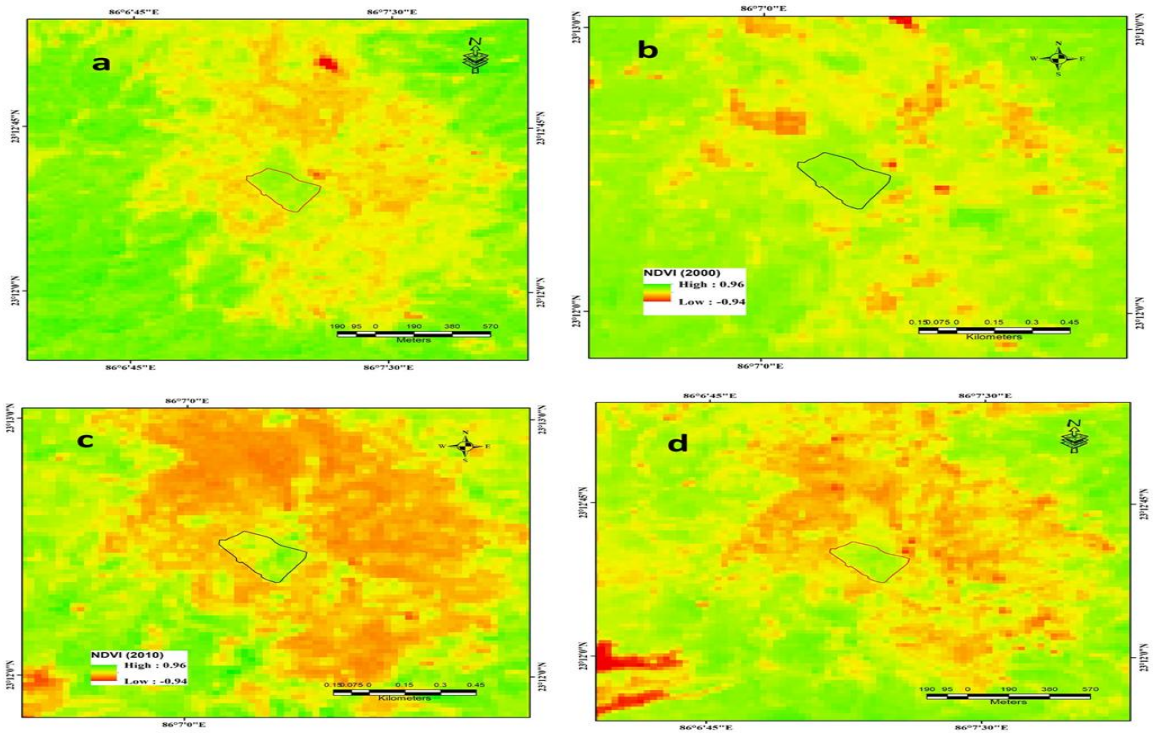


Fig. 3: Changes of vegetation cover between sacred groves and non-sacred groves area. Vegetation covers of Gardham sacred grove and non-sacred groves area during 1990 (a), 2000 (b), 2010 (c), and 2023 (d).

24 families of plants have been identified from sacred groves of Ajodhya Hill and above 50 types of trees has been also identified (Table 4). The majority of the forested areas in Ajodhya are classified as protected forests and are under the jurisdiction of the forest range. During the survey, notable distinctions have been observed between the flora inhabiting the sacred groves and the flora present in the adjacent vicinity. The trees within the sacred groves

exhibit a considerable degree of age, but the surrounding trees lack comparable age. According to Table 5, the dominant tree species in this area include Sal, Asan, Kend, Sidha, Pial, Karam, etc., while the remaining species are present in limited numbers. During the survey, 954 large trees have been identified in 17 sacred groves (Table 1).

Table 4: Plant family of sacred groves at Ajodhya hill region

Sl. No.	Plant family name at Ajodhya hill sacred groves	Sl. No.	Plant family name at Ajodhya hill sacred groves
1	Alangiaceae	13	Meliaceae
2	Anacardiaceae	14	Minosaceae
3	Apocynaceae	15	Moraceae
4	Arecaceae	16	Myrtaceae
5	Bombacaceae	17	Oleaceae
6	Combretaceae	18	Papilionaceae
7	cornaceae	19	Rhamnaceae
8	Dipterocarpaceae Local	20	Rubiaceae
9	Ebenaceae	21	Rutaceae
10	Euphorbiaceae	22	Sapindaceae
11	Fabaceae	23	sapotaceae
12	Lythraceae	24	Verbenaceae
Data source: Survey 2023 & 2024			

Table 5: Trees which are found more in Ajodhya Hill

Scientific name of tree.	Name of trees in Bengali term or local term.
BuchananialanzanSpreng	Pial
ShorearobustaGaertn.F.	Sal
Bombaxceiba.	Simul
TerminaliaalataHeyne ex roth. Syn. T. tomentosa W.& A.	Asan

Terminaliaarjuna (Roxb.) Wight. Am	Arjun
DiospyrosMelanoxylonRoxb.	**Kend**
Lagerstroemia parvifloraRoxb	Sidha
PterocarpusmarsupiumRoxb.	Murga
Adina cordifolia(Roxb.) Hook. f. ex Brandis,	Karam
Glycosmispentaphyllaauct. pl	Sheora
Data source: Survey 2023 & 2024	

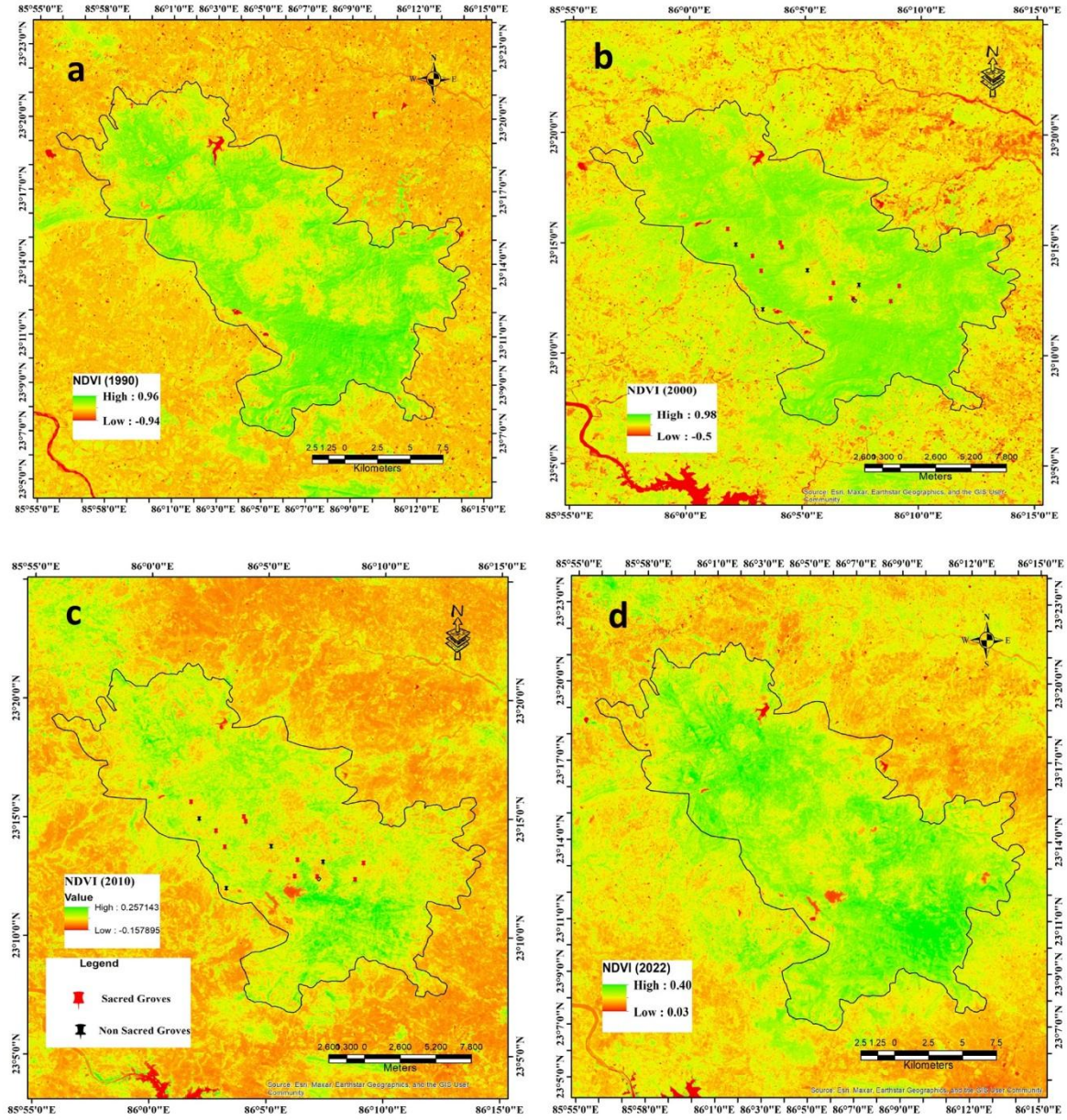


Fig. 4: vegetation cover of Ajodhya hill region during 1990 (a), 2000 (b), 2010 (c), and 2022 (d).

3.2. Santal tribe and sacred groves

Following a comprehensive survey conducted on the 17 sacred groves located in the Ajodhya Hills, a plethora of valuable insights has been acquired from the indigenous Santal population residing in the area. The use of participant observation has revealed that the villagers are engaging in several conservation practises inside the sacred groves of Ajodhya. In contemporary times, notwithstanding the influence of modernization, the indigenous Santal community continues to prioritise its religious beliefs and practises. Currently, there exist multiple hydroelectric projects that are being built in the Ajodhya hills region, with one project having already reached completion. The local community is actively involved in opposing these initiatives with the aim of safeguarding the environment, so preventing any potential harm to the ecosystem additionally, they are willing to take numerous precautions to safeguard their Jaher Than or Sacred Grove. Before the monsoon season, they dispersed seeds of various plants in and around Jaher Than so that, after the monsoon, the seeds would germinate and reduce the plant deficit The authorities consistently maintain vigilance in order to prevent any instances of anti-social behaviour within the confines of Sacred Grove. Puja is still conducted within Sacred Groves, adhering to prescribed rites, and certain Sacred Groves are enclosed by bamboo fences. Currently, each individual belonging to the Santal community adheres strictly to the doctrines and guidelines prescribed by their religious beliefs, as indicated in the provided table 6.

Table 6: Current religious activity at the sacred grove

Age group	Total no. of respondents	Yes (%)	No (%)
Below 25	41	All	0
25-50	64	All	0
Above 50	50	All	0
Total	155	100 %	0%
Data source: Survey 2023 & 2024			

4. Discussion:

Baha festival - The local designation for the Sacred Grove is "Jaher Than," where the Santal community engages in the veneration of several trees as representations of divinity. The deities revered within this context include Jaher Aye, Marang Buru, and Lukapath, among others. The Ajodhya hill region experiences leaf shedding throughout the spring season due to the presence of deciduous forests in the area. Baha festival is the most Holy festival of santal in the month of March. The term "Baha festival" refers to a cultural event often known as the "festival of the flower". During this period, the emergence of fresh blooms and leaves can be observed on the trees. During this festival, the blooms of the Sal tree (Shorearobusta Gaertn.F.) play a particularly significant role, and the flowers of the Sal tree are emblematic of both the Baha festival and the Santals. Jaher Than celebrates the Baha festival, which is also known as Shahrul. The aforementioned festival is commemorated with a series of santals dance performances spanning duration of three consecutive days, commencing shortly after the occurrence of the full moon in the month of March. Um, Sardi, and Jale are the three days program name. The Santal community demonstrates a concerted effort to preserve and protect the environment. The indigenous population residing in Ajodhya Hills continues to actively utilise a significant portion of their ancestral knowledge and practises. Approximately 70% of indigenous communities employ their ancestral wisdom to preserve the environment, with sacred sites assuming a significant part in this endeavour (Table 7).

Table 7: Traditional knowledge application for environment protection

Age group	Total no. of respondents	yes	%	No	%
Below 25	41	12	7.74	29	18.71
25-50	64	51	32.90	13	8.37
Above 50	50	47	30.32	3	1.94
Total	155	110	70.97	45	29.03
Data source: Survey 2023 & 2024					

The Santal people observe four primary seasons throughout the year, including summer (Situng), rainy season (Japud), winter (Rabang), and spring (Niron). Additionally, their new year commences with the celebration of the Maghi festival, which takes place on the first day of the Bengali month of Magh (January 15th). The Santal community engages in the practise of observing climatic patterns throughout the several months of the year by means of their

traditional customs. The following discourse pertains to the traditional knowledge of the Santal community. The next section is a description of the traditional knowledge data acquired during the survey using observation and participant methods.

1. If there is an insufficient or excessive amount of precipitation throughout the summer season, there is a significant likelihood of experiencing drought conditions in that particular year. The probability of precipitation during the monsoon season that year is significantly low.

2. Following the conclusion of the Rohini celebration, paddy seedlings are sown, and a portion of individuals engage in the cultivation of vegetables. In the event of paddy seedlings or vegetables perishing as a result of insufficient water, there exists a significant likelihood of experiencing drought conditions during that particular year.

3. The prediction of rainfall can be made by studying the behaviours and movements of diverse animal species, particularly insects such as red ants, frogs, dragonflies, and cows.

4. In the Santali language, the term used to refer to rain is 'Japud'. They make predictions about the occurrence of rain by observing the thickness of clouds and the presence of fog in the vicinity of hilltops.

5. The Ajodhya hill region is characterised by a dense forest cover, and experiences a temperature range of approximately 10 degrees Celsius throughout the winter season. The local populace possesses knowledge that the absence of precipitation during the winter season is indicative of an impending drought in the subsequent year.

6. The Santals residing in Ajodhya have made an observation that when the growth of maize is suboptimal in a given year, there is a heightened probability of increased rainfall in the subsequent year, accompanied by reduced rainfall within the same year.

7. If there is any weather or climate associated with Sacred Groves or Jaher Than, that question has been asked during the survey. Each individual had a consistent response indicating that the Baha celebration is connected to the climate. When the prescribed rites for appeasing the God or Marang Buru are not conducted adequately or if worship is not performed in accordance with the established norms, it is believed that natural disasters may ensue in that particular year. These calamities may manifest as droughts, excessive heat, reduced rainfall, and increased prevalence of diseases, among other adverse events.

5. Conclusions:

Environmental sustainability is a field of study that focuses on the preservation of the natural environment, emphasizing a harmonious relationship between humans and their surroundings. The objective is to utilize environmental resources in a manner that minimizes harm to the ecosystem. The relationship between traditional knowledge and sustainable development is closely intertwined with indigenous communities. The traditional knowledge held by diverse tribal communities plays a significant role in achieving environmental equity. This study reveals that the Santal population residing in Ajodhya hills are actively engaged in preserving nature due to their religious beliefs. The utilization of traditional knowledge remains prevalent among individuals in their daily lives and within the context of their surrounding environment. Between the years 1990 and 2022 (Fig. 4), the sacred groves exhibited a state of stasis, with no discernible alterations seen. However, notable modifications were observed in the adjacent non-sacred forests throughout this period. It is widely acknowledged that indigenous communities, relying on their traditional knowledge, continue to make efforts towards the preservation and sustainable future of the natural environment.

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