Indian Journal of Traditional Knowledge
Vol 22(2), April 2023, pp 433-443
DOI: 10.56042/ijtk.v22i2.36406

Climate change perspectives and conservation of sacred groves: Case of *Sharngakavu*, Kerala

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Received 06 June 2020; revised 29 November 2022; accepted 05 April2023

India has a rich tradition in conserving non-forest patches known as sacred groves, through cultural and religious beliefs. Sacred groves not only preserve the indigenous biodiversity, it also mitigates the effects of climate change. This study explored the climate change awareness and environmental and cultural perceptions of people associated with *Sharngakavu* sacred grove in Kerala. Data was collected separately from native residents (NR) and non-resident devotees (NRD) through interviews and focus group discussions (FGD). Weighted average index (WAI) and Garrett scores were used to measure the perceived effects of climate change and the importance of socio-cultural values in sacred grove conservation. The results indicated that females in the middle age group of 41-65 years belonging to above poverty line economic status and graduate level of education dominated both NR and NRD categories. There was not much difference in the climate change awareness score of NR and NRD which were recorded at 97.5% and 92.5%, respectively. The majority of the respondents indicated a perceived increase in atmospheric temperature, decrease in precipitation, high seasonal variation in rainfall pattern, heavy decrease in water availability in natural sources, frequent occurrence of heat waves, and frequent recurring natural calamities as the important changes in weather parameters which was actually reflected in the weather data recorded from the region. Among the socio-economic parameters, the majority perceived food production to have recorded a very high increase despite the effect of climate change but livelihood options indicated deterioration. Religious beliefs and the conservation of biodiversity were the most important factors that influenced the continued conservation of this sacred grove.

Keywords: Biodiversity conservation, Climate change, Natural vegetation, Perception, Sacred groves

IPC Code: Int Cl.[23]: A61K 36/00, G01W 1/06

Decline in biodiversity and climate variability are two major environmental issues faced by the world today[1]. The rate of species extinction due to human activities is recorded to be 1000 times more than that of the natural rate[2]. These warrant a revisit of the indigenous concepts of biodiversity conservation like sacred groves. Sacred groves that emerged in the Megalithic times with the spread of shifting agriculture are one of the major forms of ancient local participatory conservation. These are virgin forest areas locally protected and conserved for biodiversity under the guardianship of a presiding deity. Sacred groves conserve flora, protect soil and water and also serve as a site for socio-economic events, religious festivals, and social meetings. These integrate religious and cultural beliefs and taboos that interlink local deities or ancestral spirits into principles of conservation. They are believed to be the abode of local gods, ancestral spirits, and other supernatural powers. In fact, it was these beliefs and perceptions that supported the conservation of biodiversity in these natural habitats over the years.

India has over 100,000 sacred groves, which is estimated to be the highest in the world[3]. Kerala, the southernmost state of India, is no exception with 361 major sacred groves with an average area greater than 0.02ha[4,5]. These sacred groves are based on a complex mix of cultures, beliefs and tradition spread in both developed and underdeveloped geographical areas of the state. It is reported that the biological spectrum of Kerala's sacred groves resembles closely that of the

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biodiversity of tropical forests[6]. This provides great possibility for its use in biodiversity conservation which can be integrated in climate change adaptation strategies. However, the values and perspectives, the people hold towards the conservation of sacred grove is critical in its use as a conservation tool. This assumes paramount significance in the context of increasing demand for land for developmental activities and many studies have reported tremendous threat to sacred groves from ecological, social, institutional, religious, and economic changes in communities that have protected them. Many sacred groves have encroached as the beliefs associated with them, no longer worked[7]. Studies also reported that 80% of the groves which had rich vegetation earlier remained as mere sacred places due to human interventions and threats from extensive removal of fallen wood, litter or twigs[8]. In some sacred groves of Srinagar, Jammu and Kashmir the incidence of forest fire was also noticed[9].

A study on the attitude of the residents on the conservation of the sacred groves of Meghalaya and Karnataka revealed that in both states, the residents were aware of the existing taboos, the consequences of breaking these taboos, and the rituals practiced in the grove. But there were numerous factors that posed pressure on the sacred groves, which included changes in culture and increasing demand for natural resources. There was a decline in the rituals practiced in Meghalaya and in both states there was a tremendous increase in the economic pressure to extract the resources from the grove, and reduce the size of the grove for utilization of the land for other income-generating purposes such as coffee plantations[10].

Sacred groves conceptualized as community-conserved forests, played a major role in the long-term mitigation of greenhouse gas emission in the Garhwal Himalaya as the natural forests of this area are increasingly getting converted into farmlands. Trees species growing at lower densities were under the threat of extinction and there was an immediate need to strengthen protection strategies[11]. Religious myths and associated beliefs are considered as the major factor contributing to the conservation of sacred groves in the majority of the studies. Larger groves were supporting more species but degrading of cultural beliefs have significantly affected the declining of these sacred groves, possessing a new challenge in the conservation of these sites for future[12]. Destruction of the habitat increased land degradation and displacement of the local people are also posing serious threats to the sacred natural resources[13]. It was against this backdrop, the present study was undertaken to evaluate the climate change perspectives of the rural community associated with the conservation of Sharngakavu sacred grove. The study also tried to explore how aware the local community is about the global phenomenon of climate change and the importance they associate with the conserved sacred grove in addressing the climate change-related issues they experience in their immediate socio-economic and agro-ecological context. This has been evaluated in terms of their perceptions related to the changes in local weather parameters, agro-economic factors, and changes in natural resources such as water and biodiversity.

Methodology

Study area

Sharngakavu, a more than 500 years old sacred grove situated at *Venmony* panchayat, *Chengannur* taluk of Alappuzha district in the central part of Kerala, India was purposively selected as the study area. It is located at $9^0$14'36'' and $9^0$14'41'' North latitude and between 76^0 37'44" and $76^0$37'55'' East longitudes. It is one of the sacred groves in the state located in the midst of human habitat, where devotees make frequent visits and regular ritual practices are still being followed. The vegetation of this sacred grove is spread over 1.3 ha designated as the core zone located behind the *Sharngakavu* temple with *Achankovil* river as its southern boundary and an open ground of 1.67 ha termed as the buffer zone in the eastern part (Fig. 1).

Research design

Ex-post facto research design was used in the study. Management efficiency of the natural resources at *Sharngakavu* sacred grove is assumed to be directly dependent on the values and perceptions held by the people associated with it. Therefore, perception has been conceptualized for the study as a range of beliefs, values, and judgments held by the people associated with the sacred grove with respect to environmental conservation and climate change.

Sampling

The selection of respondents was based on the accessibility and knowledge of the sacred grove. Accordingly, the people living in *Venmony* panchayat, irrespective of their religion were considered native residents (NR), and the ones who were non-residents of *Venmony* but who came to visit the grove at least

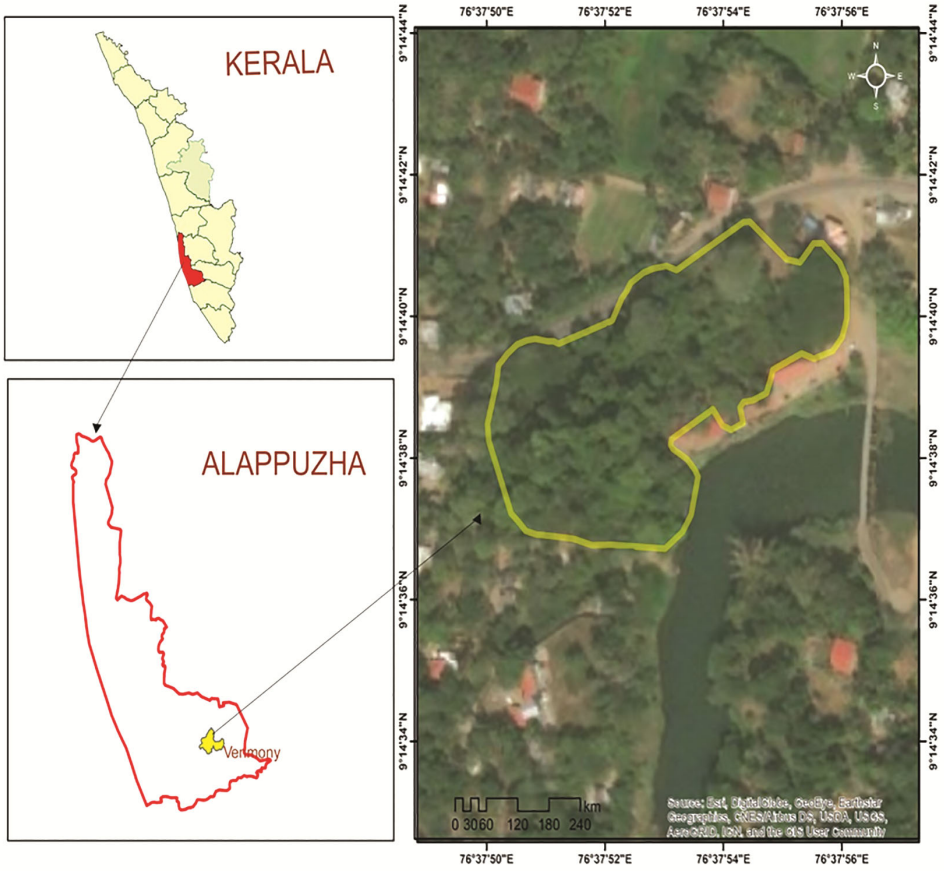

Fig. 1 — Location map of Sharngakavu sacred grove (SG), Alappuzha, Kerala (Source: Google Earth)

once a year regularly were considered non-resident devotees (NRD). The records of the past five years (2015-19) collected from the Panchayat and temple offices were used in the selection of 40 local residents and 40 non-resident devotees, respectively for the study. Thus, a total of 80 persons associated with the sacred grove formed the randomly selected study sample.

Data collection

Data was collected separately from NR and NRD through personal interviews and questionnaires, respectively. The schedule was pre-tested and standardized based on a pilot survey conducted in a non-sampled area and consisted of statements to understand people's knowledge of climate change and the perceived effect of the sacred grove on combating the regional effects of climate change. Socio-cultural, agro-economic, and ecological perspectives related to the conservation of sacred groves were selected based on a literature review and expert consultancy. The semi-structured data collection schedule had two parts as follows:

(i) Part one: Basic details of the respondents (Locality, Age, Gender, Education, Occupation, Economic status)

(ii) Part two: Knowledge of climate change, perceived changes in temperature and rainfall, water availability, extreme weather events, and other effects of climate change manifested in the region over the past ten years, perception of conserving the sacred grove, and its ability to combat weather vagaries related to climate change in the region.

Two focus group discussions (FGDs) involving the sacred group management committee members and members of local environment clubs like *Sharngakavu* sacred grove conservation forum were used to validate the data. Further, secondary weather data of the region were also compiled to compare with the data collected on perceived changes. The data collection and FGDs were conducted in the latter half of 2019.

The perceived effect of climate change was compared on the weighted average index (WAI)

calculated using equation (1) which was converted to a percentage for easy comparison

$$WAI = \sum Fi\ Wi / \sum Fi \quad \ldots (1)$$

Where, F = frequency of response; W = weight of each score; and i = score (3 = highly important; 2 = moderately important; 1 = less important).

Weights were assigned using the subjective method of ranking by an expert group of 30 on a relevancy rating scale of 1-5. Standardized means of their responses were converted into scores ranging from 0-1 and assigned as weights to the selected parameters.

Garrett ranking method was used in the ranking of socio-economic, environmental, and cultural values perceived to influence the local conservation of sacred grove. The percentage position of ranks was calculated using equation (2).

$$\text{Percentage position} = 100\ (Rij - 0.5)\ /Nj \quad \ldots (2)$$

Where, Rij = Rank given for i^{th} variable by the j^{th} respondent

Statistical analysis

The collected data was analyzed using Statistical Package for Social Sciences (SPSS Version 16.0). Frequencies, percentages, and means were the descriptive statistical tools used.

Being a social science analysis where the observations do not follow a normal distribution, the nonparametric analog of t-test *viz.* Mann-Whitney U test has been used to test whether the perception of the local people and devotees showed any significant difference towards the causes of climate change (causes), impacts of climate change (impact), and reason for the conservation of the sacred grove (reason).

Results and Discussion

Sharngakavu sacred grove is one of the 364 important sacred groves in Kerala which has been maintained for more than 500 years as reported by Induchoodan[4] (1996). The presiding deity of Sharngakavu is *Vanadurga* (*Vana* means forest and *Durga* is a form of goddess Parvathi) and the *vigraha* is considered as *swayambhu* (self-manifested). There is no explicit building or ornate architecture for the temple as the prevailing belief is that there exists a golden temple deep inside the nearby *Achankovil* river. The belief forbids the construction of any new temple or other complex structures in and around the grove. During the monsoon showers, the water level of the *Achankovil* river rises and the water enters the premises of the deity which is considered the holy bath of the deity (*arattu*). Another salient feature of the grove is the presence of Bonnette monkeys who dwell in the core zone of the grove. The monkeys are believed to be the children of the deity and they live in the core zone. They come out into the buffer zone where they are fed by the devotees who come to visit the grove as a ritual. The people here believe that the village itself was a forest that was used by the local King *Sharnga* for hunting. Once the king got cursed (*Sapa*) by Saint *Agasthya* for killing innocent animals in the forest. As a repentance, the king was asked to undertake strict *Tapas* (meditation) inside the forest and he was moved by the peace and recreation provided by the forest. Therefore, he ordered to maintain the place as a sacred grove which was later named *Sharngakavu* (grove of *Shargna*) after the king. Based on hereditary lineage, the management of the grove has been entrusted to a group of families in the village. Also, there are local environmental groups such as the *Sharngakavu* conservation form that work with the public to create awareness on issues of climate change and the importance of the sacred grove in combating its impact on local weather and natural resources. Though no legally enforceable conservation rules are in place, traditions and folklore are used to enforce social fencing that prevents encroachments and restricts the entry of the public to a certain pre-designated point. This helped to conserve the biodiversity and carbon sequestration capacity of the grove over the years without deterioration.

The annual festival associated with *Sharngakavu* called the *Vishu Maholsavam* is celebrated during the month of April every year. All the natives of the *Venmony* village, irrespective of caste or religion visit the grove at the time of the festival. Huge decorated temple cars called *Kettukazhacha* which consist of chariots on wooden horses and stilted mannequins of bullocks are the specialty of the festival. However, during the festival also the assembly of people and related activities are restricted to the open ground in the buffer zone. The open ground is maintained as such over the years without constructions or conversions based on the religious sentiments related to the folklore which associates the use of the land by Lord Ayyappa for practicing martial arts. These need to be viewed as conservation strategies to prevent the destruction of the grove's biodiversity and other

resources. All locals irrespective of their religious faith have followed these rituals associated with the grove over the generations. Villagers adjoining the grove extract medicinal herbs and fodder grass from the buffer area, especially during the months of February/ March which helps to keep the area adjoining the temple cleared for the festival in April. However, no pastoral activities are permitted inside the grove. The major categories of visitors to the grove are religious devotees, environmental study clubs, and recreational groups.

Floristic analysis was done based on the species-area curve method and the plant diversity recorded from the grove is presented in Table 1. Ten quadrants of size 5 m X 5 m were taken randomly from both the core and buffer zones of the grove. The species identification was done following standard literature and with the help of expert taxonomists. It could be observed that there has been a predominance of tree species (60%) followed by climbers (20%) in the grove. Palms, ferns, herbs, shrubs, and orchids were also found. Most of the trees were indigenous species with medicinal or carbon sequestration properties having IUCN status of vulnerable or threatened. As such, the conservation of these had a direct influence on the local weather and soil properties. However, it was significant to note that the timber value of these trees was comparatively low. Estimates from the study suggest that the core zone has a better floral diversity of 1.9 based on the Shannon Weiner index as compared to the buffer zone value of 1.57. However, both these zones showed a similar range of species dominance (Simpson's Diversity index) of 0.75 and 0.73, respectively in core and buffer zones. The species richness of the core (13.2) was found to be about two times that of the buffer (6.6) region. But the species evenness was found to be more in the buffer (0.13) than in the core (0.07) zone.

Socio-economic and cultural profile of respondents

Socio-economic and cultural profile of the respondents on selected variables is given in Table 2. Results indicate that females dominated both resident (60%) and non-resident (52.5%) respondents. Majority of both the groups were in the age range of 41-65 years. However, the respondents of age group below 25 years were minimum in both the groups and represented only 12.5%. Also, with respect to education, the majority (25% and 50%, respectively) were graduates among residents and non-residents. There were no illiterates among the studied sample of both categories, and upper primary was the minimum level of education. With respect to economic status also, the majority of the NR and NRD belonged to the

Table 1 — Phyto diversity recorded from *Sharngakavu* sacred grove

Sl. No.	Names of species recorded	No. of species recorded*	Type of vegetation
1	*Acacia caesia, Annonaceae liana, Artabotrys zylanicus, Asparagus racemoses, Calamus rotang, Cyclea pellata, Dalbergia horrida, Geophila repens, Morinda umbellate, Myxopyrum smilacifolium, Piper nigrum, Strychnos columbrina, Wattakaka volubilis*	13 (20)	Climber
2	*Actinodaphne malabarica, Adenanthera pavonine, Aegle marmelos, Ailanthus excelsa, Alangium salvifolium, Alstonia scholaris, Antiaris toxicaria, Aphanamixis polystachya, Aporosa cardiosperma, Ardisia pauciflora, Azadirachta indica, Boswellia serrate, Broussonetia papyrifera, Calycopteris floribunda, Canarium strictum, Canthium angustifolium, Canthium coromandelicum, Carallia brachiate, Cinnamomum verum, Cinnamomum malabatrum, Drypetes oblongifolia, Ficus hispida, Grewia tillifolia, Holoptelea integrifolia, Hopeaponga, Ixora pavetta. Lagerstroemia macrocarpa, Macaranga peltate, Memecylon malabaricum, Morinda citrifolia, Olea dioica, Phyllanthus emblica, Pongamia pinnata, Strebles asper, Strombosia ceylanica, Strychnos nux-vomica, Tabernaemontana alternifolia, Theobroma cacao, Vateria indica, Xanthophyllum arnottianum*	40 (60)	Tree
3	*Caryota urens*	01 (01)	Palm
4	*Adiathum pedatum*	01(01)	Fern
5	*Chassalia curviflora, Chromolaena odorata Hibiscus rosa-sinensis, Ixora coccinea, Jasminum angustifolium, Memecylon randerianum, Pothos scandens*	07 (10)	Shrub
6	*Curculigo orchioides, Hydnocarpus laurifolia, Rauvolfia serpentine*	03 (05)	Herb
7	*Gastrochilus acaulis, Vanilla walkeriae,*	02 (03)	Orchid
	Total	67 (100)	07

(*Figures in parathesis indicate percentage)

Table 2 — Distribution of respondents on socio-economic and demographic variables of respondents associated with *Sharngakavu* sacred grove

Variables (unit of measurement)	Distribution of respondent category (%)	
	Native Residents (n=40)	Non resident Devotees (n=40)
Gender (%)		
Female	60.0	52.5
Male	40.0	47.5
Age (years)		
< 25	12.5	12.5
25-40	20.0	27.5
41-65	50.0	42.5
>65	17.5	17.5
Education		
Upper primary	5.0	7.5
High school	25.0	25.0
Higher Secondary	20.0	05.0
Graduate	25.0	50.0
Post Graduate & above	25.0	12.5
Economic Status		
Above poverty line (APL)	82.5	85.0
Below poverty line (BPL)	17.5	15.0
Occupation		
Government job	17.5	17.5
Private job	35.0	42.5
Wage labour	07.5	07.5
Agriculture	25.0	15.0
Unemployed	15.0	17.5
Annual frequency of scared grove visit		
Once	0	12.5
Frequent (>5times)	97.5	45.0
Occasional (2-5 times)	02.5	42.5

Above Poverty Line (APL) category at 82.5 and 85%, respectively. Among the sampled population, only 15% of the NR and 17.5% of NRD were unemployed. All others were engaged in some form of occupational activity. These indicate that there was not much difference in the socio-economic and cultural variables among the NR and NRD except for their frequency of visits to the sacred grove. While there was a group of once-a-year visitors (12.5%) among the NRD, all the NR group members were either frequent (>5 times per year) or occasional visitors (2-5 times per year). The physical access and the cultural ownership can be attributed to this difference in the cultural variable when on all other socio-economic variables, they shared similar characteristics. It could be inferred from the study that based on the purpose of the visit there were basically three categories of visitors to the grove. Most of the NRs visited the sacred grove for religious and spiritual reasons, but there were regular visitors who valued the recreational and cultural benefits also. There were also the local environmental groups that considered the ecosystem services provided by the grove. However, it was the legacy of cultural heritage that brought the non-residents to the temple for their annual visits, especially during the festivals. Biodiversity and other ecosystem services offered by the grove served as the driving force for the visits of nature clubs and environmental study groups to the sacred grove from far-off places also.

Awareness of climate change issues

The results in Table 3 indicate that the concept of climate change was well understood by both categories of respondents. The awareness score of NR and NRD was 97.5% and 92.5%, respectively. However, on the importance of local actions to reduce climate change, the awareness score of NR was 72.5% and NRD was 82.5%. There was no difference in the importance of biodiversity conservation among the categories as both recorded an awareness score of

100%. Results also suggest that international issues of climate change were not much known among the NR and NRD respondents as indicated by awareness scores of 47.5% and 45%, respectively. Compared to other issues, the scores were low despite it being an often-discussed topic in the awareness campaigns of the local environmental groups and media. However, the awareness score of NR and NRD on the understanding of the role of the sacred grove in environmental conservation was high with 77.5% and 57.5%, respectively.

The results indicate that despite the high average level of education, the respondents were more concerned about local issues related to climate change and the importance of the conservation of natural vegetation in the form of sacred groves. This contradicted the findings of a study from Maharashtra which stated that its respondents were least concerned about the conservation of sacred groves and did not believe in its importance in climate change and biodiversity. Therefore, it can be inferred that awareness is a region-specific variable and was intrinsically related to the emotional and physical dependence of the respondents on the sacred grove. There are also research findings that proved that the positive perception of people on issues related to the conservation of sacred groves depended directly on gender, educational qualification, and occupation[15]. The present findings confirmed it as the socio- economic profile of people associated with *Sharngakavu* as given in Table 2 indicated that the majority of the respondents were women, with an average graduate level of education and some form of employment.

Perceived changes in the weather related parameters

It is evident from the results presented in Table 4 that, both NR and NRD had the same average

Table 3 — Awareness of respondents associated with Sharngakavu SG on issues of climate change

Sl. No.	Issues of climate change	Awareness score (%)	
		NR* (n=40)	NRD** (n=40)
1	Concept of climate change	97.5	92.5
2	Importance of local action to reduce climate change	72.5	82.5
3	Importance of biodiversity conservation	100	100
4	Paris Agreement	47.5	45.0
5	Importance of sacred grove in environment conservation	77.5	57.5

*NR-Native Residents; NRD-Non-Resident Devotees

Table 4 — Changes in the weather related parameters as perceived by the respondents associated with Sharngakavu SG

Sl. No.	Weather parameter	Type of perceived change (score)	Frequency			Weighted Average Index (%)		
			R * (n=40)	NRD** (n=40)	Total (N=80)	NR*	NRD**	Total
1.	Temperature	Very high increase (3)	37	37	74	18.5 (46.3)	18.5 (46.2)	37.0 (92.5)
		Normal increase (2)	03	02	05	1.0 (3.7)	0.70 (2.5)	1.7 (6.2)
		Cannot say (1)	0	1	1	0	0.17 (1.3)	0.17 (1.3)
2.	Precipitation	High increase (3)	20	21	41	10 (25.0)	10.5 (26.3)	20.5 (51.3)
		High decrease (2)	16	09	25	5.33 (19.8)	3.00 (11.1)	8.33 (30.9)
		No change (1)	04	10	14	0.67 (5.2)	1.67 (12.6)	2.33 (17.8)
3.	Rainfall pattern	High seasonal variation (3)	37	37	74	18.5 (46.3)	18.5 (46.3)	37 (92.4)
		Sporadic changes (2)	01	02	03	0.33 (1.2)	0.67 (2.5)	1.0 (3.7)
		No variation (1)	02	01	03	0.33 (2.6)	0.17 (1.3)	0.50 (3.9)
4.	Water availability in natural sources	Heavy decrease (3)	32	23	55	16.0 (40)	11.5 (28.8)	27.5 (68.8)
		Decrease (2)	08	17	25	2.67 (10)	5.67 (21.2)	8.33 (30.9)
		No change (1)	0	0	0	0	0	0
5.	Heat waves	Frequent occurrence (3)	33	26	59	16.5 (41.3)	13.0 (32.5)	29.5 (73.8)
		Occasional (2)	05	13	18	1.67 (6.2)	4.33 (16.0)	6.0 (22.2)
		Very rare (1)	02	01	03	0.33 (2.5)	0.17 (1.3)	0.50 (3.8)
6.	Incidence of natural calamities	Very frequent & recurring (3)	33	32	65	16.5 (41.3)	16.0 (40.0)	32.5 (81.3)
		Seasonal occurrence (2)	07	07	14	2.3 (8.6)	2.3 (8.6)	4.6 (17.3)
		Cannot say (1)	0	01	01	0	0.17 (1.3)	0.17 (1.3)

*NR- Native Residents; **NRD – Non-resident Devotees

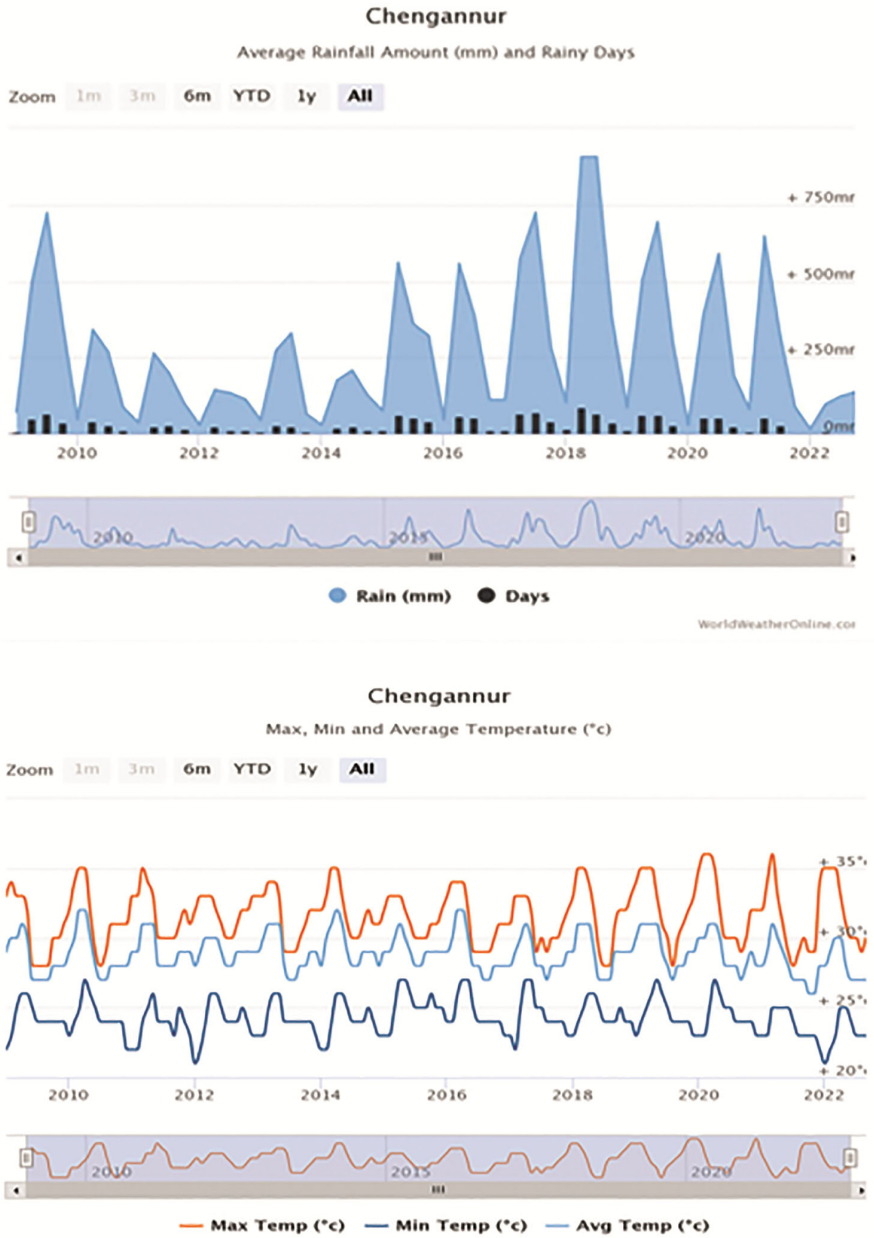

Fig. 2 — Changes in selected weather parameters of *Sharngakavu* sacred grove recorded at Chenganur Taluk (Source: World weather online)

weighted index (AWI) score of 18.5 each on the perception of an increase in atmospheric temperature in the region over the past ten years. An overwhelming 92.5% of the total respondents agreed on the steep rise of temperature over the years. In addition, a decrease in precipitation was observed by nearly half (51.3%) of both the native residents (25.0%) and non-resident devotees (26.3%). AWI scores of NR (18.5) and NRD (18.5) indicated high seasonal variation in rainfall patterns. The majority (92.4%) of the total respondents confirmed the observed changes in rainfall patterns. An attempt to validate the perceived changes in weather parameters using temperature and rainfall data recorded from the region is presented in Figure 2[15].

A heavy decrease in water availability in natural sources such as wells and ponds was observed by 68.8% of total respondents which was in conformity with the AWI scores of 16.0 and 11.5, respectively. Frequent heat wave occurrence was another change perceived by a majority of 73.8% of the respondents and the respective AWI scores for the NR

Table 5 — Perceived changes in the selected socio-economic parameters given by the respondents of Sharngakavu SG

Sl. No.	Socio-economic parameter	Type of perceived change (score)	Frequency			Weighted Average Index (%)		
			NR * (n=40)	NRD** (n=40)	Total (N=80)	R*	NRD**	Total
1.	Food production	Very high increase (3)	19	27	46	9.5 (23.6)	13.5 (33.8)	23 (57.4)
		Normal increase (2)	07	10	17	2.33 (8.4)	3.33 (12.4)	5.67 (20.8)
		Steady decrease (1)	14	03	17	2.33 (18.0)	0.5 (3.8)	2.83 (21.8)
2.	Plant pest & disease	High increase (3)	31	26	57	15.5 (38.8)	13 (32.5)	28.5 (71.3)
		Steady decrease (2)	5	10	15	1.67 (6.2)	3.33 (12.3)	5.0 (18.5)
		No change (1)	4	4	8	0.67 (5.3)	0.67 (5.3)	1.3 (10.6)
3.	Livelihood options	Steady improvement (3)	6	04	10	3.0 (7.5)	2.0 (5.0)	5.0 (12.5)
		Deterioration (2)	33	35	68	11.0 (40.7)	11.67 (43.2)	22.67 (84.0)
		No variation (1)	01	01	02	0.17 (1.3)	0.17 (1.3)	0.33 (2.5)
4.	Human health & diseases	Frequent occurrence (3)	38	31	69	19 (47.5)	15.50 (38.8)	34.5 (86.3)
		Occasional (2)	02	07	09	0.67 (2.5)	2.33 (8.6)	3.0 (11.1)
		Very rare (1)	0	02	02	0	0.33 (2.6)	0.33 (2.6)

*NR- Native Residents; **NRD – Non-resident Devotees

and NRD were 16.5 and 13.0, respectively. Very frequent and recurring occurrences of natural calamities such as cyclones, heat waves, landslides, and floods were also observed as a climate change issue by 81.3% of the respondents. There has been an increase in the number of cyclones, devastating floods (of 2018 and 2019), and landslides in Kerala during the past ten years. The results are in line with the perceived increase in atmospheric temperature and uncertainty in the rainfall as reported by many studies[16].

Perceived changes in the socioeconomic parameters

The results shown in Table 5 reveal the perceived impacts of climate change on selected socio-economic parameters. It is interesting to note that despite climate change, the majority of respondents (57.4%) which include both NR (23.8%) and NRD (33.8%), perceived a very high increase in agricultural food production. This can be attributed to the high education influencing their perception to favor the technological advances contributing to food production. There is also a chance for the increased accessibility to food grains through the public distribution system (PDS) might have been mistaken as an increase in food production.

The majority of 71.3% and 86.3% of all respondents perceived an increase in the occurrence of plant and human diseases, respectively. A steady deterioration in traditional livelihood activities was perceived by 84.0% of respondents with AWI scores of 11.0 and 11.67 for NR and NRS, respectively. The deterioration in livelihood options has been conceptualized for the study as the loss and structural changes that have occurred in some of the livelihood options which were prevalent in the area and are no more available.The major livelihood option which reported a steady decline in the region was agriculture as evidenced by Table 2 which reports the dependence of just 25 and 15% of NR and NRD respectively on agriculture as their primary vocation. Further, the conversion of agricultural land to other uses and the decline in the no. of farmers also testify to the changes. Fishing and boat services in the *achankovil* river were abandoned as a result of water quality deterioration and the construction of bridges as part of infrastructure development in the area. Rearing of goats was another vocation that has been restricted to a few pockets due to the loss of common pastoral lands as testified in the discussions of FGD conducted in the area.

Perceived importance of selected factors in the sacred grove conservation

Based on the Garret score, the factors were ranked and the results in Table 6 reveal those religious beliefs related to the sacred grove were ranked as the most important factor perceived to influence the conservation of sacred groves by the respondents with a mean total score of 60.28. This is considered a heritage legacy maintained over the generations. However, the conservation of biodiversity was ranked the second most important factor with a score of 51.19. This is considered a logical reason popular among the people for maintaining the sacred grove, the biodiversity of the entire grove was left undisturbed, except for the allowed collection of medicinal plants from the buffer zone. Conservation of microclimate (45.53) and cultural heritage

Table 6 — Perceived importance of environmental and cultural factors in the sacred grove conservation by respondents associated with Sharngakavu SG

Sl. No.	Influencing Factors	Rank given by respondents (N=80)					Total Score	Mean score	TotalRank
		1	2	3	4	5			
1	Religious beliefs	48	7	2	10	13	4822	60.28	1
2	Conservation of biodiversity	24	17	9	7	23	4095	51.19	2
3	Conservation of microclimate	10	24	3	18	25	3642	45.53	3
4	Cultural heritage of locality	17	11	7	17	28	3620	45.25	4
5	Divinity of nature	1	2	1	6	70	2159	26.99	5

Table 7 — Comparison of causes, impact of climate change on local weather and reasons for sacred grove conservation as perceived by different respondent groups

Sl. No	Perception issues and respondent categories	Man-Whitney statistic	p-value
1	Native residents Vs Non-resident devotee (Causes)	797.00^{ns}	0.977
2	Native residents Vs Non-resident devotee (Impact)	656.5^{ns}	0.164
3	Native resident Vs Non-resident devotee (Reason)	787.00^{ns}	0.895

ns = non-significant

associated with the grove (45.25) was closely ranked at the third and fourth positions. The divinity of nature with a score of 26.99 had the least influence on the conservation of the sacred grove.

There are many studies that reported the relaxation of conservation norms for the utilization of resources for the construction and maintenance of the temple structures as one of the major reasons for the vanishing of the existing sacred groves[17]. But in *Sharngakavu*, there exists a taboo against any structural constructions, even temple structures, in the area. This prevents the felling of trees from the grove and can be considered as an informal mechanism imposed by the ancient people to conserve the biodiversity of the sacred grove over the generations. These served as self-enforced rules that are unquestioningly followed even by educated youths of the area who have found reasons to integrate this ancient wisdom in terms of the principles of environmental conservation.

The result of Mann-Whitney U test given in Table 7 indicated that there does not exists any significant difference in the perception of causes of climate change, its impact on local weather and biodiversity, and the reasons for the conservation of sacred groves as perceived by NR and NRD in the study.

Conclusion

The results proved that cultural beliefs and taboos continue to be the best conservation strategies against the exploitation of local sacred groves. They serve as invisible fences which keep out the economic exploits of its resources. However, pressures of development lead to the relaxation of traditional norms and social taboos. The increased demand for improved infrastructural facilities has caused the utilization of resources and the deterioration of many sacred groves. Moreover, many of the rituals associated with these groves are questioned and are often subjected to scientific inquiries. Therefore, reinterpretation of norms associated with sacred groves in the light of modern conservation theories can help in conserving them as is evident from *Sharngakav*. It needs to be reiterated that the conservation of the scared grove is being continued here because the people associated with it arewell aware of the impacts of climate change and have understood thatthe impacts can largely be mitigated by conserving such greenery. They seem to value more the ecological services provided by the sacred grove and the biodiversity conserved by it.

Moreover, it was observed that even with good educational background, one of the major reason why they believed that the grove must be conserved is the religious beliefs associated with it. Though education increases awareness on biodiversity and its conservation, it also provides insights that create a loss of belief in traditional norms. Therefore, programs for increased ecological awareness can play a critical role in biodiversity conservation and more importantly in combating climate change through the

conservation of these natural sites. Directing this knowledge towards the conservational aspect of the grove and the necessity of mitigating climate change is the major challenge for preserving these sacred natural sites for future generations.

Acknowledgment

The authors wholeheartedly thank the local residents of Venmony village and devotees for their cooperation and willingness to share their perceptions. The local administration members of the *Sharngakavu* temple especially Adv. Radhakrishnan is gratefully acknowledged.

Conflict of Interest

This manuscript has not been submitted to, nor is it under review at, another journal or other publishing venue. The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript and have no conflicting interests in the publication.

Authors' Contributions

All authors have participated in (a) conception and design, conducting the interviews, discussions & analysis, and interpretation of the data; (b) questionnaire preparation, drafting the article or revising it critically for important intellectual content, and (c) conception and design, approval of the final version.

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