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Community attitude towards Riparian Tree's attributes on Livelihood and Ecotourism in the Cauvery River Basin of South India

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ABSTRACT

The majestic floral marvels, *Terminalia arjuna* of the Cauvery River Basin are the dominant species in the riparian region. The evergreen dense canopy of these trees is a prominent feature of the reverie landscape. Several, medicinal, religious cultural and ecological roles played by them paints a halo of selfless service over their crown. Beneath the crown of these gigantic trees, livelihood and tourism thrives. A field-based study was conducted across three tourism sites—Sangama, Muthathi, and Hogenakkal using structured questionnaires and interviews with local communities and tourists followed by statistical analysis using SPSS. The findings revealed that *Terminalia arjuna* plays a crucial ecological and socio-economic role by supporting biodiversity, microclimate regulation, and local livelihoods, with tourists and communities recognizing its aesthetic and commercial value, though its decline is linked to riverbank erosion and unregulated tourism. *T. arjuna* is treasured and in jeopardy, the claws of 'anthropocene' has reached its roots, thus despite nestling in protected area the tree faces several threats. The study is therefore an example of the benefits provided by the gigantic riparian flora of the globe to the indigenous communities and tourism industry at a micro level.

1. Introduction

Standing magnificently at a height of 25 meters in the riparian landscape, *Terminalia arjuna* practically acts as a keystone species in the Cauvery River Basin (CRB) of India [1]. The dense, evergreen canopy of this riparian tree is a remarkable feature of the Cauvery Wildlife Sanctuary (CWS), particularly during the summer season, as the surrounding landscape comprises dry deciduous and scrub forests [2]. The brilliant green color, the interlocking root framework, along with the buttressed trunk, make these majestic trees breathtakingly beautiful.

The distribution of these trees ranges from India and Sri Lanka to Myanmar. *T. arjuna* is mentioned as 'Hirdya,' a drug that strengthens the heart. Apart from curing cardiac diseases, *T. arjuna* is used as a remedy for snakebites, scorpion stings [3], headaches, and earaches [4]. The parts of the tree also have anti-ischemic, anti-bacterial, anti-oxidant, and lipid-lowering effects [5]. It is regarded as 'Sthalavriksha' (temple tree) in Tamil Nadu [6] and is identified as a sacred tree in the states of Madhya Pradesh and Karnataka [7].

A study conducted by the Department of Ecology at Bangalore University [8] highlighted *Terminalia arjuna* as "Ecosystem Engineers" of the CRB, as they adjust the physical environment by releasing assets that can be utilized by various species in the riparian region. This giant tree stands resilient, stabilizing the riverbank and reducing flood efficiency. The interlocking root system purifies the water, acts as a soil binder, and provides shelter and a breeding ground for fish. The dense green canopy of the tree serves as a carbon sink and helps in stabilizing the microclimate. It also offers a safe habitat for the giant grizzled squirrel and potential nesting sites for bees and bats. Underneath the canopy of this glorious tree, indigenous livelihoods and ecotourism thrive. The present study investigates how these riparian trees play a significant role in sustaining the livelihoods of local communities and tourism in the Cauvery River Basin, offering a global perspective on how the remnant giant riverine trees of the planet altruistically serve both aquatic and terrestrial species.

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2. Methodology

2.1 Study Area

2.1.1 River Cauvery

The Cauvery River, often revered as the "Dakshina Ganga" or the Ganges of the South, is the eighth largest river in India, encompassing 24.7% of the nation's geographic area. Originating from the Brahmagiri Hills in the Western Ghats, Cauvery flows south-eastward for about 805 kilometers. Along its course, it traverses the states of Karnataka and Tamil Nadu—covering approximately 320 km in Karnataka, 416 km in Tamil Nadu, and a 64 km stretch forming the boundary between them before emptying into the eternal vastness Bay of Bengal at Poompuhar [9]. The Cauvery River Basin (CRB) spans an estimated 81,155 km², distributed across three states and one Union Territory: Tamil Nadu (43,856 km²), Karnataka (34,273 km²), Kerala (2,866 km²), and Puducherry (160 km²) [10]

Cauvery Wildlife Sanctuary- Sustained by the perennial grace of the Cauvery River and enriched with deciduous, riparian, and scrub forests, the Cauvery Wildlife Sanctuary (CWS) supports a diverse range of species. Notified in 1987 under Section 18 of the Wildlife Protection Act of 1972, the sanctuary spans 52,695 hectares across the districts of Chamarajanagar, Ramanagar, and Mandya. It is located between 11° 56' 49" to 12° 21' 26" N and 77° 1' 5" to 77° 46' 55" E in the Western Ghats of Karnataka, India. It receives an average annual rainfall ranging from 750 mm to 800 mm, primarily during the Northeast monsoon, with additional contributions from the Southwest monsoon. [11] Dedicated to the conservation and protection of wildlife and their habitats, CWS is renowned for its ecological richness, dry deciduous vegetation, and the vital Cauvery River, which winds through the landscape, creating numerous scenic and culturally important locations.

Muthathi, a village in the Cauvery Wildlife Sanctuary (CWS) in *Mandya* District is a place of revered religious importance, one of the major shrines of CWS - *Muthatheraya* Temple dedicated to Lord Hanuman is situated here [12]

Sangama, located in *Kanakpur*, *Karnataka*, marks the confluence of the *Arkavathi* and *Cauvery* rivers and is a site of significant ecological, hydrological, and cultural importance . [13] Situated at a distance of 100 km from Bengaluru, surrounded by lush greenery, it a favored destination for nature lovers. Its serene environment provides an ideal backdrop for picnics, photography, and peaceful retreats.

Hogenakkal Falls, located on the Cauvery River along the Tamil Nadu–Karnataka border, is a renowned natural attraction celebrated for its striking beauty and vibrant tourism. Often referred to as the "Niagara of India,". The site supports the livelihoods of about 3,000 locals who engage in fishing, offer coracle boat rides, run fish eateries, and provide traditional massages. Women also play a key role by managing fish restaurants, contributing to household incomes.. [14]

2.1.2 Sampling and Survey

Preliminary visit and pilot survey were conducted to examine the feasibility of the questionnaires. After field testing the tool, two different questionnaires were framed focusing on the targeted stakeholders, The study area was divided into three regions namely *Sangama -Mekedatu*, *Muthathi* and *Hogenakkal* using cluster sampling. Two sampling units were selected, first being the indigenous communities of the area and second the tourists visiting the protected area a total number of hundred respondents were sampled, fifty being people from local communities and fifty tourists respectively. Simple random sampling was used while interviewing the different stakeholders. The interviews were conducted in English and the regional languages *Kannada* and *Tamil* and the survey was carried out by the following means:-direct questioning, participant observations, qualitative and semi-structured interviews and field observations The data was analyzed by performing correlation and t-test using Microsoft Excel and IBMSPSS.

3. Results and Discussion

3.1 General Information of the stakeholders

As the cases were selected on the basis of simple random sampling, the maximum locals observed (54%) in the region were in their middle ages, this may be a result of the migration of the young population (18-30) to the nearby cities for pursuing their studies and career. The highest percentage of tourists was observed to be the young crowd (64%). The number of interviews conducted at each sites were divided according to the size of the area and its role with respect to tourism. 20% of the target population was surveyed in *Sangama- Mekedatu*, 30% in *Muthathi* and 50% in *Hogenakkal*. The survey depicted that 38% of the locals were uneducated, 30% had achieved primary education and only a mere 2% were graduated whereas only 2% of the tourists surveyed had no education qualifications, 46% were graduated and 10 % were post graduated. The study revealed that 82% of the total local stakeholders surveyed were vendors depicting the dominance of this profession in the region. The total revenue of the 50 local people surveyed for a week is ₹85550 and out of these vendors a mere 14% pay monetary value for the land they use for business. The maximum number of tourists (52%) get their private vehicles to the protected area, while only 20% use the public transportation. This increases the load on the natural environment.

3.2 Knowledge on tree attributes and Self-determined Travel Motivation

When questioned about the self-determined travel motivation of the tourists' maximum opted for extrinsic motivation, therefore it can be interpreted that the tourism in the area is mainly attracted by the river and the surrounding green

landscape which is mainly attributable to the presence of *T.arjuna*. The visitors were quite familiar with this enormous tree which adds brilliant green colour to the canvas of the Cauvery River Basin. The questionnaire designed for tourists also involved question which examined whether they were aware if they are present inside a protected area, to this 70% responded positively, however the rest 30% being unaware of this fact can result in irresponsible behavior, hence it becomes an vital aspect that the tourists are made conscious that they are entering a protected area with the purpose of assisting them self-monitor their behavior.

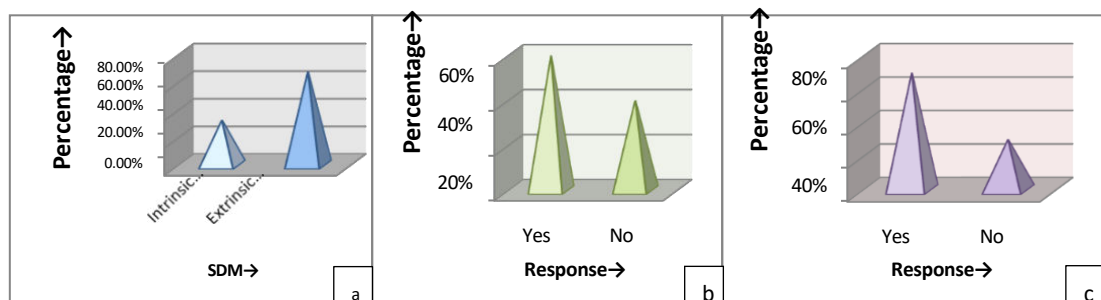


Fig 1. a. Self- determined travel motivation, b. awareness about *T.arjuna*, c. awareness about the protected area

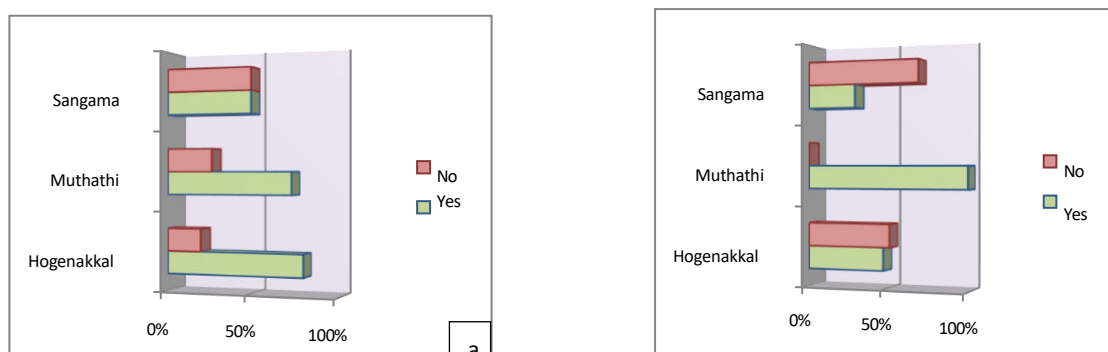


Fig 2 a. Medicinal importance,

b). Religious Significance of *T.arjuna*

The medicinal benefits of the riparian tree are well known amongst the locals. The awareness on the religious association of the tree is less in *Sangama* and *Hogenakkal*, however in *Muthathi* is 100% respondents are familiar with the pious association.

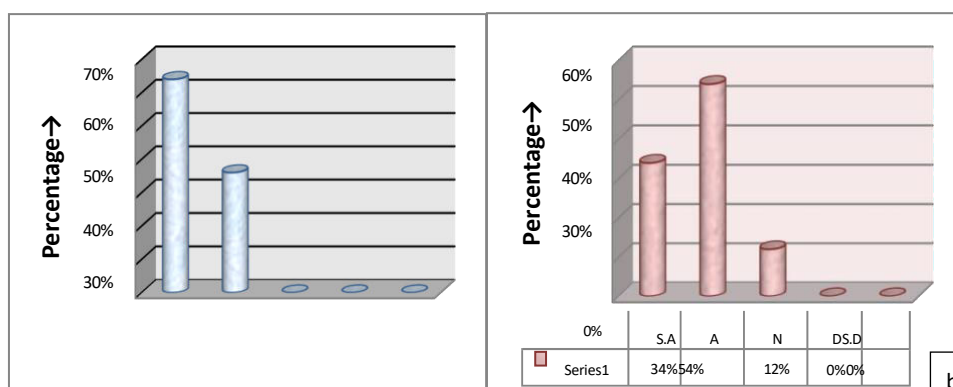


Fig 3 a. Absence of *T. arjuna* will have negative effect on Tourism, b. would increase Cost of Living for Local Community

As per the indigenous community's perception absence of *T.arjuna* will negatively affect tourism and increase their cost of living.

3.3 Statistical analysis

The results (Table 1) reveal the agreement between the two stakeholders with respect to the assets provided by *T.arjuna* in the study area. The t-test performed at 5% level of significance ($\alpha=0.05$) proves that both the sampling units strongly approve that *T.arjuna* attracts and nurtures biodiversity and flourishes tourism in the area, the local communities and tourists also have similar mindset when it comes to the concept of aesthetic beauty provided by these splendid riparian trees. Then option that *T.arjuna* provides suitable land for the local communities to set up their business also held a similar opinion, simultaneously the stakeholders mutually agreed that the thick evergreen canopy of the tree regulates the microclimate of the region

Table 1. Overall mean and standard deviation of respondent's attitudes towards assets of *T.arjuna* in the entire study region

Assets of <i>T. arjuna</i>	Mean	Standard Deviation	T (cal) value	p-value
Aesthetic beauty	0.08	0.72	0.78	0.44
Attracts and nurtures biodiversity	-0.04	0.78	-0.36	0.72
Suitable Land for Business	0.2	1.12	1.26	0.21
Regulates Microclimate	0.16	1.02	1.11	0.27
Tourism	-0.06	0.31	-1.35	0.18

Table 2 compares the difference in the attitudes of the two stakeholders across three sites with respect to assets provided by *T.arjuna*. The t-test performed at 5% level of significance ($\alpha=0.05$) reveals that the people in *Sangama* are more aware to the concept of aesthetic beauty provided by the tree, this may be due to the fact that *Sangama* comes under the wildlife sanctuary and is away from any religious influence. The stakeholders of *Hogenakkal* hold a negative opinion about these trees attracting and nurturing biodiversity, the reason behind opinion may be the fact that *Hogenakkal* does not come under the CWS and anthropogenic activities in the region are comparatively high than the other two sites. Thus, the people are not able to spot much fauna in the region. The notion that the riverine tree provides suitable land for local communities for their business hold a negative vote by the sampling units of *Muthathi*, the cause behind this is the pilgrims which visit the Lord *Anjaneya* temple believe that even if the trees are absent the vendors will be present as the tourists won't stop coming for the religious reasons.

Table 2. Mean and standard deviation of respondent's attitudes towards assets of *T.arjuna* across the three study areas.

Assets provided by <i>T.arjuna</i>	Mean			Standard Deviation			T (cal) value			p-value		
Study Areas→	S	M	H	S	M	H	S	M	H	S	M	H
Aesthetic beauty	-0.2	0.2	0.12	0.78	0.86	0.66	-0.80	0.89	0.90	0.44	0.38	0.37
Attracts and nurtures biodiversity	-0.6	-0.2	0.28	0.84	0.67	0.54	-2.25	-1.14	2.58	0.51	0.27	0.01
Suitable L and for business	-0.5	0.73	0.16	1.17	1.03	1.06	-1.34	2.75	0.74	0.21	0.01	0.46
Regulates microclimate	0.2	0.13	0.16	1.47	0.74	0.68	0.42	0.69	1.16	0.67	0.49	0.25
Tourism	-0.4	-0.6	-0.1	0.35	0.25	0.31	-0.56	-1.00	-1.00	0.57	0.33	0.34

The stakeholders in all the three sites agree that these gigantic evergreen trees regulate microclimate and hold the same opinion about tourism in the area. The local communities' attitude towards assets of *T.arjuna* between the three study (Table 3) areas reveals their difference in opinion with regards to *T.arjuna* affecting fishing trends, considering the comparison between *Sangama* and *Muthathi* similar responses are observed. However while associating *Muthathi* to *Hogenakkal* difference amongst the same stakeholders in the two sites is perceived, this may be because the Fisheries Department of *Hogenakkal* (falling within a reserved forest) Tamil Nadu, has allowed fishing in the region, whereas *Muthathi* is the part of CWS and thus fishing is banned. A tremendous difference is observed while comparing *Hogenakkal* to *Sangama*, this is due to the fact that, *Sangama* lies in a Wildlife Sanctuary, therefore fishing in this region is strictly monitored however the activity is allowed in *Hogenakkal*.

Table-3. Mean of the attitudes of Local Communities towards assets of *T.arjuna* between the three study areas.

Assets of <i>T. arjuna</i>	Mean			t-value			p-value		
Study Areas	S-M	M-H	H-S	S-M	M-H	H-S	S-M	M-H	H-S
Aesthetic beauty	1.616	1.766	1.65	2.069	2.024	2.034	0.252	0.635	0.080
Suitable Land	1.350	1.48	1.23	2.069	2.024	2.034	0.083	0.223	0.270
Tourism	1.516	2.58	1.51	2.069	2.024	2.034	0.033	0.929	0.021
Fishing	0.940	0.400	1.48	2.069	2.024	2.034	0.209	0.0174	0.0008
Medicinal Benefits	0.766	0.616	0.6165	2.024	2.070	2.070	0.635	0.252	0.252
Decline of <i>T.arjuna</i>	0.366	0.446	0.280	2.069	2.024	2.0345	0.103	0.295	0.372

Table 4 indicates the Environmentally Responsible Behavior (ERB) [16] of the tourists visiting the tourism sites in the protected areas. The behavior of visitors in *Sangama* and *Muthathi* differs in respect to the rules and regulations followed. The presence of the religious shrine in *Muthathi* attracts huge amount of pilgrims, who cook at the banks of the river Cauvery as a part of the religious ceremony, thus imposing threat to the riparian biodiversity slight difference was observed in the environmental attitudes of the people of *Sangama* and *Hogenakkal*, as the later does not come under CWS.

Table 4. Mean of the Environmentally Responsible Behavior (ERB) of tourists towards the protected area across the three study areas.

E.R.B	Mean			t-value			p-value		
Study Areas→	S-M	M-H	H-S	S-M	M-H	H-S	S-M	M-H	H-S
Followed rules	0.95	2	1.13	2.0686	2.024	2.0345	0.0148	0.198	0.0427
Didn't disturb biodiversity	0.75	0.62	0.97	2.0686	2.024	2.034	0.723	0.156	0.4415
No Smoking	1.183	1.373	1.29	2.0686	2.024	2.0345	0.723	0.46	0.2976

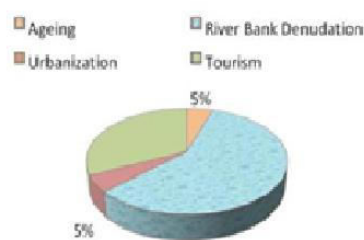
Table 5. Correlation between different attributes covered by *T. arjuna* in the Cauvery River Basin

Sr. No	Variable1	Variable2	Correlation
1	Provide Shade	Land for business	0.167
2	Land for business	Cost of living	0.338025
3	Provide Shade	Use of Plastic sheets↑	0.064775
4	No of Tourist ↓	Cost of living↑	0.322131

The table 5 illustrates the correlation between various aspects covered by *T. arjuna* in the riverine regions of the Cauvery. Under the majestic crown of the tree, the businesses of the local community flourish. The land provided by *T. arjuna* for businesses helps them to cover the cost of living. The shade also reduces the use of plastic covers in the guided areas. If the trees are absent from the region, tourism will be affected, which would, in turn, increase the cost of living for the local communities.

3.4 Reasons for Decline

According to the responses, the main reason for the decline of *Terminalia arjuna* is river bank denudation. Tourism also plays a major role in the waning of this riparian tree. Thus, there is an urgent need for us to come up with a pragmatic approach that would benefit the escalating tourism industry while maintaining the authenticity of wilderness.

**Fig 4a.** Reasons for decline of *Terminalia arjuna***b.** *T. arjuna* fallen due to river bank denudation (Muthathi)

4. Conclusion

The results of the present study depicts that *T. arjuna* provides a wide array of assets in the CRB, one of them being regulating tourism in the study areas, which in turn affect the livelihood of the local communities residing in the protected areas. The study, conducted in the tourism sites of the Cauvery River Basin high lights the socio-economic prominence of these riparian trees. The previous years of winds and rains have left a scar in the CRB. Cauvery has always been and apple of discord between the states of Karnataka and Tamil Nadu, thus *Terminalia arjuna*, bordering the river portrays the unbiased attitude of nature in nurturing livelihood and flourishing tourism equally on both sides of the artificial border.

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