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Spatial Analysis of the Islands of Kaveri: Exploring landscape themes using placemaking indicators

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Abstract:
Every river's islands allow a variety of uses, assigned to them by the primary stakeholders over centuries of habitation. Identification of these islands based on thematic classification would aid in the decision-making process.
Kaveri is a significant river from the south of India, also one of the seven holy rivers. Besides creating a host of unique landscapes, several of its islands are inhabited and also culturally significant.
This paper will document and study islands of river Kaveri using parameters such as land use, demography, heritage components and narratives from popular media. Some of these islands are known for their exceptional cultural and natural significance. GIS will be used to map and analyze these islands and its attributes. Thematic classification will be arrived at using indicators of placemaking. This paper will set a precedent to look at river islands and provide a tool kit to classify island landscapes.

Keywords: placemaking, island, Kaveri, culture, spatial analysis

1. Introduction

Riverine cultures have played a significant role in human civilization for ages. History is proof that many of the major ancient civilizations thrived along rivers. Mesopotamian civilization survived for centuries owing to the two rivers Euphrates and Tigris, Egyptian civilization centred around the river Nile and Indus Valley civilization owes its existence to the river Indus. The Indian subcontinent is no stranger to this phenomenon and is home to many such rivers. Not only are these rivers critical ecological systems, but some are also accorded sacred status, hence becoming noteworthy through religious and cultural realms. Geomorphologically, the rivers in the southern part of the Indian subcontinent are older than their northern counterparts, the important ones being Godavari, Krishna, Tungabhadra, and Kaveri.
Kaveri is the southernmost of all the major rivers in India. Southwest and northeast monsoon rains mainly feed the river. The waters of the Kaveri are swelled by many tributaries which include Hemavathy, Shimsha, Arkavathy, Lakshmana Tirtha & Lokapavani rivers which rise in the Western Ghats in Karnataka. The physical structure of the river can be classified into Upper, Middle and lower basins together constituting an area of around 80,000 square kilometres (refer to Figure 1). From source to mouth, the river runs around 800 kilometers. The primary source of the river Kaveri is considered to be at Talakaveri in Brahmagiri hills in Kodagu district in Karnataka state.

2. Kaveri River and its Islands

Kaveri is one of the seven holy rivers in India and is worshipped as goddess Kaveri, and also holds the distinction of being associated with all three gods of the Hindu trinity[1]. The river basin passes through three states and one union territory namely Karnataka, Tamil Nadu, Kerala and Puducherry.
After the river leaves the Kodagu Hills and flows onto the Deccan Plateau, it bifurcates twice, forming the islands of Srirangapatna and Shivanasamudra, each culturally significant, after which the river narrows and winds its way through Deccan Plateau, eventually to plunge and form the Gaganachukki and Bharachukki waterfalls(Warrier, 2014). Continuing the flow further, Kaveri is her slimmest at Mekedatu[2]. A little further down the course, the river enters the state of Tamilnadu, traversing along the state border and plummeting further at the Hogenakkal Falls. Once the last of her tributaries joins her near Karur, Kaveri is known as Akhanda Kaveri or undivided Kaveri, where she is her broadest. Owing to the extensive length of the river and its perennial flowing waters, several dams and reservoirs have been built across Kaveri, since the times of Chola kings[3]. The river is also home to many natural reserves which speak of the rich biodiversity reliant on the river.

[1]Three major deities namely Brahma, Vishnu and Shiva
[2]Mekedatu - Kaveri flows through a deep and narrow gorge. Mekedatu' means 'goat's leap' in Kannada.
[3] The Chola dynasty was a Tamil thalassocratic empire of Southern India and was one of the longest-ruling dynasties in world history.

The great divide starts near the town of Tiruchirapalli, where Kaveri splits into two at Srirangam, the two arms join to form the island of Srirangam only to separate again. The upper arm is called Kollidam, and lower remains Kaveri. It is here, at the tip of Srirangam that the famous Kaveri Delta begins, where it is its most fertile. This river is a complex one with several tributaries and distributaries. Five major distributaries of Kaveri which contribute to the Delta are Vadavar, Vettar, Vennar, Kudamurutti and Kaveri. It is in Chola land that she is most fertile and known as Ponni, the golden river. She finally unifies with the Bay of Bengal at Poompuhar in Tamil Nadu.

Kaveri, also known as Jeevanadi[4], supports life as millions of people depend on it for water, power and food. This river has been a source of extensive irrigation systems, ever since the time of the Chola kings (c. 900-1270 CE). It also reflects in her name Kaveri, derived from two Tamil words, 'Ka' meaning fertile and 'viri' meaning to extend, which is also synonymous with prosperity and abundance (Warrier, 2014). Kodagu, Mysore, Kongumandalam and Cholamandalam, four of the most prosperous regions from today's states of Karnataka and Tamil Nadu have thrived for centuries because of the river Kaveri.

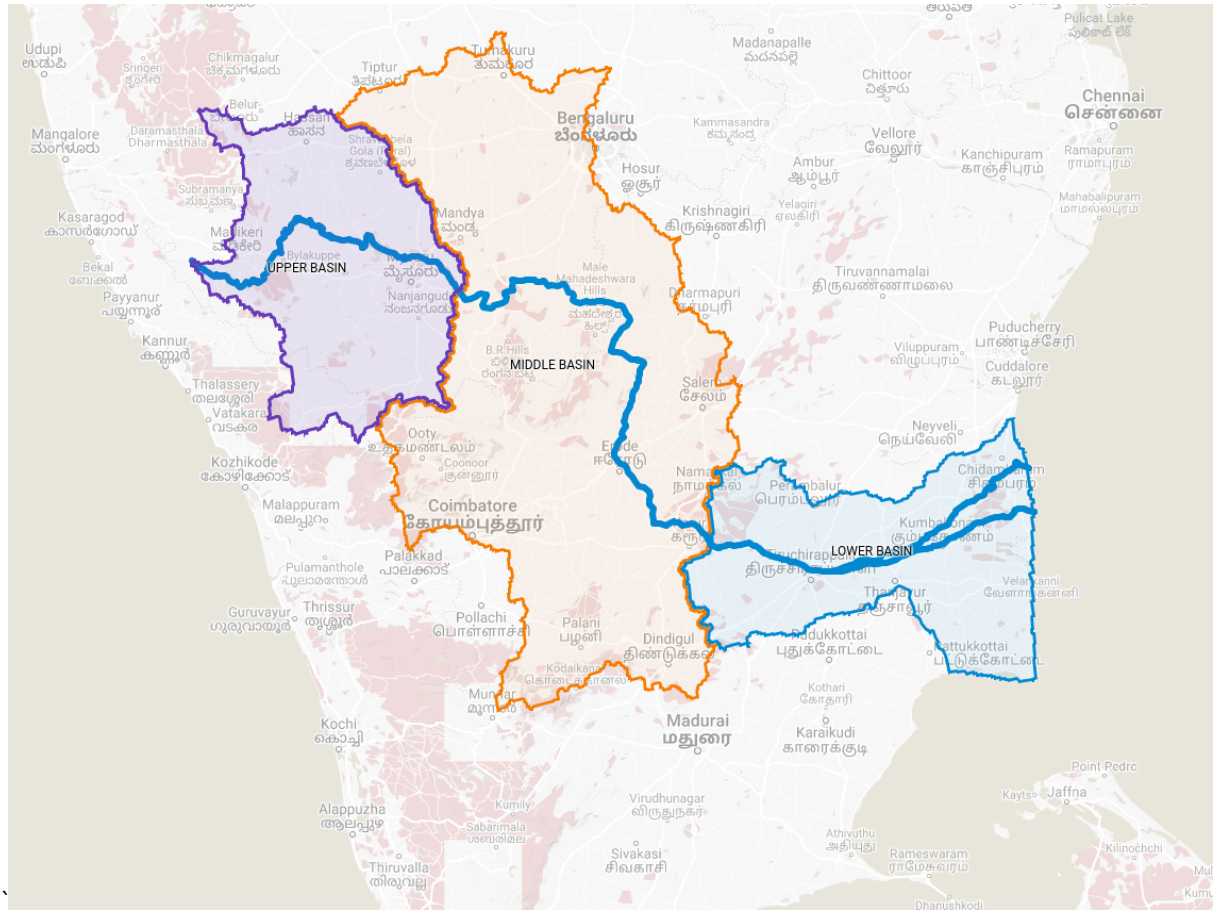

Figure 1: River Kaver and sub basins
Source: (Venkatachary & Kawathekar, 2020)

This river is significant, finding mentions in several Puranic legends[5], which have become an integral part of the cultural heritage of south India. As she continues to flow, Kaveri has amassed a large collection of songs and myths of gods, mortals, and sacred places (Seshadri & Sudararaghavan, 2012). Devotees, having heard of these songs, have discovered a deep connection with their gods along the banks of the river. For centuries their devotion was expressed through various performing arts and rituals, including singing, dancing, theatre, and embarking on pilgrimages to temples.

[4] Literally translates into river of life.

[5] Skanda Purana - is one of the most important and the largest *Mahāpurāṇa*, a genre of eighteen Hindu religious texts.

3. Material and Methods

Rivers and associated settlements have been widely studied; however, island ecologies still have a large potential to be explored. Even when these islands are studied, the tendency is to study them as independent entities or as being associated with other mainland settlements. It is essential to see these islands as a network in themselves, even the ones without any significant cultural footprint. The main aim of this paper is to read these islands as places and not merely their physical form. An approach like this helps in protecting the integrity of these islands as places. To be able to do this, developing an understanding of what goes into making a place is essential. The place has numerous definitions. This paper particularly focuses on understanding places from the lens of a geographic place. Simply put, it is a space or location with meaning, and can go on to be explained further as part of collective cultural values and principles overlaid on physical settings. This idea extends even further when there is a large geographical area connected with a network of many such places. Location, locale, and sense of place are considered to be the three key components of a place (refer to Figure 2).

Location is a point on the surface of the Earth usually identified with the help of unique coordinates, whereas locale is the physical setting that includes tangible context and lastly, sense of place is the intangible element which takes into account people and their experiences (Montgomery , 1998). People and the meanings that they associate with a place cannot be separated from the place (Ujang & Zakariya, 2015). Places are not just defined by their physical attribute, but are interpreted, narrated, felt, perceived, understood, and imagined (Gieryn, 2000).

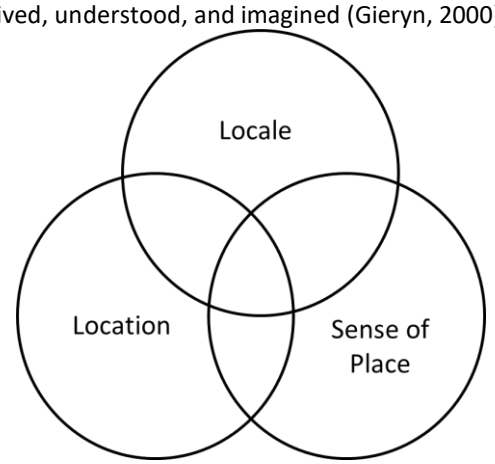

Figure 2:Representing the relationship between locale,location, and sense of place that together represent Placemaking.
Source:(Agnew, 1987)

Using the framework of these theories, a methodology has been arrived at to study the islands of Kaveri River and to interpret the islands as places of diverse nature. This methodology allowed us to derive comparable parameters and also explain the findings.

The following indicators were used to map the islands. Location information includes coordinates and distribution along the sub-basins. To understand the locale and sense of place, indicators such as land use, ecology and landscape metrics were used. Land use classes used to describe the islands are natural, agricultural/farming, habitation, infrastructure, tourism and sacred/religious. Ecology and setting of the islands are described using the characteristics such as geomorphology and vegetation. Landscape metrics such as area and shape index[6] were used to understand the shapes and sizes of the islands. However, it should be understood that riverine islands exhibit seasonal variations in terms of the extent and its shapes owing to the change in the course and the level of the river water.

All the significant islands along the spine of the river and Kollidam distributary were identified and drawn to scale, which indicates the approximate shapes, locations and sizes. The database was managed using interactive GIS[7] that facilitated accurate analysis(Amen, 2021; Aziz Amen, 2022; Amen et al., 2023; Amen & Nia, 2020). All islands below 1000 sqm were excluded from the study (refer to Figure 3).

[6] Shape index represents the perimeter of the island divided by the perimeter of a square having the same area of the given island.

[7] Geographic Information System.

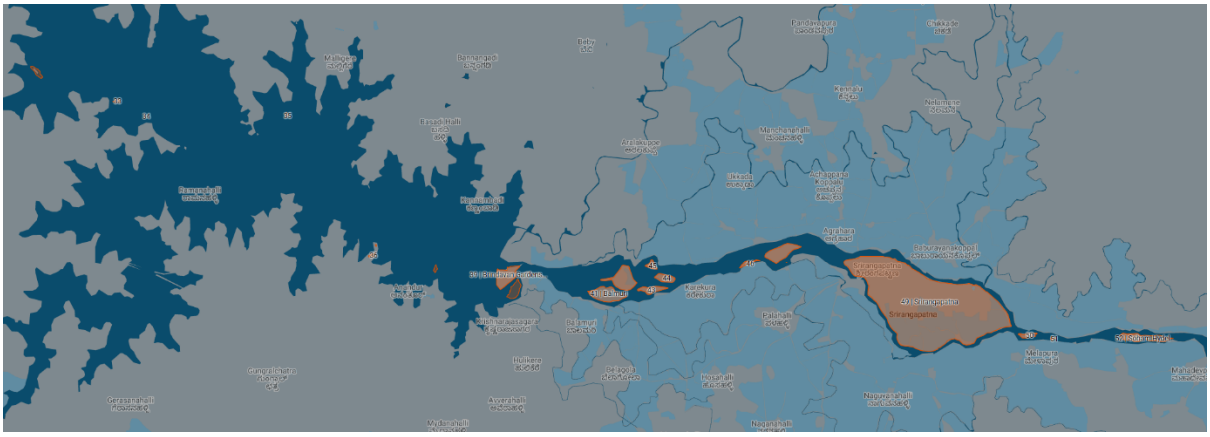

Figure 3: Mapping sample of the Islands of Kaveri
Source: Authors

Landsat 8 satellite imagery was used as the primary source for identification, mapping and classification of the islands. Table 1 shows a sample set of the data. Several of these islands remain inaccessible, however, the team managed to visit many of the inhabited islands and a few uninhabited ones too. Primary visits as well as historical records were used to gather and validate qualitative data.

The data thus collected was analysed using both quantitative as well as qualitative techniques such as descriptive statistics, thematic analysis, comparative and overlay studies.

ID | NAME	ECOLOGY	LAND USE	OBSERVATION
01	Narrow formation. Rocky and Vegetated	Natural	Central part is rocky and the two ends are densely vegetated
02	Broad formation, Rocky and Vegetated	Natural	Densely vegetated
03	Triangular broad formation. Rocky and Vegetated	Natural	Surrounded by shallow waters and weathered rocks. Vegetated
04 | Basaveshwara Bana	Broad formation. Rocky and Vegetated	Sacred	Densely vegetated, and is considered sacred.
05 | Dubare	Broad formation, Vegetated	Tourism	Sparsely vegetated and dense at the edges. Tourist infrastructure with adventure sports like rafting.
06	Narrow formation and vegetated	Natural	Sparsely vegetated and dense at the edges
17	Broad formation, vegetated	Natural	Densely vegetated
07	Narrow formation and vegetated	Natural	Surrounded by shallow waters and weathered rocks. Vegetated
08	Narrow formation and vegetated	Natural	More than 2/3 of the island in the southern part is densely vegetated and doesn't show any evidence of human activity whereas a kucha pathway can be clearly seen indicating activity. It appears to be used to move across the two banks of the river.
09 | Nisargadhama reserve	Large landmass, densely vegetated	Natural (Reserve) / Deer park / Tourism	Forest, home to deers and elephants. Tourist infrastructure.
10	Rocky formation.	Infrastructure (Bridge)	South western edge of the island provides support for the structural elements of the bridge.
211	Broad formation, vegetated and sandy	Natural	Sparsely vegetated and sandy in nature
K 25	Broad formation, vegetated and sandy	Natural/Farming	Predominantly used for farming. Interesting patterns can be seen as a result of agricultural activity. Some parts of the island is densely vegetated with sandy banks. Two temples are located on the island. Northern tip of the island is a mangrove forest. A road which connects both the banks of the mainland passes through this island.
209	Narrow formation and sandy	Natural	Bare land and sandy in nature.
K 27	Broad formation, vegetated and sandy	Natural	Vegetation can be seen on the eastern and western edge of the island. Sandy banks on the southern bank. A built structure can be seen on the island.
212	Narrow formation, vegetated and sandy	Natural	Sparsely vegetated and sandy in nature
213	Narrow formation, vegetated and sandy	Natural	Sparsely vegetated and sandy in nature. A kucha pathway suggests human activity
214	Narrow formation, vegetated and sandy	Natural	Sparse vegetation and sandy in nature. kucha pathway suggests human activity and is also connected to the the mainland bank from the southern bank of the island
215	Broad formation, vegetated and sandy	Natural	Sparsely vegetated throughout the island and sandy in nature.
216	Narrow formation, vegetated and sandy	Natural	Sparsely vegetated and sandy in nature
217	Narrow formation, vegetated and sandy	Natural	Densely vegetated on the eastern tip of the island. Sandy banks

Table 1: Sample Database part 1
Source: Authors

ID | NAME	BASIN	SHAPE INDEX METRIC	HABITATION	AREA (Hectares)
01	Upper	1.81	uninhabited	1.7
02	Upper	1.36	uninhabited	4.48
03	Upper	1.21	uninhabited	4.25
04 | Basaveshwara Bana	Upper	1	uninhabited	0.628
05 | Dubare	Upper	1.23	uninhabited	10.4
06	Upper	1.8	uninhabited	8.52
17	Upper	1.1	uninhabited	0.825
07	Upper	1.5	uninhabited	2.65
08	Upper	1.7	uninhabited	6.77

Table 4: Sample Database part 2
Source: Authors

4. Analysis and Results

Through the study that was undertaken, around 245 significant islands were identified over the entire course of the river Kaveri, from the source to the mouth, however, most of these islands remain untouched by human activity. This stretch also includes a couple of islands in one of its major distributaries, Kollidam.

As the river originates as a small stream of water in the Brahmagiri hills and does not grow large until it gathers considerable amount of water fed through its numerous tributaries, for around the first 70 km of its run there are no identifiable islands in the river. The first tributaries join the river in Bhagamandala at Triveni Sangama.

Out of the identified islands, 62 are in the upper basin, 99 are in the middle basin and 84 are in the lower basin. Owing to the sizes of the sub-basins, the lower basin is the densest in terms of the number of islands followed by the upper basin. Using the parameters described earlier in this paper we were able to make the following observations.

Sizes of these islands vary between 0.116 hectares (Pelican's Island) to 2980 hectares (Srirangam). Most of the islands fall within the average area range of 37 hectares.

The shape index of these islands ranges between 0.9 to 2.72, which indicates how narrow or broad these islands are. The average shape index is 1.33. Table 2 shows the sample data set with shape indices and Figure 3 shows the frequency. The narrowest islands can be found in the middle basin.

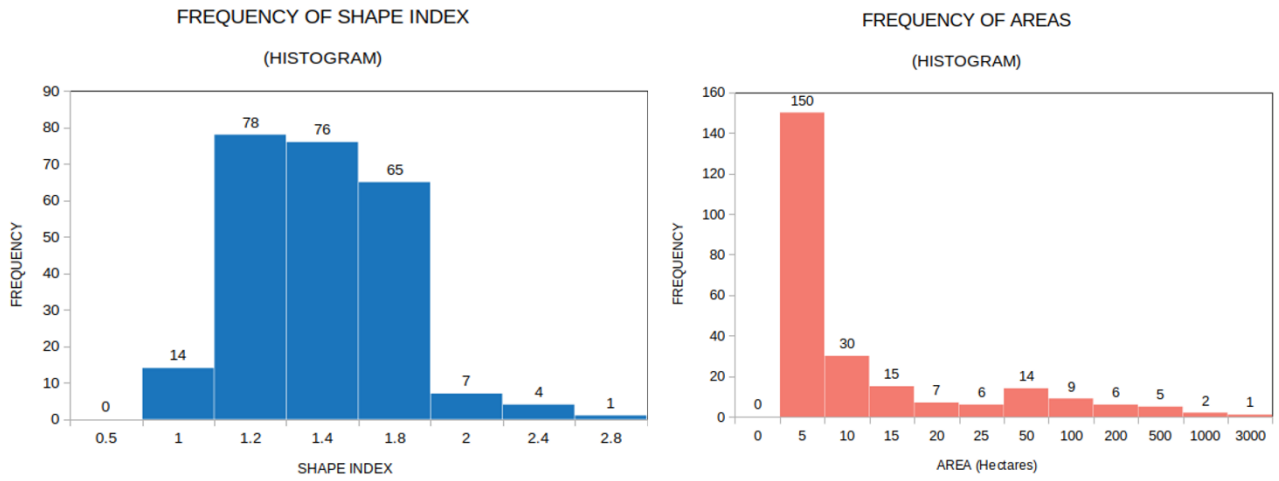

Figure 3: Frequency of Shape Index and Areas of the islands (245)
Source: Authors

Out of the 245 islands, 16 are predominantly known for their sacredness, 2 to 3 have historical significance, and around 40 are used for infrastructure such as dams, bridges, pumping stations and hydel power stations. 56 number of islands are used predominantly for agricultural activities. It is interesting to note that of these islands, 3 islands are designed gardens closely associated with their respective dams and are used for tourism.

When all these parameters are read together and analysed, certain patterns become evident, which indicate the community's understanding of the geography of the river and its potential. The inhabited islands are some of the largest and relatively broader than their counterparts, but not all large islands are occupied. Some of them serve as natural reserves for migratory birds and other wildlife. The islands in the upper basin are mostly rocky and vegetated and see lesser human activity when compared to the islands in the middle and lower basin. Owing to the structure of the basins and the course of the river, the lower basin is at the receiving end of the fertile silt deposition, it is also here we see the intensity of agricultural activity significantly increases. However, concentration of the agricultural activity is not only along the river beds, some large islands have been used too. As these islands serve as a source of livelihood for nearby villages, they are extensively connected at least to one bank and in some cases both.

Two of the narrowest Islands with the highest shape index are the island of Nattatreeshwara temple (shape index: 2.29) and the island of Srirangam (shape index: 2.72). That these islands are also culturally significant is a particularly important observation.

After inventorying the islands of Kaveri along its main spine, the following six categories emerge namely;

1. Inhabited
2. Uninhabited with cultural footprint
3. Uninhabited with infrastructure
4. Uninhabited with significant agricultural lands
5. Uninhabited with cultural association
6. Uninhabited

It appears that there is a correlation between these very physical attributes and the making of a place. The islands of Kaveri, as places, are unique due to the meanings associated with them. Communities here have been able to identify the opportunities provided by these islands and read them as places. Each island doesn't necessarily always form one place, there are instances where an entire network also becomes a place. It is not just the physical features of the islands that determine the choice of making a place, certain other parameters such as historicity, cultural associations and socio-economic factors also play a significant role.

In our study of the islands of Kaveri, we were able to identify these five recurring themes enabling us to read these places:

1. Cultural places
2. Historical places
3. Places of livelihood
4. Scenic places
5. Island gardens

Cultural places

Of the inhabited islands, one of the most recurring places is where the strongest connotation is that of culture.

According to Vishnu Purana[8], an ancient Hindu mythological text, lord Vishnu's abode is believed to be Vaikuntha, located amidst the vast cosmic ocean Ksheerasagara (literally translating to milky ocean). The three of the most significant islands Srirangapatna, Shivanasamudra and Srirangam are associated with this belief. These islands symbolise the Seshanaag[9], and the river Kaveri symbolises the cosmic ocean. These beliefs are reinforced with the building of temples for lord Ranganatha, Vishnu in his reclining posture. Together they form the network that represents the grand cosmology found in the Puranas. In the order of their appearance along the course of the river, these three are called Adiranga Kshetra, Madhyaranga Kshetra and Antaranga Kshetra. It is interesting to note that the size of these islands progressively increases in the same order and incidentally Srirangam is also the largest of all the islands.

Island of Srirangam is formed by Kaveri and her largest distributary Kollidam. The Ranganathaswamy temple here is also known as Thiruvaranga Tirupati, one of the most illustrious *Vaishnav*[10] temples in the country. Srirangam is dominated by this temple and its seven prakarams (high walled enclosures), which sit in its centre. This living temple and sacred centre of pilgrimage is counted as the first and foremost among the 108 Divya Desams[11] dedicated to Lord Vishnu.

Another significant example is that of Natrateeswarar temple. This sacred island, represents the metaphorical center of the river and the idea is sanctified in the form of a temple that houses the deity Natrateeswarara, in Tamil means the deity of the center of the river. It is interesting to note that this metaphorical center almost aligns with both the width

[8]The Vishnu Purana is one of the eighteen Mahapuranas, a genre of ancient and medieval texts of Hinduism.

[9]Seshnaag: A sacred serpent from Hindu mythology on which lord Vishnu rests.

[10]A sect of Hindu religious tradition

[11] Most revered Vaishnavite centres

and the length of the river Kaveri. This indicates the geographical sense of the community and the value it holds. There are many more such examples of islands that are sacred hills, islands that are located at sacred confluences or are sacred groves, where people have associated stories with the setting.

Historical places

There are few islands in Kaveri which have elaborate histories, Srirangapatna is an example where its history is its most significant attribute. Srirangapatna is incidentally also one of the largest inhabited islands. This island has seen many wars and been home to one of the most prosperous dynasties in the south. The town is around five kilometres long and over one and half kilometres wide. This Island was shaped under the rule of several important powers such as Vijayanagara empire, kingdom of Mysore, English East India company and Wodeyars between 17th century CE until Indian independence. The town is most remembered for its glorious past under Hyder Ali and Tipu Sultan (Gupta, Das, & Rajani, 2017). The stories of this glorious past come alive in many of its monuments and sites and serve as a constant reminder to the people even today.

The two important temples in town the Ranganatha and Tirumala seem to have been founded around 894 CE. The next important feature of this island is its fort, which was first built in 1454 CE in mud by Hebbar of Nagamangala and further strengthened by consecutive rulers. Srirangapatna's palaces, mosques, temples, burial sites, gateways, mausoleums, memorials, prison, gardens, add to its landscape(Gupta, Das, & Rajani, 2017). The brave acts of Hyder Ali and Tipu Sultan fighting the mighty British are stories that resonate as a national sentiment today. These tangible and intangible elements dominate the story of the island and establish it as a historical place. The landscape of this place has enabled them to make these histories and also serves as a constant reminder in a very tangible way.

Places of livelihood

Along the course of the river we come across several islands which are predominantly used for agriculture and fishing. In some of these islands we see humble settlements as well. Some of the noteworthy examples include Yadakuriya, Rajaganapathy Nagar, Keezhakundalapadi and Thogur. When observed these islands are dominated by these activities which is apparent in the way the land is used.

Scenic places

There are several islands which have assumed importance for their natural beauty and biodiversity. These islands can be classified as scenic places. Depending on its location, orientation, shape and size characteristics it can be observed that these islands are diverse ecosystems. Dubare is known for its elephant habitat, Shivanasamudra for its unique island waterfalls Gaganachukki and Barachukki, Hogenakkal is known for its gorges and crocodiles, Ranganathittu for its migratory birds. There are other islands that are home to deers and mangroves and several other scenic tourist destinations. Many of these places are protected by law because of their scenery and biodiversity which are of value to the community, thus a unique phenomenon.

Ranganathittu Bird Sanctuary, also known as the Pakshi Kashi of Karnataka, is situated in the Mandya District. It covers an area of 40 acres and is the largest bird sanctuary in the state. This sanctuary is unique for two major reasons. One being it is a composition of six islets and the other is the fact these were the result of human intervention. The significance of this is further reinforced when it was officially designated as a protected Ramsar site in 2022, marking the first such recognition in the state (Ranganthittu Bird Sanctuary, 2023).

These islets were formed when Kanteerava Narasimharaja Wadiyar, the then-king of Mysore built an embankment across the Kaveri River between 1645 and 1648. Originally 25 in number they soon started attracting birds. The islets functioned as an important nesting ground for a wide variety of birds, according to ornithologist Salim Ali, who convinced the king of Mysore to designate the region as a protected area in 1940. In 2014, an additional 28 square km around the sanctuary was declared as an eco-sensitive zone.

Island gardens

Three of these islands are also unique because the entire island is designed as a garden. It appears these designed gardens were created to invite the public to solely appreciate the feats of engineering like dams and reservoirs. The island of the Brindavan gardens measures 34.7 hectares. To the west of this garden is Krishnarajasagara dam and the garden itself features interesting water features and other amenities.

The Mettur park is split into two islands, one measuring 5.81 hectares and the other 14.1 hectares. The north eastern periphery of the garden is synonymous with the dam wall built across the Stanley reservoir. People experience these places as places that mark human achievement.

The above categories and themes capture the diverse characteristics of river islands of Kaveri and establishes their uniqueness.

4. Discussion

Riverine islands are formed through various processes including erosion, shifting of the course of the river and deposition of sediments. These islands are significant for several reasons viz. they provide unique canvas for thriving biodiversity; these are helpful in control of floods and regulating the flow of water and many of these islands are culturally significant, evident in the Indian subcontinent. These are sensitive ecosystems which are under constant threat. Hence, it is important to sensitively study these islands to develop useful tools for effective governance.

Through this paper an attempt has been made to study riverine islands using placemaking indicators in order to establish a holistic perspective and derive functional categories. A scholarly review of placemaking studies divulge a framework constituting three major indicators, namely Location, Locale and Sense of place. Further, connecting placemaking indicators with landscape metrics enabled the authors to arrive at a set of classification based on landscape characteristics and place-based themes. Six such categories and five place-based themes were identified from the study.

This research contributes towards a holistic comprehension of riverine islands and emphasizes the need for a sensitive approach for their effective management.

5. Conclusion

Through this study we were able to arrive at an understanding of the themes of places and how not all places have the same meaning. This was made possible with the help of identification and classification of 245 islands and reading of various cultural and historical factors together with this physical data. This paper also establishes the need for further exploration in other perspectives like that of ethnographic, planning and policy making to name a few. This methodology can be used to replicate similar studies for other such riverine islands.

Current approaches to planning primarily emphasize on understanding the physical attributes to arrive at solutions for the identified issues. The primary approaches to these studies are also limited to administrative boundaries. When historical and socio-economic factors are considered, they are done so discreetly. This limits such studies from understanding the islands as places and complex cultural networks. This paper attempts to bring a change in the perspective of looking at the islands and water as mere resources, to be seen as valuable places where human meanings are preserved. With people's identities strongly attached to places, this becomes more important than ever. Often, we see these rivers and islands are divided due to state and district boundaries, as is the case with Kaveri, it reduces these islands and waters to mere locations. This is the limitation of the current perspective.

It is observed from our study, several islands and their setting are at risk due to extensive sand mining. Sand mining is extremely detrimental to the health of the river and her islands. We were also able to identify 3 mangrove islands, which are unique ecosystems in the entire course of the river. Unchecked farming is evident and poses a threat to these islands. In a context such as this, thematically classifying the islands using placemaking indicators provides a helpful tool for the decision-making process.

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Conflict of Interests

The authors declare no conflict of interest.

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