The Concept of Environmental Engineering in the Realm of Heritage Architecture of Tamils in India

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Abstract—To provide shelter, security and comfortable living conditions for the occupants; and to produce more than ‘housing’ – to produce homes, Yes, sweet homes. They may play an important role in social development, providing the environment in which the society can be developed. Hence, this paper dealt in detail of the concepts of the Tamils in having their abodes with a mind-full knowledge of Environmental factors. The adoption of Geo-physical norms suitable for having proper housing for their self contented life, recorded in the literatures reviewed are exposed with scientific and technical details.

Index Terms—Environment, society, housing.

I. INTRODUCTION

The Town has emerged in history with two primary characters:

a) High density of population concentration in the limited space.

b) A predominantly non-Agricultural, particularly non-culturing nature population.

This men-space ratio and occupational heterogeneity into their consequential relationships formed the primary bodies for difference between the city and the village.

"Rural – Urban continuum" the ancient towns of Tamilagam are extensions of the villages carrying over the same social united and attitudes.

II. MATERIALS AND METHODS

The present work covers mostly the first three centuries of the Christian era, generally accepted as the age of the Sangam. The Sangam literature furnishes us quite considerable information. This paper gives explanatory way of interpretation. Hence the explorative method is adapted to analyze the data collected. The main sources of the data are taken from the Sangam classical works, Bakthi literature and epics, the modern technical concepts of architecture and environmental engineering disciplines and field data also considered.

III. EXAMINATION

Invention of agriculture was the beginning of castigation. Since the occupation (cultivation) was seasonal and the fundamental Universal factors are understood by the Tamils as the basic requirement of any life in the world. Therefore they worshiped them with all reverence. They give central positions for them-the natural resources amidst their residency. They never want to live in a settlement without a space for the omni potential supreme power.

"கௌராவி கிளிக்கார் அரவிசிக்கோர்ந்தவார்” - (கல்லூரி)

“அன்பன் சாம்பவ் திருமுடைய அருணிக்கோர்ந்தவார் விருந்த வாகங்கள் முறையில் கொங்குகி காலம்பூர் கோயில் கற்க கல்லூரியை யராட்டும் காலமான குழுவினை குடியினராக உள்ளது. வீரோணகம் சாய்த்த புலியும் பார்த்திருந்து நுட்பங்கள்” - (கல்லூரியம் 220-226)

IV. ORIGIN OF TOWNSHIP

With utmost care of the environment and nature, due to the need, with little intervention of nature the ancient Tamils have created their townships. The fundamental requirements like water, shelter etc., are also given with. It is clearly stated in the following reference.

“ஏராளியான சிறுகுடி

குருற் கூனியை வாழ்த்துவது

சக்தியான உள்ளூர்கள் குறுகிய பார்ப்பு

சூனியின் நீலச்சூன் விளையாட்டு கொங்குகி

காலம்பூர் புலியை பார்த்து” - (பதிப்புகள் 283-89)

V. DEVELOPMENT OF TOWNS:

The word Nagar is having many meaning starting from single house, palace, Village, Temple, Town and City.

House) Means the polished flooring of the house was made up of cow dung mixed with natural soil. It is so hygienic to have cow dung as the anti-bacterial matter.

“சப்பானத்துக்கு சூன்” - (பலகோ வேள் 1.440) (Palace)

Gives glittering surface treatment of the palace showing its rich sense of glory and wealth. Glittering surface treatment showing.

“சூன்பு குடியை வாழ்த்துவது” - (கல்லூரியம் 1.69) (Village)

Denotes the continuous income of the village from the social and natural resources.

“டூரிக்கு குடியை வாழ்த்துவது” - (கல்லூரியம் 3-14) (Temple)

Mentions the position of the temple in the center of the town.

“யூமரக விளையாட்டு கொங்குகி” - (கல்லூரியம் 5-3) (Temple)

Shows the finial top of the golden temple as the pinnacle of the town.

“சூனி குடியை வாழ்த்துவது” - (கல்லூரியம் 3-14) (Temple)

The temple of Siva wearing the crescent moon is mentioned here.

“பார்த்திய விளையாட்டு கொங்குகி” - (கல்லூரியம் 3-14) (Temple)

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Points out the road formation to a town.

Describes the effort of town formation with little deforestation.

"It also give a wide account of the landscaping and encircling mode of town formation which explain the concept of little interaction with the existing landscape and flora.

This sentence explains the town formation in accordance with the textual references of the technicians.

This verse points out that the palace was built in the north-east direction of the town.

That particular town was capable of giving all residential accommodation to the in habitants.

"It mentions that because of the tilting nature the name of the town was formed as the place of tilting.

Enumerates the different parts of the township as bending.

The town consisting of such sky scrapers, broad roads and public halls built in traditional means were renovated without any difference is referred here.

A quality township must have a vast park of aromatic flora was the concept of the ancient Tamils can be referred here with.

The channels and big wells were giving enormous water potential to the township is explained here.

The centrally located park of an ancient town is referred here.

Those escape channels were designed and constructed in large scale of size through which a herd of grown up elephants was moving very easily.

The sky scrapping multi-storied building is referred with.

The spaces courtyard of a house with the contacts of enjoying the moon light morning and evening sunlight is referred here.

The houses constructed with burnt bricks are pointed out here.

The main streets of row houses are mentioned here.

The attractive rich market street is explained here.
The four different streets of various activities, the junction - the meeting place, the open theater, the lactrile parallel streets, the network of lanes and a main street all enhancing the accommodative quality of a township is enumerated by this passage of silapathikaram.

"The wooden float used to across the river is pointed here."

The high walls of a house is referred in this sentence.

"The embedded water supply pipeline functioning as a shower point is depicted here."

The defensive fort walls provided with different machineries are mentioned here. This couplet explains the height, thickness and defensive provisions in built with of a fort wall.

"All the above three reference are mentioning about the living conditions of the streets of ancient Pukar with different working community like blacksmith, goldsmith, royalty, car streets and pimps."

The settlement encircled by a fort wall is pointed out in this sentence.

The import and export commodities are with proper taxations and sealing of the Chola kingdom, giving powerful protection to the commodities is explained here.

"Hence the natural resource mingled together in Pukar is referred."

The defensive fort walls provided with different machineries are mentioned here. This couplet explains the height, thickness and defensive provisions in built with of a fort wall.

"The defensive fort walls provided with different machineries are mentioned here."

The spacious terraces of a mansion in which a young lady were playing Kalanku and ball are referred in these verses.

"A center of water therapy availed by sick persons is referred in this verses which can be compared with the pool of Bethastha of Bible."

"The sturt thorny aromatic flora of the seashore pandanus is in abundance in Pukar beach is referred here."

"The natural serene beauty of a hamlet is shown here."

"The water and soil richness found in Pukar is referred in these verses."

"The import and export commodities are with proper taxations and sealing of the Chola kingdom, giving powerful protection to the commodities is explained here."
The clean maintenance of housing of the high caste people
shown here

"...the nobility in dwelling..." - (Page numbers: 245-247)

A forest dwelling availed by the sangam people is referred in this passage

"...the wooden dwelling of..." - (Page numbers: 243-244)

This refers to the lively scene of the courtyard of housing

"...at the yard..." - (Page numbers: 180)

Refers the size of the granary with a young lady elephant

"...the size of the granary..." - (Page numbers: 263-265)

Makes a reference of the thatch of Karuvai, dates and a special grass called thatrupai.

"...the thatch..." - (Page numbers: 147-150)

It elaborates the thatching.

"...the thatch..." - (Page numbers: 95.99)

Points about a broad well and its springs.

"...the water..." - (Page numbers: 265-268)

This referred to the flora and shady nook of a courtyard in which the people were relaxing.

"...the flora..." - (Page numbers: 83)

This referred to a courtyard of seashore housing in which fishing net is being dried.

"...the fishing..." - (Page numbers: 353-55)

"...the seashore..." - (Page numbers: 120)

"...the flowery..." - (Page numbers: 116)

"...the seashore..." - (Page numbers: 336-38)

"...the seashore..." - (Page numbers: 80-87)

"...the seashore..." - (Page numbers: 135-38)

"...the seashore..." - (Page numbers: 254)

"...the seashore..." - (Page numbers: 128)

"...the seashore..." - (Page numbers: 181)

"...the seashore..." - (Page numbers: 34)

"...the seashore..." - (Page numbers: 325)

"...the seashore..." - (Page numbers: 26)

"...the seashore..." - (Page numbers: 79)

"...the seashore..." - (Page numbers: 69-67)

"...the seashore..." - (Page numbers: 96)

"...the seashore..." - (Page numbers: 57-66)
The role that time plays in the history and destiny of things has been keenly observed and an overall pattern of physical nature has been noticed by the Tolkappiam, Kural and Puram, A whole philosophy of life has been raised on the fascinating properties of time. In recent years, India has been experiencing a severe shortage of electrical energy. Consumers of electricity for domestic purposes have been facing frequent power shut downs at different times of the day. From the point of view of thermal comfort, the people most affected are those living in hot humid zones where air movement is very essential. Middle class and upper class people, who can afford fans and air conditioners, are being affected by the vagaries of the power supply position. The majority of people living in hot humid zones where air movement is very essential, Middle class and upper class people, who can afford fans and air conditioners, are being affected by the vagaries of the power supply position. The majority of people living in hot humid zones the low income people and the economically weaker sections, cannot afford even fans to achieve air movement in habitable rooms.

In view of this, architects have to think of using more and more passive systems of cooling in dwellings. The electrical energy conserved by the use of passive systems in dwellings would be enormous in view of the fact that the total number of dwellings being constructed every year is increasing. Many vernacular architectural elements have contributed substantially to the cooling of dwellings in hot humid zones. There is a tremendous potential for adapting these elements to the present day context of construction technology. By tapping this potential architects can fulfill their obligation of providing thermal comfort at less cost to the masses. The preservation of vernacular character of residential buildings is an added advantage.

The river Vaikai alternately known as Vaiyai is reported to have taken its course touching the tradition “Kudal” River. This river Vaikai which in the Sangam age is reported to have touched ‘Kudal’ is today at about a mile’s distance from Tirupparankunram and Palankanatham. It takes its course now touching the northern end of present Madurai. Probably, the river had changed its course. Two rivers by name ‘Pennar’ are mentioned. The ‘South Pennar’ this river meets the sea at Cuddalore and is just south of Palar. The latter river palaru is not mentioned in purananur. The land through which South Pennar flows is known as ‘Natu’ (Middle country). Another river mentioned in Purananuru is Kari Aru.

Mountains had a strange attraction to the Tamils. Lord Muruka, the great God of the Tamils, was a veritable Olympian and he resided on mountains. Venkatam is always mentioned as the northern frontier post of Tamilakam. The western mountains ranged from Coorg to
VI. SPATIAL

The Tamil country in the Sangam age was ruled by three crowned monarchs and many lesser chieftains. The country comprised the entire area to the south of line that may be drawn to connect Bangalore with Madras. It was called Tamilakam or Tamilnadu. The major political divisions of the country were the Cholanadu, the Pandyanadu and the Cheraanadu. Chera-nadu was called Kuda-nadu (Western Country) though Kutakku or Kutakku-nadu in a restricted sense came to man modern Coorg only. If the rendering of a Mohenjo-Daro pictograph as “Karamukil Malayalam Nadu” (the Malabar of the rain clouds) is admitted then Chera-nadu must have been in existence as a distinct geographical and political entity trading with the cities of the Indus Valley as early as B.C.2500. The Cholus ruled over the predominantly pastoral districts of the Tamil country – Maduradu, Tirunelveli and Ramanad Districts.

The chieftains occupied mostly the fringes, particularly the hilly tracts. The entire area was divided into many Nadus like Kattu-nadu, Konku-nadu, Kari-nadu, Parampu, Pennai-nadu, Malai-nadu, Mevakam, Mukkaval-nadu, Venkata-nadu and Ko-nadu. Kadu and Kan both man forest in the Tamil language. Probably it was a part or the whole of the present district of Ramnad. The town ‘Kanadu-kattan’ (at present in Chettinad) was perhaps situated in the midst of Ka-nadu.

The geography and terrain of the country-side of that district justify the title Ka-nadu. The inhabitants of this place were Kanavar A class of people in the area are known as Vallambar. Konku-nadu, at times formed part of the Chera kingdom and at other times. It seems to have functioned as an independent political unit. Silappathikaram refers to Konkiland-Kosar who must have ruled from Konku-nadu at least when Senkuttuvan was the Chera king. Palyanai selkelu kuttuvan, the hero of pattu III has the conquest of Konkunadu as the crowning achievement of his military career. It must have been composed of the districts of Salem and Coimbatore.


During the Sangam Age, it must have included the north and north eastern parts of the Coimbatore district and the western part of the Salem district. The northern part of Salem was near Karinadu and the eastern part nearer the junction of the Chera, Chola and Tondai-nadus. It is necessary to remember in this context that the boundaries were altered with every turn in the political fortunes of the ruling dynasties.

The pre-history of Tamilakam stretches as far back as the old-stone age. Pre-historic researches in this area by Krishnaswami and exploratory trail of Bruce-Foote located the rich vestiges of early man in the riparian stations at Attirampakkam, Vadadamuradi, Manjanakkanarai, Erumaiyettipalayam, Odappai – all in the Kottalayar valley. This was the oldest courses of the Palar river. The distribution of middle stone-age relics has been noted on a wider region almost up to the southern limits of Vaikai valley in the south with centres particularly located in the Pudukkottai tract on the one hand and Ramanathapuram on the other. The exact nature of their chronological context is not known at present. This regional division of the Tirunelveli District is well discussed by M.Muthukrishnadas. The Flora of the District combined the characteristic features of the Malabar and Coromandel coasts on the one hand and Ceylon on the other.

As for fauna, the pandya country is not noted for any special breed. The Anthologies (particularly purananuru) contain copious references to the Flora and Fauna of Tamilakam.

In the Neolithic period, man exhibited three important elements of semi-urban settled life namely agriculture or farming, domestication of animals and pottery. The Neolithic impulses in Tamil Nadu which drew their inspiration from the lower Deccan centres and throw on a copious supply of basaltic or doleritic nodules for the tool-making were restricted to North-west Tamil Nadu.


The interior of Tamilnadu seems to be untouched. ‘Salem sites’ are said to be a class of their own within the southern Neolithic culture. Richards observes “Palghat, part of Salem goes with the konku country in the karur, Namakkal, Salem, Thiruchchendode and Omalur Taluks, While Baramahal goes with Tondaimandalam and Mysore and the Rayalaseema hinterland to the north. Hence Salem district was too poor to support a capital, a dynasty or an army of its own and too important strategically to be left in peace”.

The Iron-age culture development brought enduring patterns of agricultural endeavor and semi-urban habitational growth to the bulk of Tamilakam. One and all of the ancient sites in Tamilnadu, the urban vestiges start occurring only from the early historic period and a hiatus obtains between the stone-age culture and these. The urban dwellings occur only during the latter part of the Megalithic culture and are a direct evolutionary extention of the local culture. The rise of a classical period could be plausibly related to this early historic era.

Tamilakam seems to have been inhabited by tribes. Who were evolving their own states and politics and were responsible for the numerous pathways throughout the area and the roads that penetrated into the jungle. “It is but appropriate that these kingdoms were a development on the indigenous tribes and the formation of such kingdoms marked the evolution from the tribal stage to settled life. The physical features of the land did not permit these settlers to consolidate themselves into

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larger states. Hence, the states were small self-dependent groups. Having been founded on ancient river beds with ever flowing waters and protected by the sea on the one hand and the mountains on the other they continued to flourish" ... "The Markandeya Purana refers to the Dravidas (People of the south) as ‘Maharnavas’ or living near the coast, and this reference is probably to the coastal areas in the south. Silappathikaram mentions the names of many Chera kings and lists their achievements. Kumulur is one of the places mentioned in this work, possible Ptolemy’s ‘Kourellur’. It still exists as kumuli in north Travancore, an almost deserted village at the foot of the hill. Kanakashibhai Pillai concludes that the earliest inhabitants of South India were Villavar (bowmen) and Minavar (fisherman) and it may therefore be accepted that these people lived either on the coasts or in the thickly forested hills.  
"The former being more accessible, came into contact with other people and developed a civilized life while the hill-men and the foresters out off by native barriees continued to be the same old uncivilized men unaffected by the rolling of ages".  
K.C. Mammen traces the settlements of the predraavidan Negritos and Proto-Australoid people of the Neolithic age. They lived in the forests depending on the game for their livelihood. They had a tribal organization with a head-man, living in villages knit together by social and religious ties. The centrifugal force in these villages was the common place of worship, the seat of the village headman or village assembly, where the people gathered to discuss clan rules. Baden Powell speaks of such villages as existing in the Dravidan period. It was only when nomadic life gave way to a more stable existence based on agriculture that settlers formed clans and groups, and locality or territory became more important than social or religious ties.  
The Keralaolpatti and the Kerala Mahathmayam also provide us with information. These speak of Parasurama the divine incarnation of Vishnu, who brought Arya Brahmins from the Arya country and settled them in sixty four villages along the coast of Kerala. A evidenced by these sources, the Brahmins decreed that four villages should govern all the sixty-four and subsequently that the chief of one village should rule the rest. Not satisfied with this form of Government, the bramhins then brought in rulers from Pandyadesa and Cholakara, the third being crowned at Paramba, and another living at koteesvaram. Arya-perumal is credited with having divided Kerala into four divisions; another perumal is stated to have built Kenantte (mentioned in the Periplus) and a settlement near the River Naytara. Vijayam perumal is credited with the building of the town called Tirukkannapuram. Since A.D.333, the centre of attraction is claimed to have shifted from palaces and towns to village kutams or assemblies and settlements were built round them. The existence of kingdoms is strengthened by Asoka’s Edicts, poet Kalidasa’s Raghuvamsa, Sinhalese Traditions, periplus of Erythraen Sea and by Ptolemy’s Kingdoms of the south or Dravida.  
The main factors influencing the development of settlements were (a) activities of the kings, (b) Trade, (c) places of worship, (d) Village assemblies, (e) Agriculture. The settlements were more compact, partly on account of insecurity of life and property and partly on account of the undeveloped condition of agriculture which was the main activity of the people. Ancient settlements are found near River valleys or on a hill, or on an island in backwaters which provide natural defenses. They appear to have had a well ordered government with roads, buildings, tanks and reservoir -- “almost corresponding to a feudal manor or the West”. Herodotus is one among the earliest (5th century B.C) to mention the foreign settlements in India. His Knowledge is vague and limited but his description is valuable as being the oldest existing records in the west of a ancient civilisation. The first direct account of the kingdoms of south India is that of Megasthenes. He makes mention of the ports of kumari, Topina, Cottara, Bakare, Nelkynda and Musiris which have been identified as ports of the west-coast.  
*K.P. Padmanabha Menon, p.51. Strabo (21 A.D) describes India as rhomboid with Cape-comorin as land’s end. Pliny the elder says (23 A.D) that “The Indian seas were invested with pirates”. If the wind called Hippalus be blowing, Musiris, the nearest port can be reached in forty days. It is not a desirous port of call pirates being in the neighborhood …… besides, it is not well supplied with wares for traffic ships, besides anchor at a great distance from the shores and the cargos have to be landed and shipped by employed boats.”  
This great port is also mentioned by Ptolemy, and in the Periplus, the author of which is supposed to be pliny himself. Ptolemy’s map of India (2nd century A.D) is distorted out of all recognition; but he mentions among other places Nitra, Tyndis, Bramagaram, Kalai-karai, Mouziris, Podopoura, Semne, Korcoura, Nelkynda, Bakarei, Mons-pyrrhus (Elankon of Ptolemy) and  
1) Mc Crindle; Ancient India as described by classical Literature, Westminster (1901), p.4., 2) K.A. Nilakanta Sastri, Foreign notices of south India, University of Madras, Historical Series, (1947), p.9., 3) Mc Crindle, Ancient India as described in classical Literature, p.11.  
Komarfried with Cannoaré and also as Mangalore, 2 Tyndis as Tanur (by Yule) 3 as Kadalundi by Burnell and as a busy trading centre, the seat of ruling princes and probably the Tyndis mentioned in the Periplus. Bramagara is a settlement half a degree east of Tyndis (rightly south as ptolemy’s map is distorted): and Kalai-karai, a settlement near Cranganore. To-day, there is a settlement in North Travancore called kadal - karai which may be the one mentioned by Ptolemy. Yule, Burenell and Caldwell are all of the opinion that Musiris is Cranganore. poudupara has been identified as poudu patna (New town) in Malabar Semme, a little to the east was a landing settlement. Bakara or Bacare was a coastal settlement west of Nelkynda and has been identified by V.A. Smith as Vaikkara, the landing place for Kottayam; Koroura was settlement west of Bacare. Nelkynda has been identified as Kallade or Kennet in Travancore. Schoff identifies it as a settlement near Kottayam in Travancore. All shows the knowledge gained through experiences over the yields of the nature, its values, trade, landscape and the wind blow for shipping and others practiced by the Tamils in sangam period.

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VII. CONCLUSION
One cannot speak of environment without considering the impact on the lives of people. We have hundreds of small-scale and continuing environmental disasters taking place all around us. But we overlook them so long as they do not impact our lives or our lifestyles.

➤ Architecture and Environmental Engineering were inseparable or complex formation among the ancient Tamils.
➤ The experience of the Tamils with the nature or Environment is very rich which yield the modern green house effect to the lively hood of the ancient Tamils.
➤ According to the experience and inherited knowledge, they have classified the Environment as follows.

1. The space filled with different gases around the earth. (Vayu Mandalam)
2. Water surface of the earth. (Neer Mandalam)
3. The crest of earth filled with soil, rocks, etc., (Nila Mandalam)
4. Different types of life (creatures) living in the above three surfaces (Uyir Mandalam)

These classification of the inherited knowledge prevailed among the ancient Tamil confirms the following Architecture and Environmental Engineering wisdom practiced in ancient Tamil Nadu.

• Analytical knowledge of the earth and making use of system.
• Keeping pollution free earth. Awareness of pollution etc.
• Usage of natural manures for their cultivation and agricultural efforts. Keeping the potential virgin soil.
• Minimized intervention in deforestation for having their Architectural structures.
• Afforestation in and around housing either by belief or sense of beauty or religious practice.
• Awareness of pollution free water bodies. Having different water bodies for the domestic purposes like bathing, washing, building, drinking, cattle, etc.
• The drinking purpose water bodies were protected by engaging security.
• Awareness of the potable and domestic waters and the minimum usage.
• Knowledge of the pollution free air and usage by keeping away the industries in the outskirts of their residency.
• Awareness of fire and the technical know-hows of its usage.
• The soft approach over the nature -Environment can be very well understand from the inherited behavior of the ancient Tamil people which can be inferred from the following.

All the poems of Natrinai are on love. A recurrent theme in at least 50 per cent of the verses is the reference to trees.

Today, mankind has realized the key role trees play not only as a balm for sore eyes but also in our environment. We have done this with the aid of the most advanced technology. The poets of the Natrinai had no modern technology but had not

only connected the role of trees to their well-being, but had observed even the minute variations of trees as the seasons change.

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