

## THE SCIENCE OF IRRIGATION METHODS AS GLEANED FROM EPIGRAPHS AND LITERATURE IN THE TAMIL COUNTRY

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### Abstract

One of the most important developments of the Modern period, which could be called early modern, was the rise of a new philosophy, the new experimental science. This used to be understood as a history of European achievement from the Renaissance forward, a universe changing paradigm shift that defined the modern world. There is no doubt that the growth of modern science forms one of the most significant phenomena of the modern age, affirmed today in the massive public and private funding for research into natural science and medicine. But the question for the historian is, what does this modern phenomenon have to do with the early modern period? The last generation has been an exciting time to come of age in the history of science: the field has definitively emerged from its beginnings in the history of philosophy, intellectual history, and the discrete histories of sciences written by and for their practitioners, to offer answers to this question that are more complex, less modern, less triumphal, and less Eurocentric.

Our knowledge of the art or practice of farming, especially growing of staple crops, in South India during the early Iron Age is necessarily based on the finds at Adichchanallur on the banks of the Tamaraparani river in Tamil Nadu. Material evidence from the place shows that the inhabitants of Adichchanallur, cultivated rice. For the cultivation of rice they used iron implements such as the thrust hoes, draw hoes and above all the plough shares. In the Sangam literary works<sup>5</sup> the use of such implements for agricultural operations is well depicted. It is, therefore, a fair assumption that the Iron Age people at different locations in South India perfected rice cultivation using the iron implements and utilising the available limited irrigation facilities.

**Key Word:** Modern Age, Modern Science Forms, Temple Architecture, Sangam Period

## Intruduction

The full picture is still emerging and does not always cohere neatly (it would not be history if this weren't so), but its dynamism has led to an explosion of interest in early modern science that has far exceeded the bounds of the community of professional historians of science. Over the last thirty years or so, the history of science has expanded its reach in response to new appraisals of science in society at large; to movements within the discipline, such as social history, women's history, and the new cultural history; and to work in the sociology of knowledge that has led to a focus on the practices of knowledge making.

First are studies that trace the early modern development of modern scientific objects, practices, and theories, what we might call the history of proto sciences such as astronomy and physics. However, such histories no longer take their objects of study from the early periods of civilization in a culturally and intellectually rich country like India as exclusive from Euro-centric approach. The aspirations of this type of history have been articulated by the Max Planck Institute for the History of Science in Berlin: "How did the fundamental scientific concepts — such as number, force, heredity, and probability — and practices — such as experiment, proof, and classification — develop in specific historical contexts? How and why did everyday cultural experiences, such as counting, weighing, collecting, and describing, become specialized scientific techniques? And in what ways did originally local knowledge, devised to solve specific problems, become universalized? These questions form the basis of a theoretically-oriented history of science that seeks to understand the nature of scientific thought and practice as a historical phenomenon, at once dynamic and contingent."<sup>1</sup>

The Tamil society practiced science from the early periods of history in civil engineering which is visible in the temple architecture, dams and irrigation methods and medical practices. For instance, irrigation methods followed by the Tamils have been documented well in the inscriptions and Tamil literature.

Irrigation was given the highest importance in the early civilized countries such as Egypt, Mesopotamia, India and China. It is attributed that irrigation is one of the strongest agencies in promoting civilization, encouraging providence and care, and fostering communal existence and co-operation, without which progress is impossible.<sup>2</sup>

India from the beginning has been an agricultural country. Agriculture continued to be the main industry of its people. India gets uneven rainfall. The seasonal rainfall was seldom normal in the subcontinent. Sometimes there was complete failure of monsoon dragging people to the verge of famine and sometimes it was very heavy and torrential and great havoc was caused by floods. In the sub-continent where the monsoon rains are generally inadequate, artificial irrigation is an imperative necessity. Such artificial means of irrigation are of remote antiquity in South India. Organised irrigation system began in South India during the Megalithic times. But historical records prove that the kings and princes of South India paid great attention to irrigation from the early centuries of the Christian era.

The control of these lavish natural resources resulted in stately works like the construction of dams, reservoirs and canals. In the southern part of the sub-continent the failure of the monsoon, the uneven rain fall, its scarcity and excess made the rulers devise ingenious methods to restrain and regulate these natural sources. More over in South India, the mountains are not high enough to give abundant water throughout the seasons. Further, the rivers are more non perennial than the rivers in North India. These handicaps might be the prime reasons that have forced the people of South India to carry on irrigation by means of “artificial reservoirs” or canals.

Since the beginning of time, water has been one of man’s precious needs. Its importance is described in the Tiruvalluvar has observed: “The world cannot exist without water; there will be no ceaseless supply of rainfall”.<sup>3</sup> The idea of this couplet is obvious because “rain gives life to all creation, revives the dying vegetation, restores life to what seems dead”.<sup>4</sup> Indeed it is considered to be “liquid gold” in the East. Water plays an important part not only in, mythology, in religion, and ritual but also in the following aspects: as a medium of transport, as a source of power and for irrigation and drainage.

Irrigation is the artificial application or process of supplying water to crops in countries where the rainfall is insufficient or comes in the wrong season. The old river valley civilizations of the Near East with their lack of rain and hot summer were the first to apply irrigation on a large scale. In this civilized parts irrigation was not a complement but rather a supplement of farming. Hence irrigation “as practiced in the ancient civilizations, was the product of an evolution of many generations”. People in the Tamil country excelled in the art and science of “artificial tank irrigation”.

## Sangam Period

Megalithic monuments have been erected over the mortal remains of dead persons. These megaliths are usually found to occur on rocky high grounds or hillocks for the obvious reason of easy availability of stones. But the most notable feature in these monuments is that they are:

Always in association with large irrigation tanks, holding, from the rainfall in the surrounding catchment area, a perennial supply of water, owing to the natural lie of the land, and with arable lands in the neighbourhood. The hill or outcrops supplied the material out of which the monuments were built, and the arable lands, made fertile by the water of the tanks, supported the people whose remains the megaliths bear. Since the waters of the tanks created conditions for the population to thrive, the megaliths were naturally concentrated in areas where there was an adequate rainfall. This is borne out by the distribution of the monuments themselves.<sup>6</sup>

Almost ninety per cent of the megalithic sites in South India are in close proximity to large reservoirs or river banks. This important feature was first observed by Meadows Taylor as early as 1850. A study of the remains of megaliths at Amirthamangalam and Kunrathur would throw significant light on the problem of the authors of the “artificial tank irrigation” in Tamil Nadu. Each site is situated in such a place where an excellent water supply is provided by a tank or water course.<sup>7</sup> On the data obtained from these sites it is inferred that the first large scale agricultural and urban communities, highly specialized in the manufacture of a vast amount of iron implements, were the megalith builders.

It is clear, therefore, that the authors of the megaliths were settled people who practiced agriculture as their main industry and knew the value and use of irrigation. It can, therefore, be inferred that megaliths sprang up where population could thrive only where the climate was clement in the form of abundant rains to make irrigation possible.

The importance of irrigation to an agricultural was well recognized is quite evident from many early literary Sangam works and from contemporary writings. According to the Tirukkural, the ancient Tamils had actually solved the puzzle of food problems. Its author Thiruvalluvar stresses the importance of agriculture to society. To

him the yoke and the plough were the true emblems of freedom, honour and virtue. But agriculture depends mainly on water whether it is from above (rain) or below (rivers and springs). The same poet has stressed the importance of rain thus:

“If the heavens dry up, worship to the heavenly ones with due solemnity on earth will not be paid.”“Neither alms giving nor ascetic practices will abide in the wide world, if the sky dispense not its gifts.”<sup>8</sup>

By constructing large reservoirs and canals people emphasised the importance of irrigation and encouraged artificial irrigation of the soil on an extensive scale.

According to Puranauru”Verily, he who has turned the bent (low) land into a reservoir to arrest the flow of the running water is one who has established a name in the world”.<sup>9</sup>

Among the essentials of a habitable village, good water supply was given the foremost importance. As the poetess Avvaiyar tersely puts it,

“Reside in a place where there is plenty of water”<sup>10</sup>

“A place without a river is a dreary waste”<sup>11</sup>

It will not be out of place here to repeat the words of Charles Trevelyan, who clearly observes,

“Irrigation is everything in India. Water is more valuable than land, it increases its productiveness at least six-fold and generally a great deal more and it renders great extents of land productive which otherwise would produce nothing or next to nothing”.<sup>12</sup>

The people in the Sangam period had structured the society on the basis of the geographical divisions. In the Tolkappiyam there is a direct reference to the four-fold physio-graphical divisions which are known as Kaduraiulagam (the forests).<sup>13</sup> The fivefold divisions or regions or five types of terrains or man nature situations as classified by the poets were the Kurunchior the mountain region, the Mullai or the forest or pastoral tract, the Marutam or the agricultural region, the Neithal or the sandy coastal tract and the Palaior the desert tract. The last region is recognised not as a

separate physiographic region but as a state of aridity with scrub vegetation and generally hot climate.

The Marutam tract or the agrarian region we notice in the Sangam literature that the villages were invariably surrounded by green fields. There were many tanks (ayam), minor dams (sirai) and fresh water ponds (uruni) in the villages.<sup>14</sup> In addition to the tanks and ponds, deep sunk wells were also utilised for the purpose. There were, of course, many rivers and branch channels with well-coordinated sluices. The river banks were fringed with Marutam(Arjuna) or Vanji trees. The people of this tract were called Kalamars, Ulavars and so on. In the Purananuru the method of cultivation is well documented. In the Porunarappadai, the poet estimates that a single veli(about 5 acres) of wet land in the Cauvery belt yielded harvest of 1,000 kalams of paddy.<sup>15</sup>

The three major ruling dynasties: the Chera, Chola and Pandyas ruled near river valleys. The Cheras were in the Periyar valley, the Cholas in the Cauvery valley and the Pandyas in the Vaigai and the Tamiraparani valleys.

The CheraSenguttuvan is celebrated in the Padirrupattu. The river Vani flowing near the Chera capital provided the much-needed input to increase the agricultural produce in that region. The Chola capital, Cauverypattinam is well portrayed by the author of the Pattinappalai in the Pattuupattu (Ten Idylls). In the same Idyll the river Cauvery is vividly described by the poet.<sup>16</sup>

ThePandyas who held sway in the south of the Tamil country having Madurai as their seat of power. Maduraikanchi gives a full-length graphic description of Madurai and the Pandya country during the time of Nedunjeliam. In the same work we get a glimpse of the modes or different types of water lifting devices employed in irrigation. Below the translated part of the text is given:

“In thy domain is heard the sound of those  
Who stand in rows and irrigate their fields  
From tanks with basket pails to well sweep tied  
And baskets strongly made and softly bound”.<sup>17</sup>

The words ambi and kilar stand for baskets, pails and buckets in the text. These names suggest that different types of baskets and buckets were employed in irrigation. In the same work the river Vaigai is described in a detailed manner:

“The rivers over flow  
Their banks and fill the ponds, and coloured  
flow encircling the fields of corn  
Into the Eastern Sea (Gunakkadal)”  
“Along the Vaigai’s banks are groves of trees  
That grow sky high which noisy winds do toss”<sup>18</sup>

In the Paripadal we come across a song on the flooding waters of the Vaigai near Madurai.

“All the flowers are swept, along the waves of the stream. And getting into the middle of the large, long underground sluice, the full majes, tic waters with flowers floating on them, swell up the well guarded walls of magnificent mansions and pour down, like mighty male elephants pouring down water with flowers from their raised trunks”.<sup>19</sup>

The implicit meaning of the passage is that the Vaigai was then a mighty river, and to control and regulate it when in freshes, several water heads and sluices were constructed for the purpose. So it is not a matter of coincidence that we notice in later Pandya records from the eighth century onwards a good number of references to the construction of sluices and river channels to control the impetuous nature of the Vaigai in and around the city of Madurai.

In the Chola country, even prior to the time of Karikala, the Cauvery and its numerous branches were palpably the source of fertility. The main reason attributable for the frequent floods in the Cauvery is that the river had changed its course time and again during the past. The overflow of water in Cauvery used to cause havoc in the Chola country. Consequently, the diversion of the main river was undertaken and the branch came to be known as Kollidam[Coleroon]. Reference to Kollidam could be found in the hymns of Appar and Thirunanasamandar as well as some of the stone inscriptions. Earlier, during the Sangam period the Chola King Karikala raised the

bunds on both sides of the river Cauvery thereby preventing the annual inundations for nearly 20 centuries. This great irrigation project has been testified by literary evidence as well as by more than one inscription.<sup>20</sup>

### **Early Pandyas**

Inscriptions of the Pandya period attest that every brahmadeya village in valanadu was provided with a large reservoir; or else such a brahmadeya village was located near a water source. So also the devadana lands were directly irrigated with the help of channels leading from the village tank. A careful study of the seventh and eighth centuries Pandya records show that in the Pandyan country two distinct technical advances were made in the course of time. For the construction of tanks and river embankments or bunds of channels, dressed stones were used in place of the traditional rubble and laterite material; and the stones were laid with precision using the string line technique. This technique is mentioned in the records as *nulitteruvitta* (string line). In most of the cases, stone sluices (*karthampu*) were used instead of the usual palmyra tree trunks of uniform size. They were installed at suitable places to regulate the supply of water from the tank. The same 'string line' technique was no doubt followed by the other rulers, more so by the later Pandyas.

### **The Pallavas**

Following the Tamil tradition the Pallava rulers were directly responsible for the creation of several fine reservoirs, some of which are still in the best state of preservation in the northern part of Tamil Nadu. The most notable work of the period was done by Mahendravarman I (c. A.D. 600-630), an extraordinary genius who bore many titles. He created the first large irrigation work called Mahendratataka at Mahendravadi in the northern part of Tamil Nadu. About this Cox says:

Mahendravadi has a fine tank, the date of which is not known. The tank must originally have been larger than that of Cauverypakkam and served lands some seven or eight miles distant. The bund is enormously high and might be restored to its original height in which case a great extent of land could be brought under irrigation.<sup>21</sup>

In another place he says:



“Though the water spread is not so extensive as that of the Cauverypakkam tank, the depth of water is much greater, and the supply lasts for fifteen months”.<sup>22</sup>

Mahendravarman who bore the surname Perumpidugu, also extended the PerumpiduguVaikkal from the Palar river in the beginning of the seventh century. The next ruler in this line of activity was Paramesvaravarman I (c. A.D. 670-700), the great grandson of Mahendravarman I. He was responsible for the digging of the Paramesvaratataka is attested by a copper plate from Karam near Kanchipuram in Tamil Nadu.<sup>23</sup> The object of constructing the tank was to help irrigate all the wet lands in the newly formed village of Paramesvaramangam in Panmandu, a division of Manayurkottam. This tank was provided with a feeder channel called theParamesvaravaykkl from the river Palar.

From the available data we may say that the reservoir might have been constructed during the second half of the seventh century. NandivarmanII Pallavamalla, the son of Hiranyavarman from a collateral branch, who succeeded Paramesvaravarman II is credited with having renovated several old temples and built several new ones. From the Kasakudiplates of this king we learn of the existence of a tank called tirayanri.<sup>24</sup> Dantivarman (c. 796-847 A.D.) paid attention to irrigation. From the available records it is gleaned that his name is closely associated with two famous reservoirs and a well Vairameghatataka, Marpidugueri, and Marpiduguperunkinaru.<sup>25</sup> From the available evidence it is gathered that irrigation in the Pallava period was carried on with the help of tanks, canals and wells. Tanks were provided with earthen embankments and sluice gates.

## The Cholas

The Imperial Cholas of the line of Vijayalaya came to power in the second quarter of the ninth century; and the seat of power was from the neighbourhood of Uraiyur on the banks of the Cauvery. The tradition set by the Karikala of the Sangam period was assiduously followed and practiced by them. This is well confirmed by a network of canals and branch channels from the Cauvery, besides a number of reservoirs of immense size. Canals were dug from the Cauvery to cover the entire Cauvery delta. Though the canals from the river were used for irrigation, the construction of tanks and digging of wells were not neglected. With the expansion of the Chola Empire, irrigation facilities also increased manifold under their patronage.

## Discussion

Parantaka 1, who was also called Viranarayana, founded the Viranarayana caturvedimangalam (Kattumanarkoyil) and constructed the famous Viranameri near the place.<sup>26</sup>The other tanks and feeder channels caused to be constructed by Parantaka I were the Cholavaridhi near Sholingur, the Vinamangalam tank at Ambur, the Kaliyaneri near Anaimalai (Madurai). Further, he was evidently responsible for diverting the Cauvery waters along the Mannairiver which was called Kunjaramallan after him. Like his predecessors, Rajaraja I (A.D. 985 1014) also had the distinction of having built three tanks the Kavirkulam or Kavir Nadu tank, the 'Big Tank' at Bahur (Pondicherry) and the Arikesarimangalam tank. It is mentioned in a record that the Bahur tank was managed by the tanksupervision committee.

Rajaraja I also was responsible for the construction of the Uyakondan channel. This channel which leaves the Cauvery above Tiruchirappalli, flows through the same area, and finally falls into a tank in the village of Valavandankkotai, about 10 miles to the east of Tiruchirappalli, an ancient irrigation tank in that district. Of all the Chola rulers, Rajendra I (A.D. 1012 1044) elevated to a place of noticeable eminence in history; for he celebrated his victories in the north by constructing a large irrigation tank called Cholagangam in his new capital, Gangaikondacholapuram. The Tiruvalangadu plates refer to this tank as the "Liquid Pillar of Victory" and states that, "This lord constructed in his own dominion as a pillar of victory (a tank) known by repute as Cholagangam which consisted of the waters of the Ganges." This tank having an embankment of about 1.6 miles long was provided with the necessary sluices and channels for the irrigation of a larger area.

Unfortunately this huge tank has been ruined and useless, but still it continues to represent the skill of the Chola engineers and the concern of the ruler for the welfare of his subjects. The inscriptions of Rajaraja III refer to a large reservoir namely the Sembarambakkam tank. It is "one of the biggest irrigation tanks in the Chingleput district whose vast expanse, of water, when it is full, is an object of attraction to the people in the vicinity, not to mention its immense utility for the agriculturist." A few records belonging to the time of Kullottunga III speak of a large sized madagu (sluice) and other channels connected to the reservoirs for conveying water to nearby lands.

The Later Pandya rulers were not only contended with the provision of irrigation facilities in and around Madurai but extended them to other regions. The Vikramangalam inscriptions speak of some other works of the kind mentioned above. Maintenance of irrigation works was by and large left to the local administration and individual initiative. As far as the technical expertise is concerned, it is presumed that the later Pandyas followed and practiced the same technique that was in vogue for centuries in the early Pandya period.<sup>27</sup>

## Conculution

Engineers specialised in the construction of tanks and dams were known as jalasutrada.<sup>28</sup> We find references to them in the inscriptions mostly from South India. From the Viliavatti grant of the Pallava Simhavarman, it is learnt that the king also collected taxes from kupadarsakas (water diviners). The occurrence of such terms in the lithic records proves that there were professional water diviners practicing the art of locating the water.<sup>29</sup> It is further believed that they (kupadarsakas) might have been working as inspectors of wells in those days. But a doubt naturally arises whether these diviners were also masters of the science of hydrology for which we do not have any definite information. Further, it is supposed that the Jalasutradas might also have been employed by the State as water diviners.

The skill displayed in the construction of dam works by the tank builders of South India deserves to be cited. From the days of the early Chola king Karikala a through planning was made in the construction of irrigation tanks of the river Cauvery. For the accomplishment the task, about 12,000 captives from Sri Lanka were employed to work on the construction of banks which extended along the course of the river to a distance of about 100 miles from its mouth.<sup>30</sup> On the subject of irrigation, South Indian offers special material because it is recognised to be among the oldest areas in the world where 'artificial irrigation' was practiced on a large scale.

Thus, we have ample evidence to understand the science of artificial irrigation which was the backbone of Tamil economy and agricultural practices.

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